TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Units and Measurement**

ANSWER KEY

Q.1 (1)	**Q.2** (2)	**Q.3** (3)	**Q.4** (1)	**Q.5** (2)	**Q.6** (4)	**Q.7** (1)	**Q.8** (2)	**Q.9** (4)	**Q.10** (3)
Q.11 (1)	**Q.12** (2)	**Q.13** (3)	**Q.14** (1)	**Q.15** (2)	**Q.16** (2)	**Q.17** (3)	**Q.18** (4)	**Q.19** (3)	**Q.20** (4)
Q.21 (1)	**Q.22** (*)	**Q.23** (2)	**Q.24** (2)	**Q.25** (2)	**Q.26** (2)	**Q.27** (1)	**Q.28** (2)	**Q.29** (2)	**Q.30** (3)
Q.31 (2)	**Q.32** (4)	**Q.33** (2)	**Q.34** (3)	**Q.35** (4)	**Q.36** (4)	**Q.37** (1)	**Q.38** (2)	**Q.39** (2)	**Q.40** (1)
Q.41 (4)	**Q.42** (4)	**Q.43** (4)	**Q.44** (1)	**Q.45** (3)	**Q.46** (1)	**Q.47** (1)	**Q.48** (3)	**Q.49** (4)	**Q.50** (2)

Hints and Solutions

Q.1 (1)
Factual.

Q.2 (2)
Among the given quantities displacement gradient is unitless quantity.

Q.3 (3)

$\because$ r = m^2 sin pt the sinpt is dimensionless. Hence unit of r is same as that of m^2. Here unit of m is N.

Q.4 (1)
The 7 basic units are: meter, kilogram, second, Ampere, candela, mole, and Kelvin

Q.5 (2)
Light year and year measure distance and time

Q.6 (4)

$$\frac{C^2}{g} = \frac{L^2T^{-2}}{LT^{-2}} = [L]$$

Q.7 **(1)**

Q.8 (2)

$$\frac{\pi Pr^4}{3Ql} = \frac{ML^{-1}T^{-2} \times L^4}{L^3T^{-1} \times L} = ML^{-1}T^{-1}$$

Dimension of coefficient of viscosity.

Q.9 (4)

Q.10 (3)

$P \times Q = ML^2T^{-2}$ ... (i)

$\frac{P}{Q} = ML^0T^{-2}$ ... (ii)

(i) × (ii)

$P^2 = M^2 L^2 T^{-4}$

$P = M L T^{-2}$

$\frac{P}{Q} = ML^0T^{-2}$

$Q = [M^0LT^0]$

Q.11 (1)

$$[\text{Area}] = \left(\frac{[V]^2}{[A]}\right)^2 = V^4A^{-2}$$

$$[Y] = \frac{[F]/[A]}{[\Delta\ell]/[\ell]} = FV^{-4}A^2$$

Q.12 (2)

Rate of heat flow $\frac{dQ}{dt} = \frac{KAd\theta}{l}$

or $\frac{l}{KA} = \frac{d\theta}{(dQ/dt)}$

$$\therefore \left[\frac{l}{KA}\right] = \left[\frac{K}{ML^2T^{-3}}\right] = [M^{-1}L^{-2}T^3K]$$

Q.13 (3)

The statement given in option (3) is incorrect.

for e.g., acceleration has zero dimension of mass (base quantity).

Q.14 (1)

Q.15 (2)

As speed of light, c = $\sqrt{\frac{1}{\mu_0\varepsilon_0}}$

so, $\sqrt{\frac{2}{\mu_0\varepsilon_0}} = \sqrt{2}\,c$

$$\Rightarrow \left[\sqrt{\frac{2}{\mu_0\varepsilon_0}}\right] = [LT^{-1}]$$

Q.16 **(2)**

Q.17 **(3)**

Q.18 (4)

$$P = \frac{ML^{-3}}{\alpha}$$

$$\alpha = \frac{ML^{-3}}{ML^{-1}T^{-2}} = L^{-2}T^2$$

Q.19 (3)

$[k] = [x] = L$

& $[k\ell t] = [M^0L^0T^0]$

$\Rightarrow [\ell] = \dfrac{M^0L^0T^0}{[k][t]} = M^0L^{-1}T^{-1}$

Q.20 (4)

$C = \dfrac{1}{\sqrt{\mu_0\varepsilon_0}}$

$\mu_0\varepsilon_0 = \dfrac{1}{C^2} = \dfrac{1}{(\text{velocity})^2}$

Q.21 **(1)**

Here kt is dimensionless.

Hence $[k] = [1/t] = [1/s] = s^{-1} = Hz$.

Q.22 (*)

$[a] = [y]; [At] = [Bx] = [c] = M^0L^0T^0$

Q.23 (2)

$a = S^2\ t^{-4}$. Hence unit of 'a' is $m^2\ s^{-4}$.

Q.24 (2)

Dimension of at = Dimension of F

$[at] = [F] \Rightarrow [a] = \left[\dfrac{F}{t}\right]$

$[b] = \left[\dfrac{MLT^{-2}}{T}\right] \Rightarrow [a] = [MLT^{-3}]$

Dimension of bt^2 = Dimension of F

$[bt^2] = [F] \Rightarrow [b] = \left[\dfrac{F}{t^2}\right]$

$[b] = \left[\dfrac{MLT^{-4}}{T^2}\right] \Rightarrow [b] = [MLT^{-4}]$

Q.25 (2)

$F = \dfrac{KV^2A}{r}$ So $K = \dfrac{Fr}{V^2A}$

unit of $K = \dfrac{N \times kg/m^3}{\dfrac{m^2}{s^2} \times m^2}$

Unit of $K = \dfrac{N \times kg \times s^2}{m^7}$

Dim. of K

$= \dfrac{M^1L^1T^{-2} \times T^2 \times M^1}{L^7}$

$= [M^2L^{-6}T^O]$

Q.26 (2)

$F = Av + \dfrac{Bt}{C+L}$ $[C] = L$

$[Av] = [F]$ $\Rightarrow A = \dfrac{MLT^{-2}}{LT^{-1}} = MT^{-1}$

$\dfrac{B}{L} = MLT^{-2}$ $\Rightarrow [B] = ML^2T^{-2}$

$[A][C] = MLT^{-1}$

$\dfrac{[A][C]}{[B]} = \dfrac{MLT^{-1}}{ML^2T^{-2}} = \dfrac{1}{LT^{-1}}$ Dimension of speed

Q.27 (1)

$[E] = [ML^2\,T^{-2}]$

From principle of homogeneity ,

$[A] = [x^2] = [L^2]$

$\Rightarrow [E] = [ML^2\,T^{-2}] = \dfrac{[L^2]}{[Bt]}$

$\Rightarrow [MT^{-2}] = \dfrac{1}{[Bt]}$

$\Rightarrow [BT]\,[MT^{-2}] = 1$

$\Rightarrow [B\ MT^{-1}] = 1$

$\Rightarrow [B] = \dfrac{1}{[MT^{-1}]}$

$\Rightarrow [B] = [M^{-1}\,T]$

$[AB] = [M^{-1}L^2\,T]$

Q.28 (2)

$[-\alpha t] = M^0L^0T^0$

$\Rightarrow [\alpha] = T^{-1}$

& $[x] = \Rightarrow [v_0] = [\alpha]\,[x]$

Now $\alpha^2v_0^{\,3} = (T^{-1})^2\,(LT^{-1})^3$

$= L^3T^{-5}$

Q.29 (2)

$n_1[M_1L_1^2T_1^{-2}] = n_2[M_2L_2^2T_2^{-2}]$

$n_2 = 8\left[\dfrac{M_1}{M_2} \times \left(\dfrac{L_1}{L_2}\right)^2 \times \left(\dfrac{T_1}{T_2}\right)^{-2}\right]$

$= 8\left[\dfrac{1}{2} \times \left(\dfrac{1}{\frac{1}{2}}\right)^{-2}\right]$

$= 8 \times \dfrac{1}{2} \times \dfrac{1}{4} = 1$

Q.30 **(3)**

Q.31 (2)

Q.32 (4)

Dimensions of

$\dfrac{e^2}{4\pi\varepsilon_0} = [F \times d^2] = [ML^3T^{-2}]$

Dimensions of G = $[M^{-1}L^3T^{-2}]$,
Dimensions of c = $[LT^{-1}]$

$$\ell \propto \left(\frac{e^2}{4\pi\varepsilon_0}\right)^p G^q c^r$$

$$\therefore\ [L^1] = [ML^3T^{-2}]^p [M^{-1}L^3T^{-2}]^q [LT^{-1}]^r$$

On comparing both sides and solving, we get

$$p = \frac{1}{2},\quad q = \frac{1}{2} \text{ and } r = -2$$

$$\therefore\ \ell = \frac{1}{c^2}\left[\frac{Ge^2}{4\pi\varepsilon_0}\right]^{1/2}$$

Q.33 (2)

Capacitance, $C = \frac{q}{V} = \frac{q}{W/q} = \frac{q^2}{W}$

$$= \frac{i^2t^2}{W}$$

Dimensional formula for capacitance

$$= \frac{[I^2][T^2]}{[ML^2T^{-2}]} = [M^{-1}L^{-2}T^4I^2]$$

Q.34 (3)

Let $G = kc^xg^yP^z$
where k is a dimensionless constant.
$\therefore [M^{-1}L^3T^{-2}] = [LT^{-1}]^x [LT^{-2}]^y [ML^{-1}T^{-2}]^z$
$= [M^zL^{x+y-z}T^{-x-2y-2z}]$
Applying principle of homogeneity of dimensions, we get
z = –1 .....(i)
x + y – z = 3 .....(ii)
–x – 2y – 2z = –2 .....(iii)
On solving (i), (ii) and (iii) we get
x – 0, y = 2, z = –1 $\therefore [G] = [c^0g^2P^{-1}]$

Q.35 (4)

Let
$[F] = [P^aM^bV^c]$
$[M^1L^1T^{-2}] = [M^1L^{-1}T^{-2}]^a [M^1]^b [L^1T^{-1}]^c$
$[M^1L^1T^{-2}] = [M^{a+b}L^{-a+c}T^{-2a-c}]$
Comparing powers,
a + b = 1; –a + c = 1 & –2a – c = –2
Soving we get

$$a = \frac{1}{3},\ b = \frac{2}{3}\ \&\ c = \frac{4}{3}.$$

Q.36 (4)

$P = A + B^4$
$dP = dA + 4B^3dB = 0.01 + 4(1)^3 (0.02) = 0.09$
$P = 4 + 1^4 = 5$
$P = (5 \pm 0.09)$

Q.37 (1)

$X = [M^a L^b T^c]$
Maximum % error in X=aα + bβ + cγ

Q.38 (2)

According to the rules of significant figures,
1.64×10^{20} kg has three significant figures
0.006 m^2 has one significant figures
7.2180 J has five significant figures
5.045 J has four significant figures

Q.39 (2)

As area = length × breadth, as per rules numerical value of area has four significant digits

Q.40 (1)

Percentage error in the volume of the ball

$$= 3\frac{\Delta r}{r}\times100 = 3\times\frac{0.2}{5.4}\times100 = \frac{200}{18} = 11\%$$

Q.41 (4)

Q.42 (4)

Least count of screw gauge = $\frac{1\text{ mm}}{100}$

Reading of screw gauge = Main scale reading + Least count × circular scale reading

Q.43 (4)

0.005 m^2 has 1 significant figure
0.23480 g/cm^3 has 5 significant figures
0.005020 m^2 has 4 significant figures
2.54×10^{24} kg has 3 significant figures

Q.44 (1)

$$\frac{\Delta x}{x} = \frac{a\Delta M}{M} + \frac{b\Delta L}{L} + \frac{c\Delta T}{T}$$

$$\Rightarrow \%\frac{\Delta x}{x} = (a \propto + Bb + yc)\%$$

$$\left[\because \text{Given} : \%\frac{\Delta M}{M} = \alpha\%\frac{\Delta T}{T} = \gamma\%\frac{\Delta L}{L} = \beta\right]$$

Q.45 (3)

50 VSD = 49 MSD.
1MSD = 0.5 mm.
LC = 1MSD – 1VSD

$$= 1\text{MSD} - \frac{49}{50}\text{MSD}$$

Q.46 (1)

$$\frac{\Delta P}{P} = \frac{\Delta x}{x} + \frac{\Delta y}{y}$$

$$= \left(\frac{0.6}{12} + \frac{0.2}{5}\right)$$

$$\frac{\Delta P}{P} \times 100 = 9\%$$

Also, $\frac{\Delta D}{D} \times 100 = 9\%$

$\Delta R = \Delta x + \Delta y = 0.8$

$$\frac{\Delta R}{R} \times 100 = \frac{0.8}{17} \times 100 = \frac{80}{17}\%$$

$$\frac{\Delta S}{S} \times 100 = \frac{0.8}{7} \times 100 = \frac{80}{7}\%$$

Q.47 (1)

Percentage error in the value of

$$x = \frac{1}{3}(\text{P.E. in a}) + 2\times(\text{P.E. in b}) + \text{P.E. in c}$$

$$= \frac{1}{3} \times 0.3 + 2\times1 + 0.9 = 3\%$$

Q.48 (3)

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

$$= \frac{6.237}{3.5}$$

$= 1.782$

In this question density should be reported to two significant figures. As rounding of the number, we get

density = 1.8 g/cm^3

Q.49 (4)

Reading = MSR + (VSR × CC) – ZE

= 6 mm + (5 × 0.1) mm – (– 0.3 mm)

= 6.8 mm

Q.50 (2)

TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Motion in a Straight Line (Kinematics)**

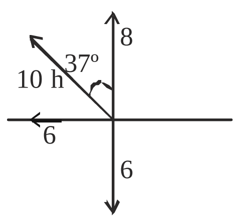
ANSWER KEY

Q.1 (2)	**Q.2** (3)	**Q.3** (4)	**Q.4** (2)	**Q.5** (3)	**Q.6** (1)	**Q.7** (4)	**Q.8** (3)	**Q.9** (3)	**Q.10** (3)
Q.11 (1)	**Q.12** (1)	**Q.13** (2)	**Q.14** (1)	**Q.15** (4)	**Q.16** (4)	**Q.17** (2)	**Q.18** (1)	**Q.19** (4)	**Q.20** (1)
Q.21 (1)	**Q.22** (4)	**Q.23** (2)	**Q.24** (4)	**Q.25** (1)	**Q.26** (1)	**Q.27** (4)	**Q.28** (2)	**Q.29** (2)	**Q.30** (3)
Q.31 (1)	**Q.32** (4)	**Q.33** (2)	**Q.34** (4)	**Q.35** (2)	**Q.36** (3)	**Q.37** (2)	**Q.38** (1)	**Q.39** (4)	**Q.40** (3)
Q.41 (1)	**Q.42** (1)	**Q.43** (1)	**Q.44** (4)	**Q.45** (3)	**Q.46** (4)	**Q.47** (2)	**Q.48** (2)	**Q.49** (4)	**Q.50** (1)

Hints and Solutions

Q.1 **(2)**

Q.2 (3)

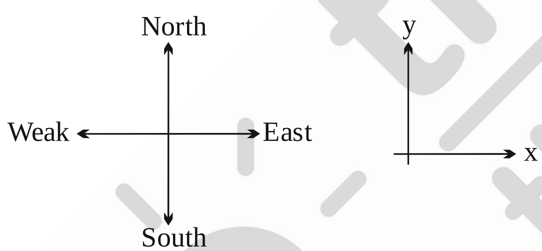


$\vec{S} = -6\hat{i} + 2\hat{j}$

Co-ordinate = (–6,2)

Q.3 (4)

Displacement in north direction = 54000 m = 54 km $(\hat{i})$



Displacement in south direction = (40) × 15 × 60

= (40 × 900 = 36000 m = 36 km $(-\hat{i})$

Total differnce travelled = (54 + 36) = 90 km

Net displacement = $54\hat{i} - 36\hat{i} = 18\text{km}\,\hat{i}$

= 18 km in North

Q.4 **(2)**

Q.5 (3)

$$\frac{s_P}{s_Q} = \frac{\frac{3}{2}\pi r}{2r} = \frac{3}{4}\pi$$

Q.6 (1)

Q.7 (4)

$$\text{Velocity} = \frac{dy}{dt} = 8 - 20t = 0$$

$$\Rightarrow t = \frac{8}{20} = \frac{4}{10} = 0.4 \text{ sec}$$

At t = 0.4 sec, particle will comes to instantaneous rest.

⇒ Velocity is zero only form instant.

Q.8 (3)

$$\text{Average speed} = \frac{\text{Total distance}}{\text{Total time taken}}$$

$$\Rightarrow V_{avg} = \frac{\frac{S}{4} + \frac{3S}{4}}{t_1 + t_2}$$

$$= \frac{S}{\frac{S}{4}\left(\frac{1}{V_1} + \frac{3}{V_2}\right)} = \frac{4V_1V_2}{V_2 + 3V_1}$$

$$\text{time} = \frac{\text{distance}}{\text{speed}}$$

$$t_1 = \frac{\frac{S}{4}}{V_1} = \frac{S}{4V_1}$$

$$t_2 = \frac{3S}{4V_2}$$

Q.9 (3)

$$\frac{dv}{dt} = -2at + b = 0 \text{ at } t = \frac{b}{2a}$$

$$V_{at\,'t'} = -a\frac{b^2}{4a^2} + b\frac{b}{2a}$$

$$= \frac{b^2}{4a}$$

Q.10 (3)

$$\text{Velocity} = \frac{dy}{dt} = b + 2ct - 4dt^3$$

Initial velocity ∴ t = 0 ⇒ v = b

$$\text{Acceleration} = \frac{dV}{dt} = 2c - 12dt^2$$

Initial acceleration $\Rightarrow t = 0 \Rightarrow a = 2c$

Q.11 **(1)**

at $t = 0, v = 0$

now $a = 2(t-1)$

so $\frac{dv}{dt} = 2(t-1)$

$$\int_0^v dv = \int_0^5 (2t-2)dt$$

$$v = \left[\frac{2t^2}{2} - 2t\right]_0^5 = (5)^2 - 2(5) = 15 \text{ m/s}$$

Q.12 (1)

Q.13 (2)

$v = u + at \Rightarrow -2 = 10 + a \times 4 \Rightarrow a = -3\text{m/sec}^2$

Q.14 (1)

velocity $v = a + bx$

$$a = v\frac{dv}{dx} = ab + b^2x$$

so a increases with increase in distance x

Q.15 (4)

A particle could be moving to the right (positive velocity), in which case the acceleration speeds the particle up. The particle could be moving to the lift (negative velocity), in which case the acceleration is causing the particle to slow down. There is no information about the velocity of the particle, so no conclusion can be made.

Q.16 (4)

Q.17 (2)

$X = 3t^2 - 2t + 4$

(a) velocity $V = \frac{dx}{dt}$

$V = 6t - 2$

at $t = \frac{1}{3}$sec

$V = 0$

(b) acceleration

$$a = \frac{dV}{dt} = 6$$

(c) Velocity at $t = 1$

$V = 4$

(d) displacement ($t = 1$ sec)

$X = 5$ m

Q.18 (1)

$$24 = u(4) + \frac{1}{2}a(4)^2 \quad \text{......(1)}$$

$$(24 + 64) = u(8) + \frac{1}{2}a(8)^2 \quad \text{.....(2)}$$

$(1) \times 4 - (2),\ 8 = 8u \Rightarrow u = 1$ m/s

Q.19 **(4)**

$S \propto u^2$

$$\frac{S_1}{S_2} = \left(\frac{u_1}{u_2}\right)^2 = \left(\frac{u}{4u}\right)^2 = \frac{1}{16}$$

Q.20 **(1)**

$v = 0 = u + at = 10 - 2 \times t$

$\Rightarrow\ t = 5\text{sec}$

$$S_{n^{th}} = u + \frac{a}{2}(2n-1)$$

$$= 10 - \frac{2}{2}(2 \times 5 - 1) = 1\text{m}$$

Q.21 (1)

$\vec{v} = \vec{u} + \vec{a}\,t$

$= (3\hat{i} + 4\hat{j}) + (0.4\hat{i} + 0.3\hat{j}) \times 10$

$= 7\,i + 7\,j \qquad \Rightarrow |\vec{v}| = 7\sqrt{2}$

Q.22 **(4)**

Let the body be projected upwards with velocity u from top of tower. Taking vertical downward motion of boy form top of tower to ground, we have

$u = -u, a = g = 10\text{ms}^{-2}, s = 50\text{m}, t = 10\text{s}$

As $s = ut + \frac{1}{2}at^2$,

So, $50 = -u \times 10 + \frac{1}{2} \times 10 \times 10^2$

On solving $u = 45\text{ms}^{-1}$

If t_1 and t_2 are the timings taken by the ball to reach points A and B respectively, then

$$20 = 45t_1 + \frac{1}{2} \times 10 \times t_1^2$$

and $40 = -45t_2 + \frac{1}{2} \times 10 \times t_2^2$

On solving, we get $t_1 = 9.4$ s and $t_2 = 9.8$s

Time taken to cover the distance AB

$= (t_2 - t_1) = 9.8 = 9.4 = 0.4$s

Q.23 (2)

(i) $V = u + at_1$

$40 = 0 + a \times 20$

$a = 2\ m/s^2$

$v^2 - u^2 = 2as$

$40^2 - 0 = 2 \times 2s_1$

$s_1 = 400m$

(ii) $s_2 = v \times t_2 = 40 \times 20 = 800m$

(iii) $v = u + at$

$0 = 40 + a \times 40$

$a = -1\ m/s^2$

$0^2 - 40^2 = 2(-1)s_3$

$s_3 = 800m$

Total distance travelled = $s_1 + s_2 + s_3$

$= 400 + 800 + 800 = 2000m$

Total time taken = 20+20+40 = 80s

Average velocity = $\dfrac{2000}{80} = 25m/s$

Q.24 (4)

Q.25 (1)

If the relative initial velocity, relative accleration and relative displacement of the second body with respect to the first body be u_r, a_r and s_r, then

$s_r = u_r t + (1/2) a_r t^2$

But $u_r = u_2 - u_1 = 2 - 0;\ \therefore\ u_r = 2m/s$

$a_r = a_2 - a_1 = 9.8 - 9.8 = 0$ and $s_r = s_2 - s_1 = 18\ m$

$\therefore\ 18 = 2t + \dfrac{1}{2}(0)\,t^2$ or $18 = 2t$ or $t = 9$ sec

Q.26 (1)

Q.27 (4)

By using $v^2 = u^2 + 2aS$

$u = 72 \times \dfrac{5}{18}$ m/sec = 20 m/sec

$\Rightarrow 0 = (20)^2 - 2 \times a \times 200$

$\Rightarrow a = \dfrac{400}{400} = 1 \quad \Rightarrow a = 1\ m/s^2$

Q.28 (2)

Applying third equation of motion

$v^2 = u^2 + 2as$

$\Rightarrow 0 = 400 + 2a(10)$

$\Rightarrow a = \dfrac{-400}{20} = -20$

$a = -20\ m/sec^2$

Q.29 (2)

$x = 6 + 12t - t^3 \qquad \dfrac{dx}{dt} = v = 12 - 3t^2$

$v = 0$

$t = 2s$

$a = -6t \qquad a|_{t=2s} = -12\ m/s^2$

Q.30 (3)

Q.31 **(1)**

Q.32 (4)

$30^2 = 2 \times 10 \times s$

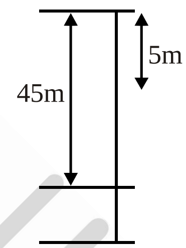
$s = 45\ m$

$30 = gt$

$\Rightarrow t = 3sec.$

t particle = 1 sec.

$s = \dfrac{1}{2} \times 10 \times 1^2 = 5\ m$



Q.33 **(2)**

$S = vt - \dfrac{1}{2}gt^2$

$40 = v(2) - \dfrac{1}{2} \times 10 \times (2)^2$

$v = 30\,m/s$

$v^2 = u^2 + 2aS$

$900 = 0 + 2(-10)(-h)$

$h = 45\,m$

Q.34 **(4)**

Height of the rocket when engine switched off

$= \dfrac{1}{2} \times 19.6 \times (5)^2$

Speed(u) = $0 + 19.6 \times 5$

max. height = $\dfrac{1}{2} \times 19.6 \times 5^2 + \dfrac{u^2}{2g} = 735\,m$

Q.35 (2)

$h = \dfrac{1}{2} \times g \times 1^2 = \dfrac{g}{2}$

Q.36 **(3)**

Q.37 **(2)**

Q.38 (1)

$S_1 : S_2 : S_3 : ....$

$1 : 3 : 5 : ....$

Q.39 (4)

In vertical directin (4-direction)

$U_y = 0;\ a_y = -gm/s^2;\ t = 1$ sec

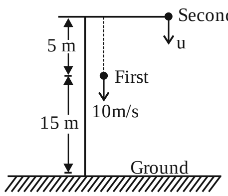
$V_y = U_y + a_y t \Rightarrow V_y = -g = -10\ m/s$

as speed remain same in horizontal direction

So, $v_{res} = \sqrt{V_x^2 + V_y^2}$

$= \sqrt{(10)^2 + (-10)^2} = 10\sqrt{2} = 14.14\ m/s$

Q.40 (3)



Let time taken by first chestnut to reach ground be t then

$15 = 10\,t + \frac{1}{2}(10)t^2$

$\Rightarrow = t^2 + 2t - 3 = 0 \Rightarrow t^2 + 3t - t - 3 = 0$

$\Rightarrow t = 1$ s

In this time second chestnut must have to reach ground.

Therefore $20 = u(1) + \frac{1}{2}(10)(1)^2 \Rightarrow u = 15$m/s

Q.41 (1)

Applying relative motion (solving in elevator frame)

$$t = \sqrt{\frac{2h}{a_{relative}}} = \sqrt{\frac{2\times 1.2}{10+2}}$$

$$= \sqrt{\frac{2.4}{12}} = \sqrt{0.2} = \frac{1}{\sqrt{5}}$$

Q.42 (1)

u = 0, a = g

$$S(0 \text{ to ls}) = 0 + \frac{1}{2}g(1)^2 = \frac{g}{2}$$

$$S(0 \text{ to } 6s) = 0 + \frac{1}{2}g(6)^2 = 18g = \frac{36g}{2}$$

$$S(0 \text{ to } 5s) = 0 + \frac{1}{2}g(5)^2 = \frac{25g}{2}$$

$$S(5 \text{ to } 6s) = \frac{36g}{2} - \frac{25g}{2} = \frac{11g}{2}$$

Q.43 (1)

Distance travelled = Area under the u-t graph

$$\therefore \Delta S = \frac{1}{2}\times 5\times 8 = 20$$

Q.44 (4)

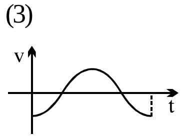
Total Distance = Area

under the curve (Positive + Negative)

$$= \frac{1}{2}\times 4\times 1 + 4\times 2 + 1\times 4\times \frac{1}{2} - \frac{1}{2}\times 2\times 1 - 2\times 2 - \frac{1}{2}\times 1\times 2$$

= 2 + 8 + 2 – 1 – 4 – 1 = 6 meter

Q.45 (3)



x = – sint

$$v = \frac{dx}{dt} = -\cos t$$

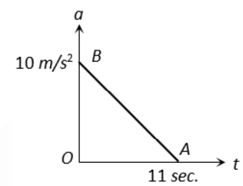
Q.46 **(4)**

Initially v → +ve and decreasing

then –ve and increasing

Q.47 (2)

The area under acceleration time graph gives change in velocity. As acceleration is zero at the end of 11 sec



i.e. v_{max} = Area of ΔOAB

$= \frac{1}{2} \times 11 \times 10 = 55$ m/s

Q.48 (2)

- In region A, slope is increasing i.e velocity is increasing, acceleration is positive
- In region B, slope is decreasing, i.e velocity is decreasing, acceleration is negative
- In region C and D, slope is constant, acceleration is zero.

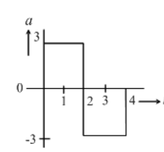
Q.49 (4)

Distance = Area under v – t graph

Distance = 100 m

$$\text{Avg speed} = \frac{100}{5} = 20\text{m/s}$$

Q.50 (1)



Taking the motion from 0 to 2 s

u = 0, a = $3ms^{-2}$, t = 2s, v = ?

v = u + at = 0 + 3 × 2 = $6ms^{-1}$

Taking the motion from 2 s to 4 s

v = 6 + (–3)(2) = $0ms^{-1}$

TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Motion in a Plane**

ANSWER KEY

Q.1 (2)	**Q.2** (1)	**Q.3** (1)	**Q.4** (3)	**Q.5** (1)	**Q.6** (4)	**Q.7** (3)	**Q.8** (1)	**Q.9** (1)	**Q.10** (1)
Q.11 (2)	**Q.12** (1)	**Q.13** (1)	**Q.14** (1)	**Q.15** (1)	**Q.16** (4)	**Q.17** (1)	**Q.18** (2)	**Q.19** (1)	**Q.20** (1)
Q.21 (1)	**Q.22** (1)	**Q.23** (3)	**Q.24** (3)	**Q.25** (3)	**Q.26** (2)	**Q.27** (4)	**Q.28** (3)	**Q.29** (3)	**Q.30** (1)
Q.31 (1)	**Q.32** (4)	**Q.33** (3)	**Q.34** (3)	**Q.35** (3)	**Q.36** (3)	**Q.37** (3)	**Q.38** (3)	**Q.39** (3)	**Q.40** (4)
Q.41 (1)	**Q.42** (3)	**Q.43** (1)	**Q.44** (2)	**Q.45** (1)	**Q.46** (1)	**Q.47** (3)	**Q.48** (1)	**Q.49** (1)	**Q.50** (2)

Hints and Solutions

Q.1 (2)

$\hat{A} = \hat{i} + \hat{j}$

Equation of x-axis $\vec{B} = \hat{i}$

Angle between $\vec{A}$ and $\vec{B}$,

$$\cos\theta = \frac{\vec{A}.\vec{B}}{(\vec{A})(\vec{B})}$$

$$= \frac{(\hat{i}+\hat{j})\cdot\hat{i}}{\sqrt{(1)^2+(1)^2}\times 1}$$

$$= \frac{1\times1+1\times0}{\sqrt{2}} = \frac{1}{\sqrt{2}}$$

= cos 45º

∴ θ = 45º

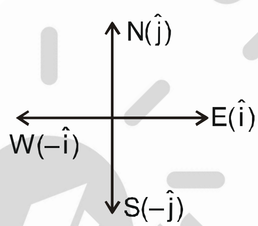
Q.2 (1)

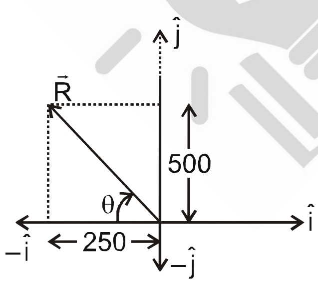
$\vec{F}_1 = 500\hat{i}$

$\vec{F}_2 = 250\hat{j}$

∴ $\vec{R} = \vec{F}_2 - \vec{F}_1$

$\vec{R} = 250\hat{j} - 500\hat{i}$





$\tan q = \frac{500}{250} = 2$

{θ = tan^{-1}(2) N to W}

$|\vec{R}| = 250\sqrt{5}$

Q.3 (1)

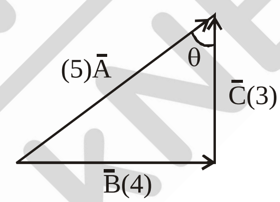
$|\vec{a}| = 3$, $|\vec{b}| = 5$, θ = 60°

$$\vec{a}.\vec{b} = |\vec{a}||\vec{b}|\cos\theta = 3\times5\times\frac{1}{2} = 7.5$$

Q.4 (3)

$\cos\theta = \vec{A}\times\vec{B} / AB$

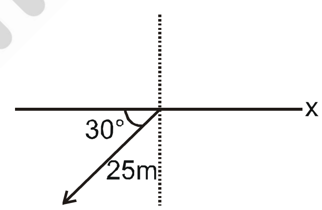
Q.5 (1)



$\tan\theta = \frac{4}{3}$

Q.6 (4)

Q.7 (3)



x-component = –25 cos 30°

Q.8 (1)

Workdone = $\int \vec{F}.d\vec{S} = \vec{F}.\vec{S}$

$\vec{S} = \left(5\hat{i}+4\hat{j}+3\hat{k}\right) - \left(2\hat{i}+3\hat{j}+4\hat{k}\right)$

$= 3\hat{i}+\hat{j}-\hat{k}$

$\vec{F} = \vec{F}_1 + \vec{F}_2 = 2\hat{i}+3\hat{j}+4\hat{k}$

$W = (2\hat{i}+3\hat{j}+4\hat{k})\cdot(3\hat{i}+\hat{j}-\hat{k})$

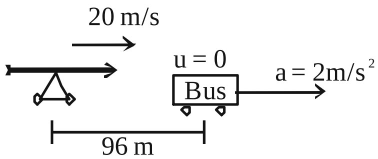
= 6 + 3 – 4 = 5 J

= 5 Joule

Q.9 (1)

Q.10 (1)

Q.11 (2)



Considering relative motion of cyclist w.r.t Bus

S_{rel} = 96 m

$U_{rel} = U_{cyclist} - U_{Bus}$ = 20 – 0 = 20 m/s

$a_{rel} = a_{cyclist} - a_{Bus}$ = 0 – (2) = –2 m/s²

appling IInd equation of motion

$$S_{rel} = U_{rel}t + \frac{1}{2}a_{rel}t^2$$

$$96 = 20t + \frac{1}{2}(-2)t^2$$

$96 = 20t - t^2$

$\Rightarrow t^2 - 20t + 96 = 0$

$\Rightarrow t^2 - 12t - 8t + 96 = 0$

$\Rightarrow t(t - 12) - 8(t - 12) = 0$

$\Rightarrow (t - 8)(t - 12) = 0 \Rightarrow t = 8$ sec

or 12 sec

so, at t = 8 sec, cyclist overtake the bus and again at t = 12 sec, bus overtake the cyclist as bus is accelerated

Q.12 **(1)**

Two cars

→ 30 →30

A B

← 5 km →

Relative velocity of third car w.r.t to A or B

$$Vr = 30 + v = \frac{5}{t} = \frac{5 \times 60}{4}$$

V = 75 – 30 = 45 km/hr

Q.13 (1)

Relative velocity of overtaking = 40 ms^{-1} – 30 ms^{-1} = 10 ms^{-1}. Total distance covered with this relative velocity during overtaking will be = 100 m + 200 m = 300 m.

$$\text{Time taken} = \frac{300\,m}{10\,ms^{-1}} = 30\,s$$

Q.14 (1)

$$\vec{V}_r = \upsilon_y j$$

$$\vec{\upsilon}_m = 5\hat{i}$$

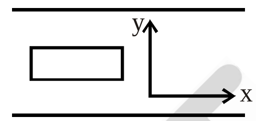
$$\vec{V}_r - \vec{V}_m = (-5)\hat{i} + \upsilon_y\hat{j}$$

$$\tan\theta = 1 = \frac{\upsilon_y}{5}$$

so υ_y = 5 km/hr

Q.15 (1)

$v_b = v_{br} + v_r = -14 + 6 = -8\hat{i}$



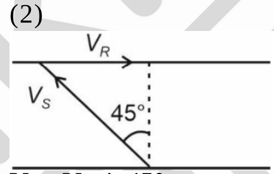
$v_m = \vec{v}_{mb} + \vec{v}_b = 6\hat{j} - 8\hat{i} \Rightarrow$ 10 km/hr.

Q.16 **(4)**

Q.17 (1)

Due north will take him cross in shortest time.

Q.18 (2)



$V_R = V_S \sin 45°$

$$\frac{V_S}{V_R} = \frac{1}{\sin 45°}$$

$= \sqrt{2} : 1$

Q.19 (1)

At the highest point, velocity is horizontal

Q.20 (1)

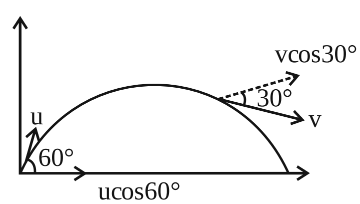
$$R = \frac{v^2 \sin 2\theta}{g} = 200, \quad T = \frac{2v\sin\theta}{g} = 5$$

$$\text{Dividing, } \frac{v^2 \times 2\sin\theta\cos\theta}{g} \times \frac{g}{2v\sin\theta} = \frac{200}{5} = 40$$

or v cosθ = 40ms^{-1}

It may be noted here that the horizontal component of the velocity of projection remains the same during the flight of the projectile

Q.21 **(1)**



ucos60° = vcos30°

$$u \times \frac{1}{2} = v \times \frac{\sqrt{3}}{2}$$

$$v = \frac{u}{\sqrt{3}} = \frac{10}{\sqrt{3}}$$

Q.22 (1)

The time of flight of given by

$$T = \frac{2u\sin\theta}{g} = \frac{2\times30\times1}{10\times2} = 3sec$$

Thus, after 1.5 sec the body is at the highest point. As the direction of motion is horizontal after 5 seconds, the angle with the horizontal is 0°.

Q.23 (3)

$$R = \frac{u^2\sin2\theta}{g}$$

or $R \propto \sin 2\theta$

or $\frac{R_1}{R_2} = \frac{\sin2\theta_1}{\sin2\theta_2}$

$\theta_1 = 30^o$, $\theta_2 = 40^o$

So, $\frac{R_1}{R_2} = \frac{\sin60^o}{\sin40^o} > 1$

$\Rightarrow R_1 > R_2$
at 30º;
It will fall beyond enemy target

Q.24 (3)

$$v_y^2 = u_y^2 - 2gh$$

$\Rightarrow u_y^2 = v_y^2 + 2gh$ = (2)2 + 2 × 10 × 0.4 = 12

$\therefore u_y = \sqrt{12}$ and $u_x = 6$

$$\tan\theta = \frac{u_y}{u_x} = \frac{\sqrt{12}}{6} = \frac{1}{\sqrt{3}}$$

$\Rightarrow \theta = 30^o$

Q.25 (3)

On a horizontal ground projectile $R = \frac{u^2\sin2\theta}{g}$

For R_{max} $\sin(2\theta) = 1 \Rightarrow \theta = 45^o$

Q.26 (2)

$u\cos\theta = \frac{\sqrt{3}u}{2} \Rightarrow \cos\theta = \frac{\sqrt{3}}{2}$

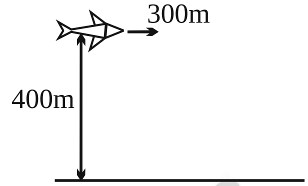
$\Rightarrow \theta = 30°$

$$T = \frac{2u\sin30°}{g} = \frac{u}{g}$$

Option 2.

Q.27 (4)

When bomb is released, velocity is horizontal direction = 300 m/s
Velocity is vertical direction = 0



Time of fall = $\sqrt{\frac{2h}{g}} = \sqrt{\frac{2\times400}{10}} = \sqrt{30}$ sec

Displacement is x-direction horizontal = (300) $\sqrt{80}$ = 2683 m = 2.68 km

Q.28 **(3)**

$$x = t\times u = \sqrt{\frac{2h}{g}}\times u = \sqrt{\frac{2\times490}{9.8}}\times50 = 500m$$

Q.29 (3)

Time taken by the body in falling

$$t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2\times5}{10}} = 1s$$

Horizontal distance covered by the body
= 10 m

$\therefore$ ut = 10
u × 1 =10
$\Rightarrow$ u = 10 ms^{-1}

Q.30 (1)

$u_x = 5$ but $u_y = 0$

$$t = \sqrt{\frac{2H}{g}} = H = \frac{1}{2}gt^2$$

$$= \frac{1}{2}\times10\times64 = 320m.$$

now time taken to cover $\frac{H}{4}$ is t_1

$$t_1 = \sqrt{\frac{2\times320}{4\times10}} = 4sec$$

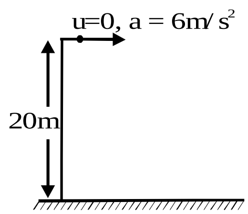
Q.31 (1)

Q.32 **(4)**

$$\sqrt{\left(\frac{2h}{g}\right)}$$

Q.33 **(3)**

Time to reach the ground = $\sqrt{\frac{2\times 20}{10}}$ =2 sec



So horizontal displacement

$= 0 + \frac{1}{2} \times 6 \times 4 = 12\text{m}$

Q.34 (3) Time taken by the bomb to cover the height

$t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2\times 490}{9.8}}$

$= \sqrt{100} = 10\text{s}$

$\therefore$ Horizontal distance covered by the bomb

R = v × t

(horizontal velocity of the bomb will be equal to horizontal velocity of plane)

R = 150 × 10 = 1500 m

Q.35 (3)

Q.36 (3)

Displacement, velocity and acceleration change continuously with respect to time because of change in direction.

Q.37 (3)

$\tan\theta = \frac{v^2}{rg} = \frac{\omega^2 r}{g}$

Q.38 **(3)**

Q.39 (3)

Body moves with constant speed it means that tangential acceleration aT=0 & only centripetal acceleration aC exists whose direction is always towards the centre or inward (along the radius of the circle).

Q.40 (4)

Q.41 (1)

Q.42 (3)

Average Velocity

$= \frac{\text{Displacement}}{\text{Time taken}} = \frac{2R}{t} = \frac{2\times 20}{20} = 2\text{ms}^{-1}$

Q.43 (1)

Q.44 (2)

Acceleration of the particle is

$a = r\omega^2 = r(2\pi n)^2$

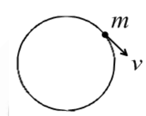
$= 0.25 \times (2\pi \times 2)^2$

$= 16\pi^2 \times 0.25$

$= 4\pi^2 \ \text{ms}^{-2}$

Q.45 (1)

$\frac{v^2}{r}$ = a, the centripetal acceleration [Given]



If v is doubled, $a'' = \frac{4v^2}{r} = 4a$

Q.46 (1)

Q.47 **(3)**

Resultant acceleration

$$= \sqrt{\begin{pmatrix}\text{tangential}\\ \text{acceleration}\end{pmatrix}^2 + \begin{pmatrix}\text{centripetal}\\ \text{acceleration}\end{pmatrix}^2}$$

$$= \sqrt{a^2 + \left(\frac{v^2}{r}\right)^2} = \sqrt{\frac{v^4}{r^2} + a^2}$$

Q.48 (1)

Q.49 (1)

$a = \frac{v^3}{r} = \frac{400\times 400}{160} = \frac{4000}{4} = 1000$

$= 1 \text{ km/s}^2$

Q.50 **(2)**

$$a = \sqrt{a_c^2 + a_t^2} = \sqrt{\left(\frac{v^2}{r}\right)^2 + a_t^2} = \sqrt{\left(\frac{30}{500}\right)^2 + 2^2}$$

$= 2.7 \text{ m/s}^2$.

TOPIC WISE TEST (NEET)

Subject : Physics | **Topic : Laws of Motion**

ANSWER KEY

Q.1 (3)	**Q.2** (2)	**Q.3** (4)	**Q.4** (3)	**Q.5** (1)	**Q.6** (4)	**Q.7** (2)	**Q.8** (1)	**Q.9** (2)	**Q.10** (1)
Q.11 (4)	**Q.12** (2)	**Q.13** (2)	**Q.14** (3)	**Q.15** (4)	**Q.16** (4)	**Q.17** (3)	**Q.18** (3)	**Q.19** (1)	**Q.20** (1)
Q.21 (1)	**Q.22** (2)	**Q.23** (3)	**Q.24** (4)	**Q.25** (2)	**Q.26** (1)	**Q.27** (2)	**Q.28** (1)	**Q.29** (2)	**Q.30** (3)
Q.31 (2)	**Q.32** (4)	**Q.33** (3)	**Q.34** (4)	**Q.35** (1)	**Q.36** (1)	**Q.37** (1)	**Q.38** (4)	**Q.39** (2)	**Q.40** (3)
Q.41 (1)	**Q.42** (1)	**Q.43** (1)	**Q.44** (4)	**Q.45** (4)	**Q.46** (3)	**Q.47** (1)	**Q.48** (1)	**Q.49** (3)	**Q.50** (3)

Hints and Solutions

Q.1 (3)

Q.2 (2)

Q.3 (4)

Q.4 (3)
Concept of Inertia.

Q.5 (1)
The compartments have a spring system between them. Firstly, the engine comes to rest ; then the compartment attached to it will come to rest.

Q.6 (4)

Q.7 (2)

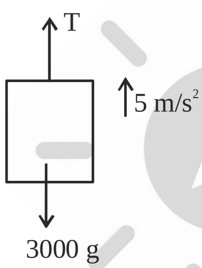
Q.8 (1)

Now, $F = \frac{mv^2}{2s}$, which implies that $s \propto \frac{1}{F}$, i.e. s is inversely proportional to F. Thus, the correct choice is (1).

Q.9 (2)

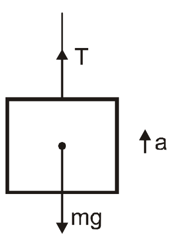
Q.10 (1)

Q.11 (4)



T – 3000 g = 3000 × 5
T = 45000 N

Q.12 (2)
Key Idea : The tension in the string during upward motion increases from weight of lift due to its upward acceleration.



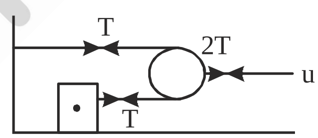
when lift moves upward with same acceleration then
T – mg = ma
or T = m (g + a)
Given m = 1000 kg, a = 1 m/s^2, g = 9.8 m/s^2
Thus T = 1000 (9.8 + 1)
= 1000 × 10.8
= 10800 N

Q.13 (2)

Q.14 (3)
F = 1.2 mg
F – mg = ma
1.2 mg – mg = ma
a = 0.2g = 2m/s^2

Q.15 **(4)**
A physical beam balance measures normal reaction which will be greater than the weight of body when elevator accelerating upwards.

Q.16 (4)



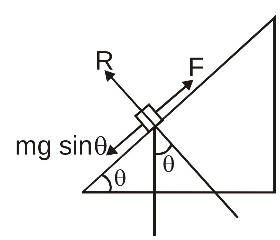
u.2T = V. T
V = 2u

Q.17 (3)

Q.18 (3)

$$a = \frac{(m_2 - m_1)g}{m_1 + m_2} = \frac{4g}{16} = 2.5 m/s^2$$

Q.19 **[1]**
F = mg sinθ = 2 x 9.8 x sin45° = 19.6 sin45°

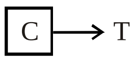


Hence the correct choice is (1)

Q.20 (1)
At equilibrium

$\boxed{F_{net} = 0}$

Q.21 (1)



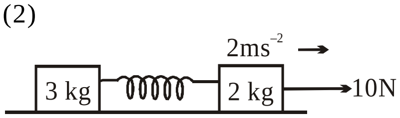
$T = m \times a = \frac{66}{1000} \times 5 = 0.33$

Q.22 (2)

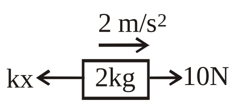
Q.23 (3)
As initially, the acceleration of aeroplane is in upward direction then it decrease.

Q.24 **(4)**

Q.25 (2)



$10 - kx = 2 \times 2$
$kx = 6$ N



$\therefore$ Acceleration of 3 kg $= \frac{6}{3} = 2$ m/s^2

Q.26 (1)

Q.27 (2)

$\tan 37^o = \frac{a}{g}$

$\Rightarrow \frac{3}{4} = \frac{a}{g}$

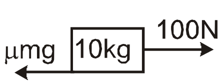
$\Rightarrow a = \frac{3}{4} \times 10 = 7.5$ m/s^2

Q.28 (1)
$f_{max} = 0.2 \times 4 \times 10 = 8$ N
Since, applied force < f_{max}
So, body would not move

Q.29 **(2)**

Q.30 (3)

Q.31 **(2)**



$a = \frac{100 - \mu mg}{m}$

$a = \frac{100 - \frac{1}{2} \times 10 \times 10}{10} = 5$ m/s^2

Q.32 (4)
Net downward force = Weight – Friction
$\therefore$ ma = 25 × 9.8 – 2
$\Rightarrow$ $a = 9.72$ m/s^2

Q.33 (3)

Q.34 (4)

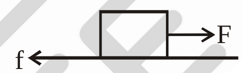
Q.35 (1)
F required to move
$F = 0.5 \times 60 \times 9.8$

$a = \frac{(F - f_x)}{m}$

$a = \frac{0.5 \times 60 \times 9.8 - 0.4 \times 60 \times 9.8}{60} = 0.98$ ms^{-2}

Q.36 (1)
Factual.

Q.37 (1)



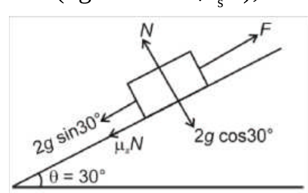
$F < f_{smax}$
friction=F
For $F > f_{max}$
friction constant

Q.38 (4)

$a_{common} = \frac{100}{40 + 60} = 1$ m/s^2
$f_{s,\,max} = \mu_s N_{12} = 0.2 \times 400 = 80$ N
$f_{required} = ma = 60 \times 1 = 60$ N
$\because$ $f_{required} < f_s$, max $\Rightarrow$ blocks move together and
$f = f_{required} = 60$ N

Q.39 (2)

Q.40 (3)
From FBD of body
To just move up
$F = (2g\sin 30° + \mu_s N)$; $N = (2g\cos 30°)$



$F_{min} = \left(2 \times 9.8 \times \frac{1}{2}\right) + \left(\frac{3}{10} \times 2 \times 9.8 \times \frac{\sqrt{3}}{2}\right)$

= 9.8 + 5.09 = 14.89 N

Q.41 (1)

Q.42 (1)

Q.43 (1)

Q.44 (4)

Q.45 (4)
Here, $\mu = 0.5$, r = 5 m, g = 10 ms^{-2}
The frictional force provides the centripetal force

$\therefore \ \frac{mv^2}{r} = \mu mg$ or $v^2 = \mu rg$

or $v = \sqrt{\mu rg} = \sqrt{(0.5)(5m)(10ms^{-2})} = 5\,m\,s^{-1}$

As $v = r\omega$ $\therefore \ \omega = \frac{v}{r} = \frac{5ms^{-1}}{5m} = 1$ rad s^{-1}

Q.46 (3)

$F_C = \frac{mv^2}{r}$

$F_C \propto \frac{v^2}{r}$

$v' = 3v,\ r' = 3r$

$F_C{}' = \frac{m\,9v^2}{3r} = 3F_C$

Q.47 (1)

$v = \sqrt{\mu Rg}$

$\mu = \frac{v^2}{Rg}$ $\left\{\begin{matrix} v = 72\times\frac{5}{8} \\ v = 20m/s \end{matrix}\right\}$

$\mu = \frac{400}{80\times10} = 0.5$

Q.48 (1)

$F_C = \frac{mv^2}{r} = \frac{mr^2\omega^2}{r} = mr\omega^2$ $T_{max} = 10$ N

$T_{max} = F_{cp} \Rightarrow 10 = mr\omega^2$

$\Rightarrow \omega^2 = 400$

$\Rightarrow \omega = 20$ rad/sec.

Q.49 (3)

Displacement, velocity and acceleration change continuously with respect to time because of change in direction.

Q.50 (3)

$\frac{v_1^2}{r_1} = \frac{v_2^2}{r_2}$ \;$\Rightarrow \frac{v_1}{v_2} = \sqrt{\frac{r_1}{r_2}} = \frac{1}{\sqrt{2}}$

TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Work, Power and Energy**

ANSWER KEY

Q.1 (2)	**Q.2** (3)	**Q.3** (3)	**Q.4** (1)	**Q.5** (1)	**Q.6** (2)	**Q.7** (2)	**Q.8** (3)	**Q.9** (3)	**Q.10** (3)
Q.11 (4)	**Q.12** (3)	**Q.13** (3)	**Q.14** (4)	**Q.15** (4)	**Q.16** (4)	**Q.17** (2)	**Q.18** (2)	**Q.19** (4)	**Q.20** (1)
Q.21 (2)	**Q.22** (2)	**Q.23** (1)	**Q.24** (2)	**Q.25** (1)	**Q.26** (4)	**Q.27** (1)	**Q.28** (4)	**Q.29** (2)	**Q.30** (1)
Q.31 (4)	**Q.32** (3)	**Q.33** (1)	**Q.34** (1)	**Q.35** (1)	**Q.36** (2)	**Q.37** (1)	**Q.38** (3)	**Q.39** (2)	**Q.40** (2)
Q.41 (3)	**Q.42** (1)	**Q.43** (2)	**Q.44** (2)	**Q.45** (3)	**Q.46** (3)	**Q.47** (2)	**Q.48** (4)	**Q.49** (1)	**Q.50** (2)

Hints and Solutions

Q.1 (2)

$W = \vec{F}.\vec{S}$

$W = (2\hat{i} + 15\hat{j} + 6\hat{k}).(10\hat{j})$ $W = 150$ joule

Q.2 (3)

$W = Fd\cos\theta$

$25 = 5 \times 10 \cos\theta$

$\theta = 60°$

Q.3 (3)

$x = 3t - 4t^2 + t^3,$

$\frac{dx}{dt} = 3 - 8t + 3t^2,$

$v(t=0) = 3 m/s$

$v(t=4) = 19 m/s$

Q.4 **(1)**

$W = \vec{F}.\vec{d}$

$= (2\hat{i} - \hat{j} + 4\hat{k}).(3i + 2\hat{j} - \hat{k}) = 0$

Q.5 (1)

$\vec{s} = 3\hat{j} + 4\hat{k}$

$\vec{F} = -\hat{i} + 2\hat{j} + 3\hat{k}$

$w = \vec{F}.\vec{S}$

$= -6 + 12 = 18J$

Q.6 (2)

As the water falls freely from a height 19.6 m, so the velocity of water at the turbine is

$v = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 19.6} = 19.6 m/s$

Q.7 (2)

$W = \mu mgd = (.4) \times 4 \times 9.8 \times 50 = 784 J$

Q.8 **(3)**

Work done $= \int_0^5 (3x^2 + 2x - 7)dx$

$= 125 + 25 - 35 = 115 J$

Q.9 **(3)**

$dW = kx^2 dx \cos 60°$

$\therefore$ Work done $= \frac{k}{2}\int_{x_1}^{x_2} x^2 dx = \frac{k}{6}(x_2^3 - x_1^3)$

Q.10 **(3)**

$\vec{d} = (3-2)\hat{i} + (3-1)\hat{j} + (4-3)\hat{k} = \hat{i} + 2\hat{j} + \hat{k}$ and

$\vec{F} = |F|\hat{F}$

So, $\vec{F} = 20\left[\frac{1}{\sqrt{6^2 + 8^2}}(6\hat{i} + 8\hat{j})\right] = 12\hat{i} + 16\hat{j}$

$W = \vec{F}.\vec{d} = 44 J$

Q.11 **(4)**

Workdone $= \int \vec{F} \cdot d\vec{s}$ = independent of time

Power $= \frac{dW}{dt} = \vec{F} \cdot \vec{v} = \frac{\vec{F} \cdot \vec{s}}{t} \propto \frac{1}{t}$

Work done by conservative force in a closed path is zero

Q.12 **[3]**

Force experienced by the body (F)

$(F) = \mu mg \cos\theta = 0.5 \times 1 \times 9.8 \times \cos 60°$

$= 1.5 \times 0.5 = 2.45 N$

Work done $(W) = F.d = 2.45$

Hence the correct answer will be (3)

Q.13 (3)

$W = U_f - U_i$

$= \frac{1}{2}k(x+y)^2 - \frac{1}{2}kx^2$

$= \frac{1}{2}k(y^2 + 2xy)$

Q.14 (4)

$\frac{\partial F}{\partial x} = -ve$

Q.15 (4)

$v = 0 + aT \Rightarrow a = \frac{v}{T}$

velocity at time t $v' = 0 + \frac{v}{T}t$

$W = \Delta K = \frac{1}{2}m\frac{v^2}{T^2}t^2 - 0$ so $W \propto \frac{v^2t^2}{T^2}$

Q.16 (4)

$x = 3t^2 + 5$

$\Rightarrow v = 6t \Rightarrow \Delta W = \Delta k$

$= \frac{1}{2}(2)(30)^2 - \frac{1}{2}2(0)^2 = 900$ J

Q.17 (2)

Energy stored in spring, $U = \frac{1}{2}kx^2$

where k = spring constant

x = extension/compression

$\Rightarrow U = \frac{1}{2}kx^2$

$\Rightarrow U' = \frac{1}{2}K(2x)^2 = 4\left(\frac{1}{2}kx^2\right) = 4U$

Q.18 **(2)**

T = kx for spring

Energy $= \frac{1}{2}kx^2 = \frac{1}{2}k\frac{T^2}{k^2} = \frac{T^2}{2k}$

Q.19 **(4)**

P.E. converted in to K.E.

K.E. = mgh = 1 × 9.8 × 10 = 98 J

Q.20 (1)

$K_f = \frac{1}{4}K_i \Rightarrow v_f = \frac{v_0}{2}$

$a = \mu g$ [as $f = \mu mg$]

So $\frac{v_0}{2} = v_0 - \mu_k g\, t_0 \Rightarrow \mu = \frac{v_0}{2gt_0}$

Q.21 (2)

Applying work Energy theoram -

$W = \Delta K.E.$

Area under F-x graph $= k_f - k_i$

$\frac{1}{2}\times(8+4)\times 10 = \frac{1}{2}m\left[v^2 - 4^2\right]$

Solving, we get

V = 16 m/s

Q.22 (2)

From conservation of energy

$\frac{1}{2}mv^2 = \frac{1}{2}mu^2 + mgh$

$\therefore v^2 + u^2 + 2gh = (10)^2 + 2 \times 10 \times 10$

$\therefore v = 10\sqrt{3}$ m/s

Q.23 **(1)**

Let spring compresses by x

By COME

$\frac{1}{2}mv^2 = \frac{1}{2}kx^2 + f.x$

$\Rightarrow$ x = 5.5 cm

Q.24 (2)

W = mgh

which is independent of time.

Q.25 (1)

By WET

$W_g + W_{fr} = 0$

$mg \sin 30\,(f_0) + W_{fr} = 0$

$W_{fr} = -mg \sin 30(10)$

$= -1 \times 10 \times \frac{1}{2} \times 10$

$= -50$ J

Q.26 (4)

$E = \frac{1}{2}m(v^2 - u^2)$

$E_1 = \frac{1}{2}m(10^2 - 0^2)$

$E_1 = \frac{1}{2}m \times 100$ .... (1)

$E_2 = \frac{1}{2}m(20^2 - 10^2)$

$E_2 = \frac{1}{2}m \times 300$ .... (2)

$\Rightarrow E_2 = 3E_1$

Q.27 (1)

K.E. = W = Fx

K.E. = max

K.E. $\propto$ x [$\because$ a = constant]

Q.28 (4)

$K.E. - 3 = \vec{F}\cdot\vec{d}$

$K.E. = 3 + (3\hat{i} - 12\hat{j}) \times (4\hat{i})$

K.E. = 3 + 12 = 15 J

Q.29 (2)

Momentum lost by bullet

= momentum gained by bob.

Bob velocity, v = 0.2 v

$v_b = \sqrt{2gh}$

$= \sqrt{2\times10\times20} = 20$ m/s

$\Rightarrow 0.2u = 20$

u = 100 m/s

Q.30 (1)

Work by done by the force = change in kinetic energy

$$= \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$$

$$\because x = 2t^3 = \frac{dx}{dt} = v = 6t^2$$

$$\Rightarrow W = \frac{1}{2}m\ (\{6\times2^2\}-0)$$

= [576]

= 576 J Hence option (1)

Q.31 (4)

Statement-I $P = \vec{F}.\vec{V}$

$$= \left(4\hat{i}+\hat{j}-2\hat{k}\right).\left(2\hat{i}+2\hat{j}+3\hat{k}\right)$$

= 8 + 2 – 6 = 4 watt correct

Statement-II also correct $P = \vec{F}.\vec{V}$

Q.32 **(3)**

Mass of water $= 2238 \times 10^{-3} \times 10^3$

$= 2238$ kg

$\therefore$ Energy = 2238 × 10 × 10 = mgh

$$\therefore \frac{2238\times30\times10}{T} = 1 \times 746 \text{ (T is time)}$$

$$\therefore T = \frac{2238\times30\times10}{746} \text{ sec} = 15 \text{ min.}$$

Q.33 (1)

$$m\frac{dv}{dt}\ v = p$$

$$\int_0^u v\ dv = \int_0^t \frac{p}{m}dt$$

$$\frac{v^2}{2} = \frac{p}{m}t$$

$$v = \sqrt{\frac{2pt}{m}}$$

Q.34 **(1)**

$$\text{Power} = \frac{\text{work done as change in PE}}{\text{time}}$$

$$\therefore P = \frac{mgh}{t} = \frac{80\times10\times6}{10} = 480\ W$$

$$\therefore P = \frac{480}{746}\ hp = 0.63\ HP$$

Q.35 (1)

$$P = \frac{w}{f} = \frac{(M+m)gh}{t}$$

$$= \frac{800\times20\times.2}{10} = 320w$$

Q.36 (2)

Q.37 **(1)**

At highest point minimum possible value of tension is zero.

Q.38 (3)

$$a = 0 \quad \Rightarrow F = 0, \quad \Rightarrow \frac{dU}{dx} = 0\ ]$$

Q.39 (2)

$$F = -\frac{dU}{dx} = +2Bx$$

Q.40 (2)

$$\vec{F} = \frac{-\partial U}{\partial x}\hat{i}\frac{-\partial U}{\partial y}\hat{j}$$

Given, U = cos (x + y)

$$\vec{F} = -\frac{\partial}{\partial x}\cos(x+y)\hat{i} - \frac{\partial}{\partial y}\cos\left(x+y\right)\hat{j}$$

$$= \sin(x+y)\,\hat{i} + \sin(x+y)\,\hat{j}$$

Given $x = 0,\ y = \frac{\pi}{4}$

$$\therefore \vec{F} = \frac{1}{\sqrt{2}}\hat{i} + \frac{1}{\sqrt{2}}\hat{j} = \frac{1}{\sqrt{2}}\left(\hat{i}+\hat{j}\right)$$

Q.41 (3) Here : m = 2kg, r = 1 m, v = 4 ms^{-1}

T = 52 N

Tension at any point in vertical circle

$$T = \frac{mv^2}{r} + mg\cos\theta$$

$$52 = 2\frac{(4)^2}{1} + (2)\times10\cos\theta$$

$52 = 32 + 20\cos\theta$

$20 = 20\cos\theta$

$\Rightarrow \cos\theta = 1$

$\cos\theta = \cos 0^\circ$

$\therefore \theta = 0^\circ$

Q.42 (1)

Let the velocity is v. The particle will not slide, if centripetal force is not there or the centripetal force is balanced by the weight of the particle.

So, $\frac{mv^2}{R} = mg$

$\therefore v = \sqrt{Rg} = \sqrt{20\times10^{-2}\times9.8}$

$= \sqrt{196\times10^{-2}} = 1.4 ms^{-1}$

Q.43 (2)

Minimum speed at lowest point of a vertical circle.

$v = \sqrt{5\,Rg}$

$\therefore v \propto \sqrt{R}$

$\therefore \frac{v_1}{v_2} = \sqrt{\frac{R_1}{R_2}}$

$\frac{v}{v_2} = \sqrt{\frac{R}{R/4}}$

$\frac{v}{v_2} = 2$

$\Rightarrow v_2 = \frac{v}{2}$

Q.44 (2)

For light rod

$v_{top} = 0$

Using energy conservation

$\frac{1}{2} mv^2 + 0 = 0 + mg\ell$

$v = \sqrt{2g\ell}$

Q.45 (3)

For water not to spill out of the bucket,

$v_{min} = \sqrt{5gR}$

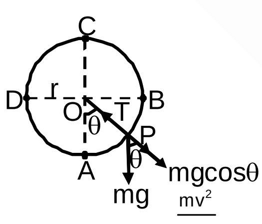
$= \sqrt{5\times10\times0.5}$

$= 5\ ms^{-1}$

Q.46 (3)

Net force towards centre = centripetal force

$T - mg\cos\theta = \frac{mv^2}{r}$



At point C ; θ = 180º

$\therefore \quad T + mg = \frac{mv^2}{r}$

or $\quad mg < \frac{mv^2}{r}$

Q.47 (2)

If speed is changing then there exist a_T and then resultant acceleration $\sqrt{a_{c^2} + a_{T^2}}$ do not directed towards centre.

Hence potion A is wrong

$\because \quad \Sigma F_r = m\,a_c$ and tension will vary during the motion option c will wrong.

'a' is a vector quantity so that acceleration is not constant.

Q.48 (4)

Tension in the string at any point

$T = \frac{mv^2}{r} + mg\cos\theta$

When the stone is at its lowest position

$\theta = 0º$

$\therefore T = \frac{mv^2}{r} + mg\cos 0º$

$= \frac{mv^2}{r} + mg \qquad (\because \cos 0º = 1)$

Q.49 **(1)**

$T_{max} = mg + mr\,\omega^2$

(At the lowest point)

$\omega = \sqrt{\frac{T_{max} - mg}{mr}} = \sqrt{\frac{30 - 0.5\times10}{0.5\times2}} = 5$ rad /sec

Q.50 (2)

Force is perpendicular to displacement hence work done is zero

TOPIC WISE TEST (NEET)

Subject : Physics **Systems of Particles and Rotational Motion**

ANSWER KEY

Q.1 (1)	**Q.2** (2)	**Q.3** (2)	**Q.4** (1)	**Q.5** (2)	**Q.6** (4)	**Q.7** (1)	**Q.8** (2)	**Q.9** (4)	**Q.10** (3)
Q.11 (3)	**Q.12** (2)	**Q.13** (2)	**Q.14** (4)	**Q.15** (1)	**Q.16** (3)	**Q.17** (3)	**Q.18** (1)	**Q.19** (4)	**Q.20** (2)
Q.21 (3)	**Q.22** (3)	**Q.23** (2)	**Q.24** (2)	**Q.25** (1)	**Q.26** (3)	**Q.27** (4)	**Q.28** (2)	**Q.29** (4)	**Q.30** (3)
Q.31 (2)	**Q.32** (4)	**Q.33** (3)	**Q.34** (3)	**Q.35** (2)	**Q.36** (1)	**Q.37** (3)	**Q.38** (3)	**Q.39** (2)	**Q.40** (3)
Q.41 (3)	**Q.42** (4)	**Q.43** (1)	**Q.44** (3)	**Q.45** (1)	**Q.46** (1)	**Q.47** (4)	**Q.48** (4)	**Q.49** (1)	**Q.50** (2)

Hints and Solutions

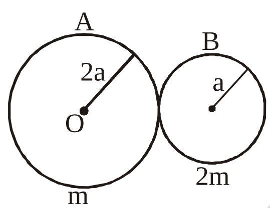
Q.1 (1)

COM of semicircular plate is $\frac{4R}{3\pi}$.

Q.2 (2)

Q.3 (2)

The situation is shown in the figure.



The distance of centre of mass from the first sphere (i.e. from the centre of sphere A) is

$$X_{CM} = \frac{m(0)+2m(3a)}{m+2m} = \frac{6ma}{3m} = 2a$$

Q.4 (1)

Still water will not apply any external horizontal force.

So, $a_{cm} = 0$ $\Rightarrow dV_{cm} = 0$

As initial $V_{cm} = 0$

$\Rightarrow$ Finally $V_{cm} = 0$

$\Rightarrow$ Position of C.O.M. = constant

$\Rightarrow$ No shift of C.O.M.

Q.5 (2)

$m_1v_1 + m_2v_2 = (m_1 + m_2)\,v$

$2 \times 25 + 2 \times (-5) = (2 + 2)\,v$

$50 - 10 = 4v$

$v = 10$m/s

Q.6 (4)

Initially, velocity of A and B = 0

$$\Rightarrow \vec{v}_{cm} = \frac{m_1\vec{v}_1 + m_2\vec{v}_2}{m_1+m_2} = \frac{0+0}{m_1+m_2} = 0$$

Later, both move due to interial pres and internal pres does not affect center of mass

$$\Rightarrow \vec{v}_{cm} = 0 = \text{constant}$$

Q.7 (1)

Force = rate of change of momentum

$$\frac{\Delta p}{t} = \frac{25}{0.05} = 500\text{N}$$

Q.8 (2)

From the law of conservation of linear momentum

$m_1v_1 = m_2v_2 \Rightarrow$ $50 \times 600 = 10^3 \times v^2$

$\Rightarrow v_2 = 30$ m/s

Q.9 (4)

The force exerted by machine gun on man's hand firing a bullet = change in momentum per second on a bullet or rate of change of momentum

$$= \left(\frac{40}{1000}\right) \times 1200 = 48\text{N}$$

The force exerted by man on machine gun = 144 N

Hence, number of bullets fired $= \frac{144}{48} = 3$

Q.10 (3)

$$M = \frac{mv}{V} = 0.05 \times 30 = 1.5 \text{ kg}$$

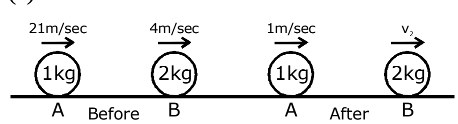
Q.11 (3)

$$\Delta K.E. = \frac{1}{2}\frac{m_1m_2}{(m_1+m_2)}(u_1-u_2)^2$$

$$= \frac{1}{2} \times \frac{40 \times 60}{(40+60)}(4-2)^2$$

ΔK.E. = 48 J

Q.12 (2)



$21 \times 1 - 4 \times 2 = 1 + 2v_2$

$21 - 8 = 1 + 2v_2$

$2v_2 = 12 \Rightarrow v_2 = 6$m/sec

$$e = \frac{v_2 - v_1}{u_1 - u_2} = \frac{6-1}{21+4} = \frac{5}{25} = \frac{1}{5}$$

$e = 0.2$

Q.13 (2)

For 1st drop : $v^2 = 0^2 + 2gh_0$

$$\Rightarrow h_0 = \frac{v^2}{2g}$$

After 1st drop : $0^2 = (ev)^2 - 2gh$

$$\Rightarrow h = \frac{e^2v^2}{2g} = e^2h_0$$

Q.14 **(4)**

$50 \times 10 = 1000 \times v$

$$\therefore\ v = \frac{1}{2} m/s$$

$$E_i = \frac{1}{2} \times \frac{50}{1000} \times 10 \times 10 = 2.5\ j$$

$$E_f = \frac{1}{2} \times \frac{1000}{1000} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8} j$$

$$\%\ \text{loss} = \frac{2.5 - 1/8}{2.5} \times 100 = 95\%$$

Q.15 **(1)**

e = 0, for perfectly inelastic.

Q.16 (3)

$$\omega = \frac{d\theta}{dt}\ \text{angular velocity}$$

$$\alpha = \frac{d\omega}{dt}\ \text{angular acceleration}$$

$$\omega = \int \tau \cdot d\theta$$

Rotational K.E. = $\frac{1}{2} I\omega^2$

Q.17 (3)

Given, $n = 1200$ rev / min

$= \frac{1200}{60}$ rev/s

= 20 rev/s

$\omega = 2\ \pi n = 2\pi(20) = 40\pi$ rads^{-1}

Angular acceleration, a = 4 rads^{-2}

From equation of rotational motion

$$\omega^2 = \omega_0^2 - 2a\theta = 0, \omega$$

$$\therefore\ \theta = \frac{\omega_0^2}{2a} = \frac{(40\pi)^2}{2 \times 4} = 200\pi^2$$

$$\therefore \text{Number of revolutions} = \frac{200\pi^2}{2\pi}$$

$= 100\pi$

$= 100 \times 3.14$

$= 314$

Q.18 (1)

$\theta = \theta_0 + \theta_1 t + \theta_2 t^2$

Now

$$\omega = \frac{d\theta}{dt} = 0 + \theta_1 + 2\theta_2 t$$

$$\&\ \alpha = \frac{d\omega}{dt} = 0 + 2\theta_2$$

Thus

$$\frac{\alpha}{\omega_0} = \frac{2\theta_2}{\theta_1}$$

Q.19 (4)

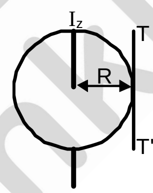
Q.20 **(2)**

From $v = r\omega$, linear velocities (v) for particles at different distances (r) from the axis of rotation are different.

Q.21 (3)

$I_z = 2I$

where, $I = \frac{MR^2}{4}$

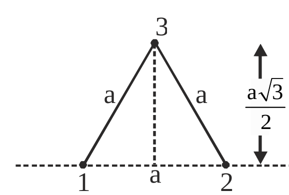


According to theorem of parallel axes, required moment of inertia about axis TT' is

$TT = I_z + MR^2$

$= 2I = Mr^2 + 2I + 4I = 6I$

Q.22 (3)



Movement of inertia of mass (1) and (2)

$$I = M\left(\frac{\sqrt{3}a}{2}\right)^2$$

$$= \frac{3ma^2}{4}$$

Q.23 **(2)**

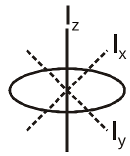
Along diameter in the plane.

Using $\perp$ Axis theorem

$I_x + I_y = I_z$

$2I_x = I_z$

$I_x = \frac{MR^2}{2}$



Q.24 **(2)**

$I_1 = \frac{2}{5}MR^2; I_2 = \frac{2}{3}MR^2; I_3 = MR^2$

Q.25 **(1)**

As $I = MR^2$ or $I \alpha R^2$

so graph between I and R will be a parabola.

Q.26 (3)

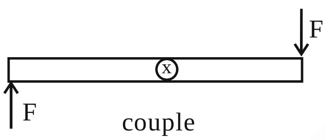
$\alpha = \frac{\omega}{t} = \frac{10}{2} = 5$

$t = I\alpha \Rightarrow MR^2\alpha$

$= 0.5 \times (0.2)^2 \times 5 = 0.10$

Q.27 (4)

A torque must be there, to rotate a body. Equal and opposite forces acting on a body is called couple.



Q.28 (2)

Q.29 (4)

Q.30 (3)

Torque equilibrium about X

$30g \times \frac{L}{2} - R_Y \times \frac{3L}{4} = 0$

$R_Y = 200\text{ N}$

Q.31 (2)

$\tau = I\alpha = \frac{mr^2}{2} \times \alpha$

$\alpha = 0.25\text{rad/sec}^2$

Q.32 (4)

for of hollow cylinder

$I = MR^2 = 3.0 \times (0.40)^2 = 0.48$ kg-m^2

Torque on cylinder $\tau = F \times R$

$= 30 \times 0.40 = 12$ N-m

Angular acceleration of cylinder

$\because \tau = I\alpha \Rightarrow \therefore \alpha = \frac{\tau}{I} = \frac{12}{0.48} = 25\text{ rad/s}^2$

Q.33 (3)

$P = \tau\omega$

$10 \times 10^3 = \tau 2\pi f$

$100 \times 10^3 = \tau \times 2\pi\left(\frac{1800}{60}\right)$

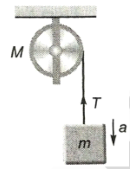
$\tau = \frac{100 \times 10^3 \times 60}{1800 \times 2\pi} = 530.51$ N-m

Q.34 (3)

Beam is not at rotational equilibrium, so force exerted by the rod (beam) decrcase

Q.35 **(2)**

When pulley has a finite mass M and radius R, then tension in two segments of string are different.



Here, $ma = mg - T$

$$a = \frac{m}{m + \frac{M}{2}}g = \frac{2m}{2m + M}g$$

Q.36 (1)

Given moment of inertia 'I' = 1.5 kgm^2

Angular Acc "α" = 20 Rad/s^2

$KE = \frac{1}{2}I\omega^2$

$1200 = \frac{1}{2}1.5 \times \omega^2$

$\omega^2 = \frac{1200 \times 2}{1.5} = 1600$

$\omega = 40\text{ rad/s}^2$

$\omega = \omega_0 + \alpha t$

$40 = 0 + 20\,t$

$t = 2$ sec.

Q.37 (3)

Q.38 (3)

Frequency of rotation = n Hz.

So, $\omega = 2\pi n$

and kinetic energy, $K = \frac{1}{2}I\omega^2$

so, $K = \frac{1}{2} \times \frac{mL^2}{3} \times (4\pi^2 \times n^2)$

$\Rightarrow K = \frac{2}{3}mL^2\pi^2n^2$

Q.39 **(2)**

Rotational kinetic energy $= \frac{1}{2}I\omega^2$

$K_1 = \frac{1}{2} I_1 \omega_1^2$; $K_2 = \frac{1}{2} I_2 \omega_2^2$

$$\therefore \frac{K_2}{K_1} = \left(\frac{I_2}{I_1}\right)\left(\frac{\omega_2}{\omega_1}\right)^2 = \left(\frac{I_1}{2I_1}\right)^2 \left(\frac{2\omega_1}{\omega_1}\right)^2 = \frac{2}{1}$$

or $K_2 = 2K_1$

Rotational KE will be doubled.

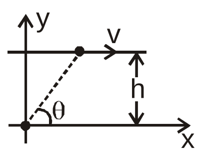
Q.40 (3)

Rotation kinetic energy

$$= \frac{1}{2} I\omega^2 = \frac{1}{2} (2mr^2)(2\pi n)^2 = 4\pi^2 mr^2 n^2$$

Q.41 **(3)**

Constant velocity



Angular momentum = $m\vec{v}_1\vec{r}$

= mvh = constant.

Q.42 (4)

Applying angular momentum conservation, about axis of rotation

$L_i = L_f$

$$\frac{ML^2}{12}\omega_0 = \left(\frac{ML^2}{12} + m\left(\frac{L}{2}\right)^2 \times 2\right)\omega$$

$$\Rightarrow \quad \omega = \frac{M\omega_0}{M + 6m}$$

Q.43 **(1)**

M = 10 kg   K = 0.1 m

ω = 10 rad/sec

angular momentum (L) = Iω

$= MK^2\omega = 10 \times (0.1)^2 \times 10$

$\Rightarrow$ $L = 1$ kg m^2/s

Q.44 **(3)**

Here, Mass, M = 1.0 kg

Diameter, D = 2.0 m

$\therefore$ Radius, $R = \frac{D}{2} = 1.0\,m$

The moment of inertia of the body.

$I = MR^2 = (1.0 \text{ kg})(1.0 \text{ m})^2 = 1.0$ kg m^2

The angular velocity of the body,

$$\omega = 2\pi\nu = 2 \times 3.14 \times \frac{10}{31.4} \text{ rad/s} = 2 \text{ rad/s}$$

The angular momentum of the body,

$L = I\omega = (1.0 \text{ kg m}^2)(2 \text{ rad/s})$

$= 2$ kg m^2/s

Q.45 **(1)**

$I = mR^2 = 10(0.2)^2 = 0.4$ kg-m^2

$$\omega = \frac{1200 \times 2\pi}{60} \text{rad/sec}.$$

ω = 40π rad/s

Angular Momentum L = Iω = 16π J-s

= 50.28 J-s.

Q.46 **(1)**

f = 0.5

ω = 2πf = π

$L = I\omega = 0.6\pi \text{ kg} \times \frac{m^2}{s}$

Q.47 (4)

Q.48 (4)

Direction of angular momentum is perpendicular to orbital plane and along the axis of rotation.

Q.49 (1)

From Torque $\vec{\tau} = \frac{d\vec{L}}{dt}$ for constant torque $\tau = \frac{\Delta\vec{L}}{\Delta t}$

$\Rightarrow L_f - L_i = \tau\,\Delta t$

$\Rightarrow L_f - 5 = 10 \times 3 = 30$

$\Rightarrow L_f = 35$ kgm^2/s

Q.50 (2)

For angular momentum conservation

$\vec{\tau}_0 = 0$

$\vec{r} \times \vec{F} = 0$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 8 & 6 & 12 \\ 2 & \beta & 3 \end{vmatrix} = 0$$

$\hat{i}\,(18-12\beta) - \hat{j}\,(24-24) + \hat{k}\,(8\beta - 12) = 0$

$18 - 12\beta = 0$

$\beta = \frac{3}{2}$

TOPIC WISE TEST (NEET)

Subject : Physics **Topic: Gravitation**

ANSWER KEY

Q.1 (3)	**Q.2** (4)	**Q.3** (1)	**Q.4** (3)	**Q.5** (3)	**Q.6** (4)	**Q.7** (1)	**Q.8** (4)	**Q.9** (3)	**Q.10** (3)
Q.11 (2)	**Q.12** (1)	**Q.13** (2)	**Q.14** (2)	**Q.15** (4)	**Q.16** (2)	**Q.17** (1)	**Q.18** (2)	**Q.19** (2)	**Q.20** (4)
Q.21 (1)	**Q.22** (3)	**Q.23** (3)	**Q.24** (3)	**Q.25** (3)	**Q.26** (1)	**Q.27** (4)	**Q.28** (3)	**Q.29** (1)	**Q.30** (4)
Q.31 (2)	**Q.32** (4)	**Q.33** (4)	**Q.34** (4)	**Q.35** (1)	**Q.36** (3)	**Q.37** (1)	**Q.38** (2)	**Q.39** (4)	**Q.40** (1)
Q.41 (1)	**Q.42** (2)	**Q.43** (2)	**Q.44** (2)	**Q.45** (4)	**Q.46** (2)	**Q.47** (3)	**Q.48** (1)	**Q.49** (2)	**Q.50** (1)

Hints and Solutions

Q.1 (3)

Newton's III law of motion.

Q.2 (4)

Newtons law of gravitation is valid for all types of bodies.

Q.3 (1)

$E_g = \frac{GM}{r^2}$

$g = \left(\frac{GMm}{r^2}\right) \times \frac{1}{m} = \frac{GM}{r^2}$

So value of E_g and g is same

Q.4 (3)

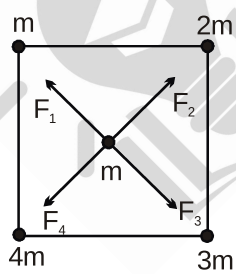
$w = \vec{F}.d\vec{r}$

$= \vec{I}_g .m. d\vec{r}$

$= 1 \times (4\hat{i} + 5\hat{j}) . (3\hat{i} + 2\hat{j})$

$= 12 + 10 = 22$ J

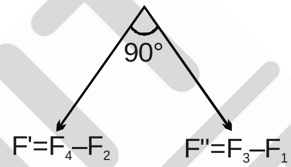
Q.5 **(3)**



$F_1 = \frac{Gmm}{(a/\sqrt{2})^2}$, $F_2 = \frac{Gm2m}{(a/\sqrt{2})^2}$

$F_3 = \frac{Gm3m}{(a/\sqrt{2})^2}$; $F_4 = \frac{Gm4m}{(a/\sqrt{2})^2}$

So resultant of forces will be



$F' = \frac{Gm4m}{(a/\sqrt{2})^2} - \frac{Gm2m}{(a/\sqrt{2})^2}$,

$F'' = \frac{Gm3m}{(a/\sqrt{2})^2} - \frac{Gmm}{(a/\sqrt{2})^2}$

$F' = \frac{2Gm^2}{a^2/2}$, $F'' = \frac{2Gm^2}{a^2/2}$

$F' = \frac{4Gm^2}{a^2}$, $F'' = \frac{4Gm^2}{a^2}$

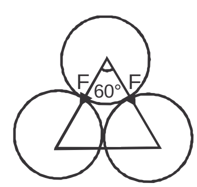
Now they are at 90°

So resultant force = $4\sqrt{2}\frac{Gm^2}{a^2}$

Q.6 **(4)**

By symmetrically all forces will cancel each other and resultant will be zero.

Q.7 **(1)**

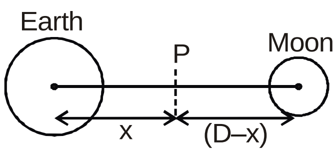


So net force = $\sqrt{3}F$

where $F = \frac{GM^2}{(2R)^2} = \frac{GM^2}{4R^2}$

So, force = $\frac{\sqrt{3}GM^2}{4R^2}$

Q.8 **(4)**



At point 'p' for gravitation field to be zero field due to earth= field due to moon

$$\Rightarrow \frac{GM_e}{x^2} = \frac{GM_m}{(D-x)^2} \Rightarrow \frac{81M_m}{x^2} = \frac{M_m}{(D-x)^2}$$

$$\Rightarrow \frac{x}{D-x} = 9 \Rightarrow 9(D-x) = x \Rightarrow x = \frac{9D}{10}$$

Q.9 **(3)**

Q.10 (3)

Force of gravity or gravitation does not depend on surrounding medium.

Q.11 (2)

$$\therefore\ g = \frac{GM}{R^2}$$

$$M = g\frac{R^2}{G}$$

Q.12 (1)

$$mg = \frac{mGM}{R^2} = \frac{GMm}{R^2} = \frac{Gm}{R^2} \times \frac{4}{3}\pi R^3 \rho$$

$$\propto R$$

So it radius is doubled weight is also doubled.

Q.13 (2)

The ratio $\frac{g'}{g} = \frac{R^2}{(R+h)^2} = \frac{1}{2}$

or $R + h = \sqrt{2}\,R$

or $h = (\sqrt{2} - 1)\,R$

Q.14 (2)

At the surface of earth $g = \frac{GM}{R^2}$

Above the surface of earth $g' = \frac{GM}{(R+h)^2}$

But, $g' = 1\%$ of $g = \frac{1 \times g}{100}$

$$\therefore \frac{g}{100} = \frac{GM}{(R+h)^2}$$

$$\therefore \frac{1}{100}\frac{GM}{R^2} = \frac{GM}{(R+h)^2}$$

$(R + h)^2 = 100\ R^2$

$R + h = 10\ R$

$\therefore\quad h = 10\ R - R = 9\ R$

Q.15 **(4)**

$$g = \frac{GM_e}{R_e^2}$$

$$g_{mass} = \frac{G(0.1)M_e}{(0.5)^2 R_e^2} = \frac{0.4GM_e}{R_e^2} = 0.4\ g$$

Q.16 **(2)**

Acceleration due to gravity $g = \frac{4}{3}\pi\rho GR$

or $g \propto \rho$

$$\therefore \quad \frac{g_1}{g_2} = \frac{\rho_1}{\rho_2}$$

$$\frac{g_1}{g_2} = \frac{\rho}{2\rho}\ [\because \rho_2 = 2\rho]$$

$$g_2 = g_1 \times 2 = 9.8 \times 2$$

$$g_2 = 19.6\ m/s^2$$

Q.17 (1)

Q.18 (2)

Acceleration due to gravity at height h

$$g' = \frac{g}{\left(1+\frac{h}{R}\right)^2}$$

$$\therefore \quad mg' = \frac{mg}{\left(1+\frac{h}{R}\right)^2}$$

$$w' = \frac{w}{\left(1+\frac{h}{R}\right)^2}$$

$$w' = \frac{w}{4} \qquad \text{(given)}$$

$$\therefore \frac{w}{4} = \frac{w}{\left(1+\frac{h}{R}\right)^2}$$

$$\Rightarrow \frac{1}{4} = \frac{w}{\left(1+\frac{h}{R}\right)^2}$$

$$1+\frac{h}{R} = 2$$

$$\Rightarrow \frac{h}{R} = 1$$

$\Rightarrow h = R$

Q.19 (2)

Mass of planet, $M_p = \frac{1}{9} M_e$

Radius of planet, $R_p = \frac{1}{2} R_e$

$\therefore$ Acceleration due to gravity at earth

$$g_e = \frac{GM_e}{R_e^2}$$

Acceleration due to gravity at planet

$$g_p = \frac{GM_p}{R_p^2} = \frac{GM_e/9}{(R_e/2)^2}$$

$$= \frac{GM_e/9}{R_e^2/4}$$

$$= \frac{4}{9}\frac{GM_e}{R_e^2} = \frac{4}{9} g_e$$

$$\therefore \frac{\text{Weight on planet}}{\text{Weight on earth}} = \frac{m g_p}{m g_e}$$

$$\frac{w'}{9} = \frac{g_p}{g_e}$$

$$= \frac{4}{9} \times \frac{g_e}{g_e}$$

$$w = \frac{4}{9} \times 9$$

$= 4$ N

Q.20 (4)

Q.21 (1)

$$W = 3 \times \left[-\frac{Gm^2}{d}\right]$$

$$= -\frac{3 \times 6.67 \times 10^{-11} \times (0.1)^2}{0.2}$$

$= -1.0 \times 10^{-11}$ J

Q.22 (3)

Potential at center of earth,

$$V_{center} = \frac{-3}{2}\frac{GM}{R}$$

and acceleration due to gravity, $g = \frac{GM}{R^2}$

$$\Rightarrow \frac{GM}{R} = gR$$

$$\therefore V_{center} = \frac{-3}{2} gR$$

Q.23 (3)

Escape velocity, $V_e = \sqrt{\frac{2GM}{R}}$

where M = mass of the planet

R = radius of the planet

$$\Rightarrow \frac{V_1}{V_2} = \sqrt{\frac{M_1}{M_2}\frac{R_2}{R_1}}$$

$$\Rightarrow \frac{V_1}{11.2} = \sqrt{\frac{8m}{m}\frac{R}{2R}} = 2$$

$\Rightarrow V_1 = 22.4$ km/s

Q.24 (3)

Work done = change in Gravitational potential Energy

$W = U_F - U_I$

$$= 3\left(\frac{-Gm^2}{2r}\right) - \left(\frac{-3Gm^2}{r}\right)$$

$$= \frac{3}{2}\frac{Gm^2}{r}$$

Q.25 (3)

$$\frac{1}{2}Mv^2 + 2\left[-\frac{GmM}{L/2}\right] = 0$$

$$v = \sqrt{\frac{8GM}{L}}$$

Q.26 (1)

As we know,

Gravitational potential energy $= \frac{-GMm}{r}$

and orbital velocity, $v_0 = \sqrt{GM/(R+h)}$ =

$$\sqrt{\frac{GM}{(R+2R)}} = \sqrt{\frac{GM}{3R}}$$

$$E_f = \frac{1}{2}mv_0^2 - \frac{GMm}{3R} = \frac{1}{2}m\frac{GM}{3R} - \frac{GMm}{3R}$$

$$= \frac{GMm}{3R}\left(\frac{1}{2}-1\right) = \frac{-GMm}{6R}$$

$$E_i = \frac{-GMm}{R} + K$$

$E_i = E_f$

Therefore minimum required energy.

$$K = \frac{5GMm}{6R}$$

Q.27 (4)

$$v_{es} = \sqrt{\frac{2GM}{R}}$$

now, $V = 2v_{es} = 2\sqrt{\frac{2GM}{R}} = \sqrt{\frac{8GM}{R}}$

By conservation of energy–

$$\frac{-GMm}{R} + \frac{8GMm}{2R} = 0 + \frac{mv^2}{2}$$

solving this, we get –

$$v = \sqrt{\frac{3\times 2GM}{R}} = \sqrt{3}\sqrt{\frac{2GM}{R}}$$

$$v = \sqrt{3}v_{es}$$

Q.28 (3)

Q.29 (1)

Gravitational P.E of a body

$$= \frac{-GMm}{r}$$

P.E at r = 2R, $E_1 = \frac{-GMm}{2R}$

P.E at r = 3R, $E_2 = \frac{-GMm}{3R}$

$\Delta E = E_2 - E_1$

$$= \frac{-GMm}{3R} + \frac{GMm}{2R}$$

$$= \Delta E = +\frac{GMm}{6R}$$

Q.30 (4)

Suppose the satellite is orbiting at an altitude of *r* from the centre of earth.

Then its binding energy

$$E = \frac{-GMm}{r} + \frac{1}{2}mv^2$$

Also, required centripetle force = gravitational force

$$\frac{mv^2}{r} = \frac{GMm}{r^2} \Rightarrow \left[v^2 = \frac{GM}{r}\right]$$

$$E = -\frac{GMm}{r} + \frac{1}{2}m\times\frac{GM}{r}$$

$E = \frac{-GMm}{2r} < 0$ Þ System is bounded

Also KE $= \frac{GMm}{2r}$

If KE is doubled ; $(KE)_2 = \frac{GMm}{r}$

New binding energy $= \frac{-GMm}{r} + \frac{GMm}{r}$

System is unbounded E¢ = 0

Therefore satellite will escape into space.

Q.31 (2)

Escape velocity from earth, $v_e = \sqrt{2gR_e}$

Fro planet, $v_p = \sqrt{2g(4R_e)} = 2(\sqrt{2gR_e})$

$= 2 \times v_e$

[For earth, escape velocity, v_e = 11.2 km-s^{-1}]

$\therefore$ $v_p = 2 \times 11.2 = 22.4$ km-s^{-1}

Q.32 (4)

$$\frac{GM_p m}{R_p} = 54 \Rightarrow \frac{GM_P}{R_P}\times 3 = 54$$

$$\frac{GM_P}{R_P} = 18$$

$$v_e = \sqrt{\frac{2GM_P}{R_P}} = \sqrt{2\times 18} = 6\,m/sec$$

Q.33 (4)

$$U_i = -\frac{GMm}{R},\ U_f = -\frac{GMm}{R+R/2}$$

$KE_i = KE_f = 0$

$$\Delta U = U_f - U_i = -\frac{2GMm}{3R} + \frac{GMm}{R}$$

$$\Delta U = \frac{GMm}{3R} \quad \text{As } \frac{GM}{R^2} = g$$

$$\Delta U = \frac{mgR}{3}$$

Q.34 (4)

From conservation of mechanical energy

$$-\frac{GMm}{R}+KE=0+0$$

$$\therefore \; KE=\frac{GMm}{R}=\frac{(gR^2)m}{R}=mgR \; (\because GM=gR^2)$$

Q.35 (1)

$$v_e=\sqrt{\frac{2GM}{R_e}} \qquad P.E=-\frac{GMm}{R_e}$$

$$v_e=\sqrt{2\times|P.E|}$$

$(100)^2 = 2 \times |P.E|$

$5000 = |P.E|$

$P.E = -5000$ J

Q.36 (3)

Areal velocity of planet

$$\frac{dA}{dt}=\frac{L}{2m}$$

for L = constant,

$$\frac{dA}{dt}=\text{constant}$$

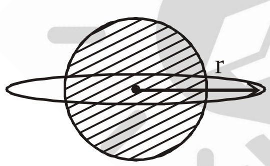
Q.37 **(1)**

$$\frac{v_1}{v_2}=\sqrt{\frac{R_2}{R_1}}=\sqrt{\frac{1.5\times10^8}{6\times10^7}}=\frac{\sqrt{5}}{\sqrt{2}}$$

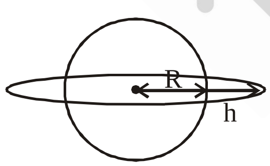
Q.38 (2)

No. of days in feb. 1992 is more than no. of days in feb. 1991.

Q.39 (4)



$$v_0=\sqrt{\frac{GM}{r}}$$



$$v_0=\sqrt{\frac{GM}{R+h}}$$

Q.40 (1)

Q.41 **(1)**

$$T=\frac{2\pi r}{v}=\frac{2\pi r}{\sqrt{\frac{GM}{r}}}=\frac{2\pi r^{3/2}}{\sqrt{GM}}$$

Hence $T^2=\frac{4\pi^2 r^3}{GM}$

$$T^2=\left(\frac{4\pi^2}{GM}\right)r^3$$

Hence slope of T^2 Vs r^3 curve is $=\frac{4\pi^2}{GM}$

Q.42 **(2)**

According to kepler's law, $T^2 \propto r^3$

or, $\frac{T_1}{T_2}=\left(\frac{r_1}{r_2}\right)^{3/2}$

or, $T_2=T_1\left(\frac{r_2}{r_1}\right)^{3/2}=T_1\left(\frac{2r_1}{r_1}\right)^{3/2}=T_1 2\sqrt{2}$

$= 2\sqrt{2}$ years ($\because$ T_1 = 1 year).

Q.43 **(2)**

$$\frac{dA}{dt}=\frac{L}{2m}=\text{Constant}$$

Q.44 (2)

$$v_0=\sqrt{\frac{GM}{r}}=\sqrt{\frac{GM}{3R/2}}$$

$$v_0=\sqrt{\frac{2GM}{3R}}=\sqrt{\frac{2}{3}gR}$$

Q.45 (4)

Orbit speed near the surface of earth

$v_o=\sqrt{gR} \Rightarrow 7$ km-s^{-1}

Orbital speed in the new orbit

$v_n'=\sqrt{g(4R)}=2\sqrt{gR}$

$= 2 \times 7 = 14$ km-s^{-1}

Q.46 (2)

$T^2 \propto R^3$

Q.47 (3)

$$\frac{T_2}{T_1}=\frac{r_2^{\frac{3}{2}}}{r_1^{\frac{3}{2}}} \Rightarrow T_2 = 1 \times \left[\frac{2}{1}\right]^{\frac{3}{2}} \text{ day} = 2\sqrt{2} \text{ day}$$

Q.48 (1)

The energy given to the body so as to completely escape from its orbit is equal to its kinetic energy KE.

Q.49 (2)

Mass of planet, $M = 2\ M_e$

Radius of planet, $R = 2\ R_e$

Escape velocity from earth

$$u = \sqrt{\frac{2GM_e}{R_e}}$$

Escape velocity from the planet

$$v = \sqrt{\frac{2GM}{R}} = \sqrt{\frac{2G(2M_e)}{2R_e}}$$

$$= \sqrt{\frac{2GM_e}{R_e}} = u$$

Q.50 (1)

$a_c = w^2 r$

T= constant so w = constant

$a_c \alpha\ r$

$$\frac{a_1}{a_2} = \frac{r_1}{r_2}$$

TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Mechanical Properties of Solids (Elasticity)**

ANSWER KEY

Q.1 (2)	**Q.2** (4)	**Q.3** (3)	**Q.4** (1)	**Q.5** (4)	**Q.6** (1)	**Q.7** (3)	**Q.8** (2)	**Q.9** (2)	**Q.10** (1)
Q.11(3)	**Q.12** (3)	**Q.13** (2)	**Q.14** (4)	**Q.15** (4)	**Q.16** (1)	**Q.17** (2)	**Q.18** (4)	**Q.19** (4)	**Q.20** (3)
Q.21 (2)	**Q.22** (4)	**Q.23** (2)	**Q.24** (1)	**Q.25** (4)	**Q.26** (4)	**Q.27** (3)	**Q.28** (1)	**Q.29** (3)	**Q.30** (4)
Q.31 (1)	**Q.32** (1)	**Q.33** (4)	**Q.34** (4)	**Q.35**(3)	**Q.36** (2)	**Q.37** (3)	**Q.38** (4)	**Q.39** (3)	**Q.40** (3)
Q.41 (3)	**Q.42** (1)	**Q.43** (4)	**Q.44** (1)	**Q.45** (4)	**Q.46** (2)	**Q.47** (1)	**Q.48** (1)	**Q.49** (1)	**Q.50** (4)

Hints and Solutions

Q.1 **(2)**
Yougs's modulus of wire does not vary with dimention fo wire. It is a constant quantity.

Q.2 (4)

Q.3 (3)

Q.4 (1)

Q.5 **(4)**
depth = 200 m

$$\frac{\Delta V}{V} = \frac{0.1}{100} = 10^{-3}$$

density = 1 x 10^3

g = 10 $\quad B = \frac{\Delta p}{\Delta v / v} = \frac{hg\rho}{\Delta v / v}$

$\Rightarrow$ B = 200 x 10 x 10^3 x 1000 = 2 x 10^9

Q.6 (1)

$$\text{Force} \propto \frac{1}{\text{area of cross section}}$$

$$\therefore \frac{F_1}{F_2} = \frac{A_2}{A_1}$$

Given, F_1 = 400 kg-wt, and $A_2 = 2A_1$

$$\therefore \frac{F_2}{400} = \frac{2A_1}{A_1}$$

or $F_2 = 400 \times 2 = 800$ kg-wt.

Q.7 (3)

$$\text{Work done } = \frac{1}{2} \times F \times \Delta\ell$$

$$\Rightarrow 0.4 = \frac{1}{2} \times F \times 0.2 \times 10^{-2} \Rightarrow F = 0.4 \times 10^3$$

$$Y = \frac{FL}{A\Delta L} = \frac{4 \times 10^2 \times 1}{10^{-2} \times 10^{-4} \times 0.2 \times 10^{-2}} = 2 \times 10^{11} N/m^2$$

Q.8 (2)

$$\text{Angle of shear } \phi = \frac{r\theta}{L} = \frac{4 \times 10^{-1}}{100} \times 30^o = 0.12^o$$

Q.9 (2)

$$B = \frac{\Delta p}{\Delta V / V} l. \Rightarrow \frac{1}{B} \propto \frac{\Delta V}{V} \qquad [\Delta p = \text{constant}]$$

Q.10 **(1)**

$$\frac{F}{A} = \eta \frac{x}{h}$$

$$\frac{500}{4 \times 16 \times 10^{-4}} =$$

$$2 \times 10^6 \frac{x}{4 \times 10^{-2}} \Rightarrow x = \frac{5 \times 10^{-2}}{32} m = 0.156 \text{ cm}$$

Q.11 **(3)**

$$\frac{F}{A} = Y \frac{\Delta\ell}{\ell}$$

If Y & $\frac{\Delta\ell}{\ell}$ are constant.

$$F = AY \frac{\Delta\ell}{\ell}$$

$\Rightarrow$ F $\propto$ A; $\Rightarrow$ F' = 4F

Q. 12 **(3)**

$$Y = \frac{\text{Stress}}{\text{Strain}}$$

For same stress, strain produced in steel is minimum. Hence it has highest elasticity.

Q.13 **(2)**

$$\text{Sheer strain } = \frac{r\theta}{\ell} = \frac{(1 \times 10^{-2}) \times (0.8)}{2} = 0.004$$

Q.14 (4)

Q.15 (4)

Q.16 (1)

$$\text{Slope} = \frac{dy}{dx} = \frac{F}{\Delta\ell}$$

$$Y = \frac{\text{stress}}{\text{strain}} = \frac{F}{A}\frac{\ell}{\Delta\ell}$$

As dimensions are some, so $Y \propto \frac{F}{\Delta\ell}$

$\Rightarrow Y \propto \text{slope}$

Q.17 (2)

$$\text{Stress} = \frac{\text{Force}}{\text{cross}-\text{sec tional area}}$$

$$\Rightarrow \frac{(\text{stress})_2}{(\text{stress})_1} = \left(\frac{A_1}{A_2}\right) \quad (\because \text{ Force = load is same})$$

$$= \left(\frac{r_1}{r_2}\right)^2$$

Q.18 (4)

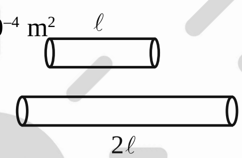
Due to tension, intermolecular distance between atoms is increased and therefore potential energy of the wire is increased and with the removal of force interatomic distance is reduced and so is the potential energy. This change in potential energy appears as heat in the wire and thereby increases the temperature.

Q.19 (4)

$A = 0.1\ cm^2 = 0.1 \times 10^{-4}\ m^2$

$Y = 2 \times 10^{11}$

$\Delta\ell = \ell$



$$Y = \frac{F\ell}{AD\ell} = \frac{F}{A}\cdot\frac{t}{t} = \frac{F}{A}$$

$F = 2 \times 10^{11} \times 0.1 \times 10^{-4}$

$F = 2 \times 10^{6}$

Q.20 (3)

$$B = \frac{-P}{\left(\frac{\Delta v}{v}\right)} \Rightarrow \frac{-\Delta V}{V} = \frac{P}{B}$$

$$= \frac{10^5}{1.25\times10^{11}} = 8\times10^{-7}$$

Q.21 (2)

$$B = \frac{\Delta P}{\left(-\frac{\Delta V}{V}\right)} \Rightarrow \frac{-\Delta V}{V} = \frac{P}{B}$$

$$V = \frac{4}{3}\pi r^3 \Rightarrow \frac{\Delta V}{V} = \frac{3\Delta r}{r} \quad ...(1)$$

$$A = 4\pi r^2 \Rightarrow \frac{\Delta A}{A} = \frac{2\Delta r}{r} \quad ...(2)$$

From eq (1) and (2) $\frac{\Delta A}{A} = \frac{2}{3}\frac{\Delta V}{V}$

$$\therefore \frac{\Delta A}{A} = \frac{2}{3}\frac{P}{B}$$

Q.22 (4)

$$Y = \frac{FL}{A(\Delta\ell)} = \frac{WL}{\pi r^2 \Delta\ell}$$

$$\therefore \Delta\ell = \frac{WL}{\pi r^2 Y}$$

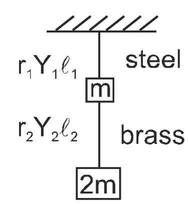
$\Delta\ell$ will be minimum for that wire whose $\frac{W}{r^2}$ is minimum.

Q.23 (2)

$\frac{r_1}{r_2} = b$

$\frac{\ell_1}{\ell_2} = a$

$\frac{Y_1}{Y_2} = c$



$$\Delta\ell_1 = \frac{(3mg)\ell_1}{A_1Y_1}$$

$$\Delta\ell_2 = \frac{(2mg)\ell_2}{A_2Y_2}$$

$$\frac{\Delta\ell_1}{\Delta\ell_2} = \frac{3\ell_1}{2\ell_2 A_1Y_1} \times A_2Y_2$$

$$= \frac{3}{2}\frac{a}{b^2c} = \frac{3a}{2b^2c}$$

Q.24 (1)

Bulk modulus, $B = \frac{P_0}{\Delta V / V_0}$ but

$\Delta V = \gamma V_0 \Delta t = 3\alpha V_0 \Delta t$ so $\Delta t = \frac{P_0}{3B\alpha}$

Q.25 (4)

$\gamma = \frac{\text{Stress}}{\text{Strain}} \Rightarrow \text{Stress} = \gamma \times \text{Strain}$

$= 2 \times 10^{11} \times 10^{-3} = 2 \times 10^{8}\ \text{N/m}^2$

Now $\Rightarrow$ Stress $= \frac{\text{Weight}}{\text{Area}}$

$\Rightarrow$ Weight = Stress × Area

Weight $= 2 \times 10^8 \times \pi\ (0.5 \times 10^{-3})^2$

= 157 N

Q.26 (4)

$Y = \frac{F/A}{\Delta L/L} \Rightarrow F = \left(\frac{AY}{L}\right)\Delta L$

$\Rightarrow W = \left(\frac{AY}{L}\right)\ell$ .....(i)

$\Rightarrow$ When W & 3W attached at two ends of string then

tension $T = \frac{2(W)(3W)}{W+3W} = \frac{3W}{2}$

$\Rightarrow \frac{3W}{2} = \left(\frac{AY}{L}\right)x$ .....(ii)

By equation (i) and (ii) $x = \frac{3\ell}{2}$

Q.27 (3)

Ductile material show high plastic property.

Q.28 (1)

$Y = \frac{F\ell}{A\Delta\ell}, F = \frac{AY\Delta\ell}{\ell}$

$\frac{F_1}{F_2} = \frac{A_1}{A_2} \times \frac{\ell_1}{\ell_2} = \left(\frac{1}{2}\right)^2 \times 2 = \frac{1}{2}$

Q.29 (3)

Force constant = Y × spacing

$= 20\times10^{10}\ \frac{N}{m^2} \times 4 \times 10^{-10}\ m$

$= 80\ \frac{N}{m} = 8 \times 10^{-9}\ \frac{N}{\text{Å}}$

Q.30 (4)

$Y = \frac{\text{Stress}}{\text{Strain}} = \frac{\frac{F}{A}}{\left(\frac{\Delta l}{l}\right)} = \frac{F}{A}\left(\frac{l}{\Delta l}\right)$

$\Rightarrow F = \frac{YA(\Delta l)}{l}$

$= \frac{2.2\times10^{11} \times 2\times10^{-6} \times 5\times10^{-4}}{2}$

$\Rightarrow F = 11\times 10 = 110N = 1.1 \times 10^{2}\ N$

Q.31 (1)

$y = \frac{1}{2} \times \frac{YA}{\ell} x^2$

$y \propto x^2$

Q.32 (1)

Energy stored

$= \frac{1}{2}.Fx$

$= \frac{1}{2} \times 400 \times 2 \times 10^{-3} = 0.4J$

Q.33 (4)

Elastic potential energy $= \frac{1}{2} \times F \times \Delta L$

$= \frac{1}{2} \times 200 \times \left(1 \times 10^{-3}\right) = 0.1J$

Q.34 (4)

Q.35 (3)

Q.36 (2)

$W = \frac{1}{2} \times F \times l = \frac{1}{2} mgl$

$= \frac{1}{2} \times 10 \times 10 \times 1 \times 10^{-1} = 0.05J$

Q.37 **(3)**

$\frac{1}{2} \times (\text{strain})^2 \times Y \times \text{volume} = \frac{1}{2} mv^2$

$\frac{1}{2} \times \left(\frac{5}{10}\right)^2 \times (5\times10)^8 \times (25\times10^{-6} \times 10 \times 10^{-2})$

$= \frac{1}{2} \times \frac{5}{1000} \times v^2$

$\Rightarrow v^2 = 25 \times 25 \times 100$

$\Rightarrow v = 250\ m/s$

Q.38 **(4)**

Q.39 **(3)**

$\omega = \frac{1}{2}\left(\frac{AY}{L}\right)(\Delta L)^2$

$= \frac{1}{2} \times \frac{1\times10^{-6} \times 2\times10^{10}}{0.5} \times (10^{-3})^2$

$= 2 \times 10^{-2}\ J$

Q.40 **(3)**

$$U = \frac{1}{2}\left(\frac{AY}{L}\right)(\Delta L)^2$$

$$= \frac{1}{2}\times\frac{(3\times10^{-6})\times(2\times10^{11})}{4}\times(10^{-3})^2$$

$= 7.5 \times 10^{-2}$ J

Q.41 **(3)**

$$\omega_{mg} = \frac{1}{2}\ k\ell^2$$

$$= \frac{1}{2}(k\ell)\ell$$

$$= \frac{1}{2}mg\ell$$

Q.42 **(1)**

$$U = \frac{1}{2}\left(\frac{AY}{L}\right)(\Delta L)^2$$

$V = AL$

$$\Rightarrow \frac{U}{V} = \frac{Y}{2}\left(\frac{\Delta L}{L}\right)\left(\frac{\Delta L}{L}\right)$$

$$= \frac{Y}{2}\left(\frac{\Delta L}{L}\right)\left(\frac{F}{AY}\right) = \frac{F\Delta L}{2AL}$$

Q.43 **(4)**

$$K = \frac{AY}{\ell},\ K' = \frac{4AY}{\ell/2} = 8K$$

$$\frac{U}{2} = \frac{\frac{1}{2}\times 8K\times\Delta\ell^2}{\frac{1}{2}\times K\times\Delta\ell^2} \Rightarrow U = 16\text{ J}$$

Q.44 (1)

$$W = \frac{1}{2}Fl1$$

$\therefore\ W \propto l\,(\text{F is constnat})$

$$\therefore\ \frac{W_1}{W_2} = \frac{l_1}{l_2} = \frac{l}{2l} = \frac{1}{2}$$

Q.45 (4)

Energy stored per unit volume $= \frac{1}{2}$ × Stress × Strain

$= \frac{1}{2}$ × Young's modulus × (Strain)^2 $\frac{1}{2}\times Y\times x^2$

Q.46 (2)

$$E = W = \frac{1}{2}\ Y\left(\frac{\Delta\ell}{L}\right)^2 AL = \frac{1}{2}\ \frac{YA\Delta\ell^2}{L}$$

$$= \frac{2\times10^{11}\times2\times10^{-6}\times(2\times10^{-3})^2}{2\times1} = 0.8J$$

Q.47 (1)

Q.48 (1)

Energy per unit volume $= \frac{1}{2}\times Y\times(\text{strain})^2$

$$\therefore \text{strain} = \sqrt{\frac{2E}{Y}}$$

Q.49 (1)

Q.50 (4)

$$U = \frac{1}{2}\left(\frac{YA}{L}\right)l^2\,l.$$

$\therefore\ U \propto l^2$

$$\frac{U_2}{U_1} = \left(\frac{l_2}{l_1}\right)^2 = \left(\frac{10}{2}\right)^2 = 25 \Rightarrow U_2 = 25U_1$$

i.e. potential energy of the spring will be 25 *V*

TOPIC WISE TEST (NEET)

Subject : Physics **Topic :Mechanical Properties of Fluids**

ANSWER KEY

Q.1 (2)	**Q.2** (3)	**Q.3** (3)	**Q.4** (1)	**Q.5** (3)	**Q.6** (2)	**Q.7** (3)	**Q.8** (3)	**Q.9** (4)	**Q.10** (1)
Q.11 (2)	**Q.12** (1)	**Q.13** (1)	**Q.14** (3)	**Q.15** (3)	**Q.16** (2)	**Q.17** (1)	**Q.18** (1)	**Q.19** (1)	**Q.20** (4)
Q.21 (3)	**Q.22** (2)	**Q.23** (2)	**Q.24** (4)	**Q.25** (4)	**Q.26** (4)	**Q.27** (1)	**Q.28** (3)	**Q.29** (1)	**Q.30** (3)
Q.31 (3)	**Q.32** (1)	**Q.33** (3)	**Q.34** (2)	**Q.35** (3)	**Q.36** (3)	**Q.37** (2)	**Q. 38** (4)	**Q.39** (2)	**Q.40** (1)
Q.41 (3)	**Q.42** (2)	**Q.43** (3)	**Q.44** (2)	**Q.45** (4)	**Q.46** (3)	**Q.47** (4)	**Q.48** (3)	**Q.49** (1)	**Q.50** (2)

Hints and Solutions

Q.1 (2)

$W_{air} = 50$ gm

$W_{water} = 40$ gm

$W_{water} = W_{air} - v\rho_w g$

$V\rho_w g = (50 - 40)g$

$V = \dfrac{10}{\rho_w}$

Now in liquid $W = W_{air} - V\rho_l.g$

$= 50g - \dfrac{10}{\rho_w}\rho_l g$

$= 50g - 10 \times 1.5g$

$W = 35$ g

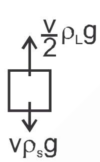
$W = 35$ gm

Q.2 (3)

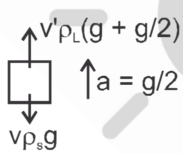
Workdone = (Pressure difference) × volume

$\Rightarrow WD = 10^4 \times 2J = 20kJ$

Q.3 **(3)**



$\Rightarrow \rho_s = \dfrac{\rho_L}{2}$



$\Rightarrow \quad v'\rho_L\left(\dfrac{3g}{2}\right) - v\rho_s g = v\rho_s\dfrac{g}{2}$

$\Rightarrow \quad v'\rho_L\dfrac{3g}{2} = \dfrac{3}{2}v\rho_s g$

$\Rightarrow \quad v' = v\dfrac{\rho_s}{\rho_L} = \dfrac{v}{2}$

Q.4 **(1)**

Let the mass of sink be 'm'

$\Rightarrow \quad mg + mg = v\rho_w g$

$\Rightarrow \quad (m + 120) = \dfrac{120}{600} \times 1000$

$\Rightarrow \quad m = 80$ kg

Q.5 **(3)**

$V_A\rho_A g = \dfrac{V_A}{2}\rho_w g$ ......(I)

$V_B\rho_B g = \dfrac{2}{3}VB\rho_w g$ ....(II)

From (I) anad (II)

$\dfrac{P_A}{P_B} = \dfrac{3}{4}$

Q.6 **(2)**

$\left(P_{atm} + \dfrac{x}{2}\rho_w g\right) = \dfrac{2}{3}(P_{atm} + x\rho_w g)$

$\Rightarrow x\rho_w g = 2p_{atm}$

$\Rightarrow x\rho_w g = 2(10\,\rho_w g)$

$\Rightarrow \quad x = 20$ m

Q.7 **(3)**

Energy required in one second is the power

$10^{-1} = A.V.$

$\Rightarrow 10^{-1} = 10^{-2} \times V$

$\Rightarrow V = 10$ m/sec.

$mgh + \dfrac{1}{2}mV^2 = P$

Here m = mass in one second

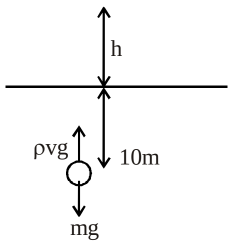
$P = \rho AVgh + \dfrac{1}{2}\rho AV^3$

$P = \rho AV[10 \times 10 + 50]$

$= 15$ Kwatt

Q.8 (3)

$\rho_w vg - \rho_b vg = \rho_b va$



$$a = g\left(\frac{1}{0.8} - 1\right) = 2.5\ m/s^2$$

$v^2 = 2as = 2 \times 2.5 \times 10$

$O^2 = v^2 - 2gh$

$$h = \frac{v^2}{2g} = \frac{2 \times 2.5 \times 10}{2 \times 10} = 2.5\ m$$

Q.9 (4)

Q.10 **(1)**

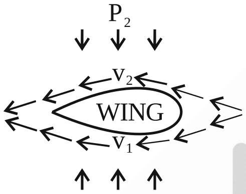
$P + 50 = 75$

$P = 25$ cm of H_g

$$\frac{10^5}{75} \times 25 = 33.3\ kPa$$

Q.11 (2)

Applying Bernoulli's theorem



$$P_1 + \frac{1}{2}\rho v_1^2 = P_2 + \frac{1}{2}\rho v_2^2$$

$$P_1 - P_2 = \frac{1}{2}\rho\,(v_2^2 - v_1^2)$$

$$\Rightarrow v_2^2 = \frac{2(P_1 - P_2)}{\rho} + v_1^2$$

$$v_2 = \sqrt{\frac{2 \times 1000}{1.3} + (50)^2} = 63.54 \simeq 64$$

Q.12 (1)

Using equation of continuity

$A_1V_1 = A_2V_2$

$$\frac{V_1}{V_2} = \frac{A_2}{A_1} = \left(\frac{4.8}{6.4}\right)^2 = \frac{9}{16}$$

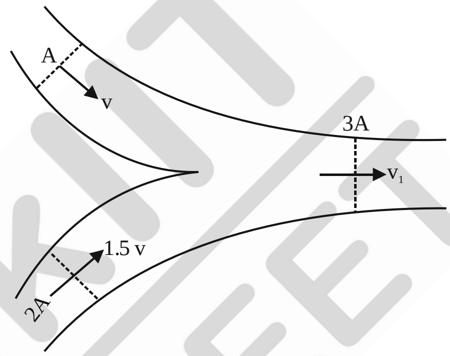
Q.13 (1)

$$\text{Rate of flow } \frac{dV}{dt} = Av$$

$$\Rightarrow \frac{3000 \times 10^{-3}}{60} = \sqrt{2gh} \times A$$

$$A = \frac{1}{20} \times \frac{1}{\sqrt{2 \times 10 \times 10}} = 35cm^2$$

Q.14 **(3)**



$AV + 2A\,(1.5\ v) = 3Av_1 \Rightarrow v_1 = 4v/3$

$$\text{Now}\ \frac{v_1}{1.5v} = \frac{4v \times 2}{3v \times 3} = \frac{8}{9}$$

Q.15 (3)

$$\frac{1}{2}gt^2 = 4$$

$$t = \sqrt{\frac{8}{g}}$$

$$R = \sqrt{2 \times g \times 2} \times \sqrt{\frac{8}{g}}$$

$$= 4\sqrt{2}$$

Q.16 (2)

$A_1v_1 = A_2v_2$

$\pi(2R)^2v_A = \pi R^2 v_B$

$$\frac{v_A}{v_B} = \frac{1}{4}$$

Q.17 (1)

Q.18 (1)

Q.19 **(1)**

Q.20 (4)

Q.21 **(3)**

Travelling microscope is used to find radius of meniscus.

Q.22 (2)

$W = T \times 2\Delta A \qquad \Rightarrow \quad T = \frac{W}{2\Delta A}$

$= \frac{2\times10^{-4}}{2[10\times6-8\times3.75]\times10^{-4}}$

$= 3.3\times10^{-2}$ N/m

Q.23 (2)
Adding soap, lowers the water's surface tension. When salt is added, surface tension of water increases.
So, $\sigma_1 < \sigma_2$

Q.24 (4)
Excess pressure for a drop

$\Delta P = \frac{2T}{R} = \frac{2\times75\times10^{-3}}{10^{-3}}$

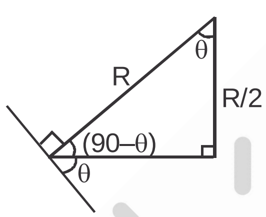
$= 150$ N/m^2

Q.25 (4)

Q.26 **(4)**

Q.27 (1)
$F_{extra} = T(2\pi R) = 75\,[2\pi(5)] = 750\,\pi$

Q.28 (3)



$\cos\theta = \frac{R/2}{R}$

$\Rightarrow \boxed{\theta = 60^o}$

Q.29 (1)
$W = T\Delta A = 4\pi R^2 T(n^{1/3}-1)$
$= 4\times3.14\times(10^{-2})^2\times460\times10^{-3}[(10)^{6/3-}1]$
$= 4\times3.14\times(10^{-4})\times460\times10^{-3}\,[(10^2)^{-1}]$
$= 0.057$

Q.30 **(3)**
Work done = Change in surface energy
$w = 2T\times4\pi\left(R_2^2 - R_1^2\right)$
$= 2\times0.03\times4\pi\,[(5)^2-(3)^2]\times10^{-4}$
$= 0.4\pi$ mJ

Q.31 (3)

$h = \frac{2T\cos\theta}{r\rho g}$

$h \propto \frac{1}{r} \Rightarrow \frac{h_2}{h_1} = \frac{r_1}{r_2} \Rightarrow h_2 = 4h_1$

mass of water = V × ρ_{water}

$\frac{M'}{M} = \frac{\pi\left(\frac{r}{4}\right)^2\times(4h)\times\rho_w}{\pi r^2\times h\times\rho_w} \Rightarrow \frac{1}{4}$

$\Rightarrow M' = \frac{M}{4}$

Q.32 (1)
$T\,.\,2\pi r = mg$
$6\times10^{-2}\times2\pi r = 75\times10^{-4}$

$2\pi r = \frac{75\times10^{-4}}{6\times10^{-2}}$

$l = 2\pi r = 12.5\times10^{-2}$ m

Q.33 (3)

Q.34 (2)

$h = \frac{2T\cos\theta}{\left(\frac{D}{2}\right)\rho g}$

$\Rightarrow \frac{h_1}{h_2} = \frac{D_2}{D_1} = \frac{22}{66}$

$\Rightarrow D_1 : D_2 = 3 : 1$

Q.35 (3)

$h = \frac{2T}{r\rho g} \Rightarrow h \propto \frac{1}{D}$

$\therefore \frac{h_2}{h_1} = \frac{D_1}{D_2}$

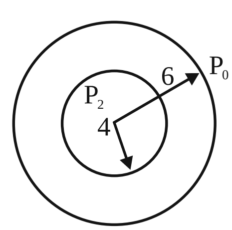
$\Rightarrow h_2 = \frac{D_1}{D_2}\times h_1$

$= \frac{D}{D/2}\times h = 2h$

$= 2\times4 = 8$ cm

Q.36 (3)

$P_0 + \frac{4T}{r_1} + \frac{4T}{r_2} = P_2$



$$\frac{4T}{6}+\frac{4T}{4}=P_2-P_0$$

$$\frac{5T}{3}=P_2-P_0$$

$$P_2 - P_0 = \frac{4T}{R}=\frac{5T}{3}$$

$$R=\frac{12}{5}=2.4\text{cm}$$

Q.37 (2)

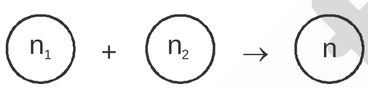
By equating volume : $\frac{4}{3}\pi R^3 = 8\times\frac{4}{3}\pi r^3$

get r = R/2.

Now pressure difference in A = $\frac{4\sigma}{R}$

and that in B = $\frac{4\sigma}{R/2}$ = 2 × pressure difference in A.

Q. 38 (4)



$n_1 + n_2 = n$

$$\frac{P_1V_1}{RT}+\frac{P_2V_2}{RT}=\frac{PV}{RT}$$

$\Rightarrow P_1V_1 + P_2V_2 = PV$

$$\Rightarrow \left(\frac{4T}{R_1}\right)\left(\frac{4}{3}\pi R_1^3\right)+\left(\frac{4T}{R_2}\right)\left(\frac{4}{3}\pi R_2^3\right)$$

$$=\left(\frac{4T}{R}\right)\left(\frac{4}{3}\pi R^3\right)$$

$\Rightarrow R_1^{\,2} + R_2^{\,2} = R^2$

Q.39 (2)

Q.40 (1)

Excess pressure at common surface is given by

$$P_{ex} = 4T\left(\frac{1}{a}-\frac{1}{b}\right) = \frac{4T}{r}$$

$$\therefore\ \frac{1}{r}=\frac{1}{a}-\frac{1}{b}$$

$$r=\frac{ab}{b-a}$$

Q.41 (3)

$\because$ Excess pressure $\propto \frac{1}{\text{radius}}$

$\therefore$ Pressure inside smaller bubble is greater than larger bubble.

Q.42 (2)

$$P=\frac{4T}{R_1}\ \ \&\ \ 3P=\frac{4T}{R_2}$$

$$\Rightarrow \frac{R_1}{R_2}=\frac{3}{1}$$

$$\Rightarrow \frac{V_1}{V_2}=\frac{\frac{4}{3}\pi R_1^3}{\frac{4}{3}\pi R_2^3}=\left(\frac{3}{1}\right)^3 = 27:1$$

Q.43 (3)

For water drop

$$P_{excess}=P_1=\frac{2T}{R}$$

For soap bubble

$$P_{excess}=P_2=\frac{4(T/2)}{R}$$

$$\Rightarrow \frac{P_1}{P_2}=\frac{1}{1}$$

Q.44 (2)

For air bubble just below the water surface

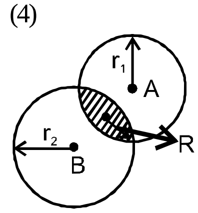
$$P_{excess}=\frac{2T}{r}=P_1$$

For water drop just outside the surface

$$P_{excess}=\frac{2T}{r}=P_2$$

Hence, $P_1 = P_2$.

Q.45 (4)



Equating pressures on the shaded portion :

$$\frac{4\sigma}{r_1}-\frac{4\sigma}{r_2}=\frac{4\sigma}{R}$$

get $R=\frac{r_2r_1}{r_2-r_1}$

Q.46 (3)

$$V_T = \frac{2r^2}{9\eta}(\rho - \sigma)g$$

Q.47 **(4)**

$$V_T = \frac{2}{9}\frac{gr^2}{\eta}(\rho - \sigma)$$

$$\Rightarrow V_T \propto r^2$$

$$\Rightarrow \frac{V_{T_1}}{V_{T_2}} = \left(\frac{r_1}{r_2}\right)^2 = \left(\frac{r}{(r/2)}\right) = 4$$

$$\Rightarrow V_{T_2} = \frac{V_{T_1}}{4} = \frac{5\times10^{-4}}{4} = 1.25\times10^{-4} \text{ m/s}$$

Q.48 **(3)**

$$V_T = \frac{2}{9}\frac{r^2 g}{\eta}(\rho - \sigma)$$

$$\Rightarrow V_T \propto r^2$$

$$\Rightarrow \frac{V}{V'} = \left(\frac{r}{2r}\right)^2$$

$$\Rightarrow V' = 4V$$

Q.49 **(1)**

Viscosity decreases with increase in temperature.

Q.50 (2)

TOPIC WISE TEST (NEET)

Subject : Physics **Topic:- Thermal Properties of Matter**

ANSWER KEY

Q.1 (2)	**Q.2** (1)	**Q.3** (2)	**Q.4** (1)	**Q.5** (4)	**Q.6** (1)	**Q.7** (1)	**Q.8** (3)	**Q.9** (3)	**Q.10** (2)
Q.11 (4)	**Q.12** (3)	**Q.13** (1)	**Q.14** (2)	**Q.15** (1)	**Q.16** (3)	**Q.17** (4)	**Q.18** (3)	**Q.19** (4)	**Q.20** (3)
Q.21 (3)	**Q.22** (2)	**Q.23** (4)	**Q.24** (3)	**Q.25** (2)	**Q.26** (2)	**Q.27** (1)	**Q.28** (3)	**Q.29** (3)	**Q.30** (3)
Q.31 (3)	**Q.32** (1)	**Q.33** (1)	**Q.34** (3)	**Q.35** (4)	**Q.36** (3)	**Q.37** (4)	**Q.38** (3)	**Q.39** (4)	**Q.40** (3)
Q.41 (1)	**Q.42** (3)	**Q.43** (3)	**Q.44** (4)	**Q.45** (1)	**Q.46** (4)	**Q.47** (4)	**Q.48** (1)	**Q.49** (1)	**Q.50** (4)

Hints and Solutions

Q.1 (2)
When temperature rises, T increases and hence clock runs slow or loses time.

Q.2 (1)

$$\rho = \frac{M}{V} \Rightarrow \rho \propto V^{-1}$$

$$\frac{\Delta\rho}{\rho} = -1\frac{\Delta V}{V}$$

$$\frac{\Delta\rho}{\rho} = -\gamma\Delta T = -49\times10^{-5}\times30$$

$$\frac{\Delta\rho}{\rho} = -1.47\times10^{-2}$$

Q.3 (2)

$$\frac{Q}{t} = \frac{KA\Delta\theta}{l} \Rightarrow 6000 = \frac{200\times0.75\times\Delta\theta}{1}$$

$$\therefore \Delta\theta = \frac{6000\times1}{200\times0.75} = 40^{o}C$$

Q.4 (1)

Q.5 **(4)**

Q.6 (1)

$$\frac{A_2}{A_1} = \left(\frac{T_2}{T_1}\right)^4 = \left(\frac{546+273}{273+273}\right)^4$$

$$= \left(\frac{3}{2}\right)^4 = \frac{81}{16}$$

Q.7 (1)

$$\frac{E_2}{E_1} = \left(\frac{T_2}{T_1}\right)^4 \Rightarrow \frac{T_2}{T_1} = \left(\frac{E_2}{E_1}\right)^{1/4} = \left(\frac{10^9}{10^5}\right)^{1/4} = 10$$

$\Rightarrow T_2 = 10\ T_1 = 10 \times (273 + 227) = 5000$ K

Q.8 (3)

$E = \sigma A_1 T^4$

Surface area $A_1 = \pi r_1^2 = \pi\left(\frac{d_1}{2}\right)^2$

if diameter is = $\frac{d_1}{4}$

surface area $A_2 = \pi\left(\frac{d_1}{2\times4}\right)^2 = \frac{A_1}{16}$

$$\therefore E_2 = \sigma A_2 T_2^4 = \sigma\frac{A_1}{16}(2T)^4 = \sigma A_1 T^4 = E$$

Q.9 **(3)**
Coefficient of linear expansion = α
Coefficient of aerial expansion = β
Coefficient of volume expansion = γ
And, $\gamma = 3\alpha$
$\beta = 2\alpha$
$\Delta\ell$ = change in length = $\ell\alpha\ \Delta T$
where ℓ = original length
ΔT = change in temperature
ΔA = change in area
ΔV = change in volume

Q.10 (2)

Q.11 (4)
$Q_1 = Q_2$
$\therefore$ ms_1 (32 – 20) = ms_2 (40 – 32)

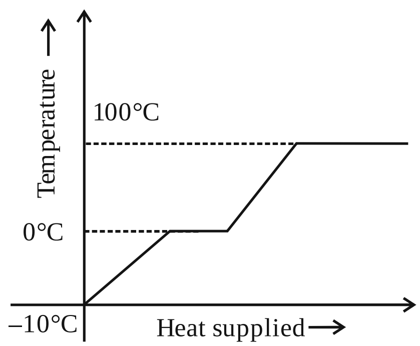
$$\therefore \quad \frac{s_1}{s_2} = \frac{8}{12} = \frac{2}{3}$$

Q.12 **(3)**
Heat required to convert 10 g of ice at 0℃ to water at 0℃
$Q_1 mL = 10 \times 80$ cal
Heat required to raise the temperature of water from 0℃ to 20℃
$Q_1 = cm\theta = 1 \times 10 \times 20 = 200$ cal
Total heat required
= $Q_1 + Q_2 = 800 + 200 = 1000$ cal

Q.13 **(1)**
Factual

Q.14 (2)
Ice heated at – 10°C
will go from – 10° to 0°C

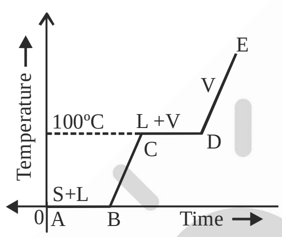
From 0°C Ice to 0°C water.
Heat will be supplied but temperature will not increase from 0°C water to 100°C water
Temperature will increase from 100° C water to 100° C steam temperature will not increase but heat will be provided.
Graph will be



Q.15 (1)
Water equivalent = m × c = 400 × 0.1 = 40g

Q.16 (3)
A gas may under go through infinite processes such process defines different value of specific heat.

Q.17 (4)



S → Solid
L → Liquid
V → Vapour

Q.18 (3)
The heat current is equal to the heat required for fusion of ice per dt time.

$$i = \frac{dm}{dt} . L_f = KA\left(\frac{20-0}{2.35}\right)$$

$$\frac{dm}{dt} = 2.4\pi\times10^{-6}$$

Q.19 (4)
$\theta = ms\,(T_2 - T_1)$

$-80 = 4 \times \frac{1}{2}\,(T_2 - (-10))$

$-80 = 2\,(T_2 + 10)$

$-40 - 10 = T_2$

$T_2 = -50°C$

Q.20 (3)
The relation between two temperature scale is given as :

$$\frac{A-42}{110} = \frac{B-72}{220}$$

For the two temperature scale to show same reading, A = B

$$\Rightarrow \frac{A-42}{110} = \frac{A-72}{220}$$

$\Rightarrow 2(A - 42) = A - 72$

$\Rightarrow 2A - 84 = A - 72$

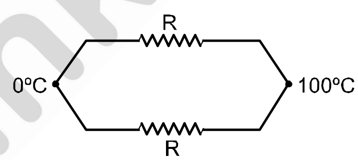
$\Rightarrow A = + 12^o$

Q.21 (3)
Here, $K_1 = K_2$, $l_1 = l_2 = 1m$,
$A_1 = 2A$, $A_2 = A$
$T_1 = 100^oC$, $T_2 = 70^oC$
$\therefore$ Temperature at C be T, then

$$\frac{\Delta Q}{\Delta t} = \frac{K2A(100-T)}{1} = \frac{KA(T-70)}{1}$$

or $T = 90^oC$

Q.22 (2)



$$\frac{Q_1}{t_1} = i_{H_1} = \frac{100-0}{2R} = \frac{50}{R}$$

$$i_{H_2} = \frac{100}{R/2} = \frac{200}{R} = \frac{Q_2}{t_2}$$

$Q_1 = Q_2 = 10$ cal.

$$\frac{50}{R}\times(2) = \frac{200}{R}\times t_2$$

$t_2 = \frac{1}{2}$ min. = 0.5 min

Q.23 (4)
Utensil should have low thermal resistance $\left(R = \frac{\ell}{KA}\right)$
and low specific heat so that heat loss is less

Q.24 (3)

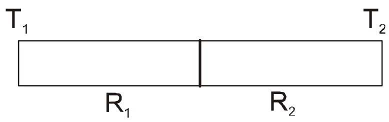
$$\frac{R_1}{R_2}=\frac{\frac{\ell_1}{K_1A_1}}{\frac{\ell_2}{K_2A_2}}=\frac{\frac{\ell}{K\pi(2r)^2}}{\frac{2\ell}{K\pi(3r)^2}}=\frac{9}{8}$$

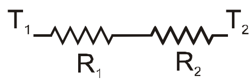
$$\because\ I=\frac{\Delta T}{R}\Rightarrow I\propto\frac{1}{R}$$

so $\frac{I_1}{I_2}=\frac{R_2}{R_1}=\frac{8}{9}$

Q.25 (2)

Q.26 (2)



Equivalent thermal circuit 

$$R_{eq}=R_1+R_2=\frac{2\ell}{KA}=\frac{\ell}{K_1A}+\frac{\ell}{K_2A}$$

$$\Rightarrow K=\frac{2K_1K_2}{K_1+K_2}$$

Q.27 (1)

$$\left(\frac{\Delta Q}{\Delta t}\right)_P=\left(\frac{\Delta Q}{\Delta t}\right)_Q$$

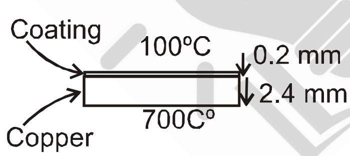
$$K_1A_1\frac{(T_1-T_2)}{l}=K_2A_2\frac{(T_1-T_2)}{l}$$

Or $K_1A_1=K_2A_2$ or $\frac{A_1}{A_2}=\frac{K_2}{K_1}$

Q.28 (3)

$$i_H=\frac{\Delta T}{R_{eq}}=\frac{700-100}{R_1+R_2}$$

Where $R_{eq}=R_1+R_2=\frac{0.24}{0.9\times400}+\frac{0.02}{0.15\times400}$

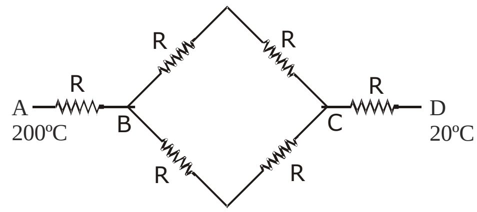


$$i_H=\frac{dQ}{dt}=\frac{\Delta Q}{\Delta t}=\frac{\Delta m.L}{\Delta t}=\frac{600}{\frac{1}{400}\left(\frac{0.24}{0.9}+\frac{0.02}{0.15}\right)}$$

$\frac{\Delta m}{\Delta t}=\frac{i_H}{L}$ where L = 540 cal/gm ; Δt = 3600 sec.

$$\Delta m=\frac{600}{\frac{1}{400}\left(\frac{0.24}{0.9}+\frac{0.02}{0.15}\right)}\times\frac{3600}{540}=4000\,kg$$

Q.29 (3)



$$T_C-20=T_B-T_C=T_A-T_B=\frac{200-20}{3}=60$$

$T_C=80$

So $T_B=80+60=140$ °C

Q.30 (3)

Temperature of interface : $\theta=\frac{K_1\theta_1l_2+K_2\theta_2l_1}{K_1l_2+K_2l_1}$

$$=\frac{K\times0\times2+3K\times100\times1}{K\times2+3K\times1}=\frac{300K}{5K}=60°C$$

Q.31 (3)

$$\frac{60-50}{10}=K\left(\frac{60+50}{2}-25\right)\qquad .....(i)$$

$$\frac{50-\theta}{10}=K\left(\frac{50+\theta}{2}-25\right)\qquad .....(ii)$$

On dividing, we get

$$\frac{10}{50-\theta}=\frac{60}{\theta}\Rightarrow\theta=42.85°C$$

Q.32 (1)

According to Wein's law λ_mT = constant

$$\Rightarrow\lambda_{m_1}T_1=\lambda_{m_2}T_2\Rightarrow T_2=\frac{\lambda_{m_1}}{\lambda_{m_2}}T_1=\frac{\lambda_0}{3\lambda_0/4}\times T_1=\frac{4}{3}T_1$$

Now $P\propto T^4$

$$\Rightarrow\frac{P_2}{P_1}=\left(\frac{T_2}{T_1}\right)^4\Rightarrow\frac{P_2}{P_1}=\left(\frac{4/3T_1}{T_1}\right)^4=\frac{256}{81}$$

Q.33 (1)

$E_{273}=eA\,(273+273)^4$

$=E$(Given)

$E_0=eA\,(273+0)^4$

$$\frac{E_0}{E}=\frac{(273)^4}{(546)^4}=\frac{1}{16}$$

$E_0 = \frac{E}{16}$

Q.34 (3)

$E \propto T^4$ (Stefan's law)

Q.35 (4)

Q.36 (3)

$P \propto T^4$

so $\frac{10}{10^5} = \frac{(427+273)^4}{T_S^4}$

$\Rightarrow T_S = 7000$ K

Q.37 (4)

According to Wein's law, λ_{max} T = constant, where T is the temperature in Kelvin.

$\therefore \frac{(\lambda_{max})_1}{(\lambda_{max})_2} = \frac{T_2}{T_1} = \frac{2227+273}{1227+273}$

$\frac{(\lambda_{max})_1}{(\lambda_{max})_2} = \frac{2500}{1500} = \frac{5}{3}$

or $(\lambda_{max})_2 = \frac{3}{5} \times (\lambda_{max})_1 = \frac{3}{5} \times 5000 = 3000$ Å.

Q.38 **(3)**

Here, water absorbs heat from paper cup preventing it to reach at it's ignition point.

Q.39 (4)

Q.40 **(3)**

The emissive power of a perfectly black body is unity.

Q.41 (1)

We know that

$\lambda_{max} \propto \frac{1}{T}$

$\frac{\lambda_{1max}}{\lambda_{2\,max}} = \frac{T_2}{T_1} \Rightarrow \frac{T_2}{T_1} = \frac{3}{4} \quad \Rightarrow \frac{T_1}{T_2} = \frac{4}{3}$

Q.42 (3)

$\frac{X-(-125)}{500} = \frac{Y-(-70)}{40}$

For Y = 50

X =1375.0ºX

Q.43 (3)

Heat lost by A = Heat gain by B

$m_A s_A [T_A - T_f] = m_B s_B [T_t - T_B]$

$\frac{m_A}{m_B} \times \frac{s_A}{s_B} [75 - T_f] = [T_f - 15]$

$\frac{2}{3} \times \frac{3}{4} \times [75 - T_f] = [T_f - 15]$

$\Rightarrow 75 - T_f = 2T_f - 30$

$\Rightarrow T_f = 35$ºC

Q.44 (4)

$S = \frac{\sigma \times 4\pi R^2 \times T^4}{4 \times D^2}$

$S \propto R^2 T^4$

$\frac{S_1}{S_1} = \left(\frac{2R}{R}\right)^2 \times \left(\frac{2T}{T}\right)^4 = 64$

Q.45 (1)

$\frac{52-36}{10} = K\left[\frac{52+36}{2} - 20\right]$ .....(1)

$\frac{36-T}{10} = K\left[\frac{36+T}{2} - 20\right]$ .....(2)

On solving equation (1) and (2) T = 28°C

Q.46 (4)

$\lambda_m T$ = constant

$(\lambda_m)_1 T_1 = (\lambda_m)_2 T_2$

$(\lambda_m)_2 = \frac{(\lambda_m)_1 T_1}{T_2} = \frac{4000 \times 10^{-10} \times 3}{2}$

$(\lambda_m)_2 = 6000$Å

Q.47 (4)

$E \propto T^4$ [stefan's law]

$\frac{E'}{E} = \left(\frac{273}{819}\right)^4 = \frac{1}{3^4} = \frac{1}{81}$

$\boxed{E^1 = \frac{E}{81}}$

Q.48 (1)

Transfer of heat due to radiation doesn't require any medium.

Q.49 (1)

$\lambda \propto \frac{1}{T}$

$\frac{T_S}{T_M} = \frac{\lambda_M}{\lambda_S} = \frac{10^{-4}}{0.5 \times 10^{-6}} = 200$

Q.50 (4)

$\frac{60-40}{7} = C\left(\frac{60+40}{2} - 10\right)$

$\frac{40-x}{7} = C\left(\frac{40+x}{2} - 10\right)$

$\Rightarrow x = 28$

TOPIC WISE TEST (NEET)

Subject : Physics | **Topic : Thermodynamics**

ANSWER KEY

Q.1 (2)	**Q.2** (2)	**Q.3** (2)	**Q.4** (1)	**Q.5** (4)	**Q.6** (3)	**Q.7** (1)	**Q.8** (1)	**Q.9** (1)	**Q.10** (2)
Q.11 (2)	**Q.12** (3)	**Q.13** (4)	**Q.14** (1)	**Q.15** (3)	**Q.16** (2)	**Q.17** (3)	**Q.18** (4)	**Q.19** (4)	**Q.20** (4)
Q.21 (2)	**Q.22** (1)	**Q.23** (2)	**Q.24** (4)	**Q.25** (1)	**Q.26** (3)	**Q.27** (1)	**Q.28** (3)	**Q.29** (1)	**Q.30** (2)
Q.31 (4)	**Q.32** (1)	**Q.33** (3)	**Q.34** (3)	**Q.35** (1)	**Q.36** (3)	**Q.37** (2)	**Q.38** (4)	**Q.39** (2)	**Q.40** (2)
Q.41 (2)	**Q.42** (1)	**Q.43** (2)	**Q.44** (2)	**Q.45** (2)	**Q.46** (1)	**Q.47** (1)	**Q.48** (4)	**Q.49** (1)	**Q. 50** (4)

Hints and Solutions

Q.1 (2)
$\Delta W = P\Delta V = 10^3 \times 0.25 = 250J$

Q.2 (2)
Using first law of thermodynamics,
$\Delta Q = \Delta U + \Delta W$
or, $\Delta W = \Delta Q - \Delta U$
Hence, $100 - 40 = 70$ J

Q.3 (2)
$W_{AB} = (20)(3-2) = 20$ J

Q.4 (1)
W = Area under PV curve = Area of trapezium ABCDA

Q.5 (4)
work done = Area under the P-V curve

$$W = \frac{1}{2}(80 \times 10^3)(250 \times 10^{-6}) = 10 \text{ J}$$

Since the arrow is anticlockwise,
$\therefore$ work done = – 10 J

Q.6 (3)
The work does not characterize the thermodynamic state of matter.

Q.7 **(1)**
$\Delta Q = \Delta W + 3\Delta W = 4\Delta W$

$$\because \ n = \frac{\Delta W}{\Delta Q} = \frac{\Delta W}{4\Delta W} = 0.25$$

Q.8 (1)
Work done = Area enclosed by triangle

$$ABC = \frac{1}{2} AC \times BC = \frac{1}{2} \times (3V - V) \times (3P - P) = 2PV$$

Q.9 (1)
$W = P(2V - V) = PV$

Q.10 (2)
$U_f - U_i = Q - W$
$U - (-30) = -50 - (-20)$
$U = -60$

Q.11 (2)
$Q = \Delta U + W$
$Q = 0 + (-(200 \times 10^{-6} \times 100 \times 10^3))$
$Q = -20$
Hence, heat rejected by the gas is 20 J.

Q.12 **(3)**
$\Delta U = Q - W = 0$
$\Rightarrow Q = W$
$\Rightarrow 5960 + (-5585) + (-2980) + (3645) = 2200 + (-825) + (-1100) + W_4$
$\Rightarrow W_4 = 765$ J

Q.13 (4)
ΔU = same is both process
$Q_{acb} - W_{acb} = Q_{adb} - W_{adb}$.
$200 - 80 = 144 - W_{adb}$.
$W_{adb} = 24$ J.

Q.14 (1)
$\Delta Q = AU + \Delta W$ and $\Delta W = P\Delta V$

Q.15 (3)
Given, $dQ = 1500$ J, $dV = 2.5 \times 10^{-3}$ m^3,
$p = 2.1 \times 10^5$ Nm^{-1}
From first law of thermodynamics
$dQ = dU + dW$
dU = change in internal energy
dW = external work
$= pdV = 2.1 \times 10^5 - 2.5 \times 10^{-3}$
$= 5.25 \times 10^2 = 525$ J
$dU = dQ - dW = 1500 - 525 = 975$ J

Q.16 (2)

Q.17 (3)

$$W = \frac{1}{2} \times (20 + 40) \times 1 = \frac{1}{2} \times 60 = 30 \text{ J}$$

Q.18 (4)
The change in internal energy ΔU is same in all process.
$Q_{ACB} = \Delta U + W_{ACB'}$
$Q_{ADB} = \Delta U$,
$Q_{AEB} = \Delta U + W_{AEB}$
Here W_{ACB} is positive and W_{AEB} is negative.
Hence $Q_{ACB} > Q_{ADB} > Q_{AEB'}$

Q.19 (4)

Key idea Heat given to a system (ΔQ) is equal to the sum of increase in the internal energy (Δu) and the work done (ΔW) by the system against the surrounding and 1 cal = 4.2 J.

According to first law of thermodynamics

$\Delta U = Q - W$

$= 2 \times 4.2 \times 1000 - 500$

$= 8400 - 500$

$= 7900$ J

Q.20 (4)

Heat given $\Delta Q = 20$ cal $= 20 \times 4.2 = 84$ J.

Work done $\Delta W = -50$ J

[As process is anticlockwise]

By first law of thermodynamics $\Rightarrow \Delta U = \Delta Q - \Delta W = 84 - (-50) = 134$ J

Q.21 **(2)**

$Q_P = nC_P(T_2 - T_1)$

$$140 = n\frac{7}{2}R(T_2 - T_1)$$

$w = nR(T_2 - T_1)$

$= 40$ J

Q.22 (1)

Process AB is isobasic an BC is isothermal, CD isochoric and DA isothermic compression.

Q.23 (2)

In adiabatic expansion of a gas system, gas expands, so temperature of the system decreases.

Q.24 (4)

In isothermal expansion

T = constant $\Delta U = 0$ $W = \Delta Q$

$\therefore$ option (4) is correct.

Q.25 (1)

$$\eta = \frac{W}{Q} = \frac{\frac{1}{2}\times(6-2)\times(8-2)\times 10^3}{30\times 10^3}$$

$$\text{In \% } \eta = \frac{3\times 4}{30}\times 100\% = 40\%$$

Q.26 (3)

Q.27 (1)

Q.28 **(3)**

$PV^r = C$

$$\Rightarrow P\left(\frac{m}{\rho}\right)^r = C$$

$\Rightarrow Pm^r \rho^{-r} = C$

Q.29 **(1)**

$$\frac{\Delta U}{Q} = \frac{nC_V\Delta T}{nC_P\Delta T} = \frac{C_V}{C_P} = \frac{1}{r} = \frac{1}{\left(1+\frac{2}{f}\right)} = \frac{1}{\left(1+\frac{2}{5}\right)} = \frac{5}{7}$$

Q.30 (2)

$\Delta U = mC_V \Delta T$

$= 1000 \times 0.172 \times 10$

$= 1720$ cal

$= 1720 \times 4.2$ J

$= 7224$ J

Q.31 (4)

Based on theory

Q.32 (1)

$$0.4 = 1 - \frac{300}{T_i} \quad \text{...(i)}$$

$$0.6 = 1 - \frac{300}{T_f} \quad \text{...(ii)}$$

from (i) & (ii)

$T_f - T_i = 250$ K

Q.33 **(3)**

Q.34 (3)

W = Area inside cycle = $(12 - 4) \times (5 - 2)$

= 24 litre-atm

Q.35 (1)

As W.D. is isobaric > W.D. in Isothermal > W.D in adiabatic

or $W_2 > W_1 > W_3$

Hence option (1) is correct.

Q.36 (3)

In adiabatic process pV^γ = constant

or $$p \propto \frac{1}{V^\gamma}$$

Q.37 (2)

$B \rightarrow A$

$\Delta Q = 0$

$0 = -30 + \Delta U_{BA}$

$\Delta U_{BA} = 30$ J

$\therefore \Delta U_{AB} = -\Delta U_{BA} = -30$ J

Q.38 (4)

Q.39 (2)

For an isothermal process, PV = constant

Differentiating both sides, we get

$$PdV + VdP = 0 \text{ or } \frac{dP}{dV} = -\frac{P}{V}$$

$$\text{Thus, slope} = \frac{dP}{dV} = -\frac{P}{V}$$

Q.40 (2)
In cyclic process $\Delta u = 0$

Q.41 (2)
$T_1V^{\gamma-1} = T_2(32V)^{\gamma-1}$

$\gamma - 1 = \frac{2}{5}$

$T_1V^{2/5} = T_2(32V)^{2/5}$

$\frac{T_1}{T_2} = 4$

$\eta = 1 - \frac{T_2}{T_1} = \frac{3}{4} \times 100 = 75\%$

Q.42 (1)
$\Delta U = nc_v\Delta T$

$= n\left(\frac{fR}{2}\right)(T_B - T_A)$

$= 1 \times \frac{5}{2}(RT_B - RT_A)$

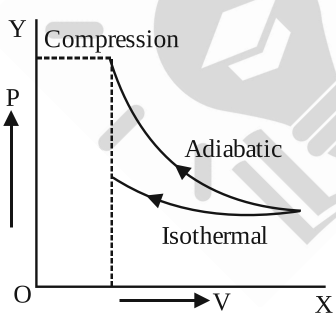
$= \frac{5}{2}(P_BV_B - P_AV_A)$

Solving we get

$\boxed{\Delta U = -20kJ}$

Q.43 (2)

Q.44 (2)
From the graph we can see that for compression of gas, area under the curve for adiabatic is more than isothermal process.
Therefore, compressing the gas through adiabatic process will require more work to be done.



Q.45 (2)

$\Delta U = \frac{nfR\Delta T}{2} = 0$

$\Rightarrow \Delta T = 0$
$\Rightarrow$ Isothermal process

$P \propto \frac{1}{V}$

Q.46 (1)

$U = \frac{f}{2}nRT$

For isothermal process, to increase internal energy, no. of molecules should be increased.

Q.47 (1)

$PV = \mu RT$ Þ $P = \mu RT \times \frac{1}{V}$

$\Rightarrow y = mx$
$\Rightarrow$ slope $\propto$ T

Q.48 (4)
$dQ = dU + dW \Rightarrow dU = nC_v\, dT$
$dU = 0$ (for isothermal)
$\therefore$ U = constant
Also $dQ > 0$ (supplied)
Hence $dW > 0$

Q.49 **(1)**
$\Delta Q = \Delta U + W$
W = area under PV curve = $\Delta Q - \Delta U$
$= 18P_0V_0 - nC_v\Delta T$

$= 18P_0V_0 - \frac{3}{2}nR\Delta T$

$W = 18P_0V_0 - \frac{3}{2}(P_2V_2 - P_1V_1)$

$= 18P_0V_0 - \frac{3}{2}(9P_0V_0 - 2P_0V_0)$

$= 18P_0V_0 - \frac{21}{2}P_0V_0$

$= 7.5\, P_0V_0$

Q. 50 (4)
For a closed loop process, Total change in internal energy is zero.

TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Kinetic Theory of Gases**

ANSWER KEY

Q.1 (4)	**Q.2** (1)	**Q.3** (1)	**Q.4** (2)	**Q.5** (1)	**Q.6** (2)	**Q.7** (4)	**Q.8** (1)	**Q.9** (1)	**Q.10** (1)
Q.11 (2)	**Q.12** (2)	**Q.13** (1)	**Q.14** (4)	**Q.15** (4)	**Q.16** (4)	**Q.17** (4)	**Q.18** (3)	**Q.19** (2)	**Q.20** (4)
Q.21 (2)	**Q.22** **(1)**	**Q.23** (1)	**Q.24** (2)	**Q.25** (1)	**Q.26** (3)	**Q.27** (4)	**Q.28** (2)	**Q.29** (4)	**Q.30** (1)
Q.31 (4)	**Q.32** (1)	**Q.33** (4)	**Q.34** (1)	**Q.35** (1)	**Q.36** (3)	**Q.37** (1)	**Q.38** (4)	**Q.39** (2)	**Q.40** (3)
Q.41 (2)	**Q.42** (1)	**Q.43** (2)	**Q.44** (1)	**Q.45** (4)	**Q.46** (3)	**Q.47** (4)	**Q.48** (4)	**Q.49** (3)	**Q.50** (1)

Hints and Solutions

Q.1 (4)

$\frac{P}{\rho} = \frac{RT}{M_w}$ (Ideal gas equation)

$\Rightarrow \rho = \frac{PM_w}{RT} = \frac{P \times (mN_A)}{kN_A T} = \frac{Pm}{kT}$

Q.2 (1)

No. of moles n = $\frac{m}{\text{molecular weight}} = \frac{5}{32}$

So, from ideal gas equation PV = nRT

$\Rightarrow$ $PV = \frac{5}{32}RT$

Q.3 (1)

$v_1 = \sqrt{\frac{3RT}{M_H}}$ & $v_2 = \sqrt{\frac{2RT}{M_O}}$

$\frac{v_1}{v_2} = \sqrt{\frac{3}{2} \times \frac{M_O}{M_H}} = \sqrt{\frac{3}{2} \times \frac{32}{2}} = 2\sqrt{6}$

Q.4 **(2)**

PV = nRT

$P \times 10^{-6} = 5 \times 1.38 \times 10^{-23} \times 3$

$P = 15 \times 1.38 \times 10^{-17}$

$P = 20.7 \times 10^{-17} = 2 \times 10^{-16}$

Q.5 **(1)**

PV = nRT

$n = \frac{PV}{RT}$

$n_1 = \frac{PV}{RT}$ $\quad n_2 = \frac{2P \times V}{R4 \times 2T}$

$\frac{n_1}{n_2} = \frac{PV}{RT} \times \frac{8RT}{2PV} = \frac{8}{2} = \frac{4}{1}$

Q.6 **(2)**

$V_{av} = \sqrt{\frac{8RT}{\pi M_0}}$, $V_{AV} \alpha \sqrt{T}$

For same temp in vessel A, B and C, Average speed of O_2 molecule is same in vessel A and C and is equal to V_1.

Q.7 **(4)**

as question

$T_2 = 4T_1$

$T_2 = 4 \times 273 = 1092$

$T_2 = 1092$ K

$T_2 = 1092 - 273 = 819°C$

Q.8 **(1)**

$V_{rms} = \sqrt{\frac{3RT}{M}}$

$V_{rms} \propto \sqrt{\frac{1}{M}}$

M_2 M is lost so its V_{rms} is maximum

Q.9 **(1)**

V_{rms} of $O_2 = \sqrt{\frac{3RT}{M_2}} = \sqrt{\frac{3RT}{16}}$

V_{rms} of $H_2 = \sqrt{\frac{3RT}{M_2}} = \sqrt{\frac{3RT}{2}}$

$\frac{H_2}{O_2} = \sqrt{\frac{16}{1}} = 4:1\sqrt{\frac{8RT}{\pi M}}$

Q.10 (1)

$V_{avr} = \bar{V} = \sqrt{\frac{8\,RT}{\pi M}} = \sqrt{\frac{8\,RT}{\pi M}}$

$\frac{\bar{V}_{H_2}}{\bar{V}_{N_2}} = \sqrt{\frac{1/2}{1/28}} = \sqrt{\frac{14}{1}} = \sqrt{14}$

Q.11 (2)

Q.12 (2)

RMS speed is given by

$$v_{rms} = \sqrt{\frac{3RT}{M}}$$

At constant temperature

$$v_{rms} \propto \frac{1}{\sqrt{M}}$$

Ratio of v_{rms} of oxygen and hydrogen.

$$\frac{(v_{rms})_O}{(v_{rms})_H} = \sqrt{\frac{M_H}{M_O}}$$

$$\frac{500}{(v_{rms})_H} = \sqrt{\frac{2}{32}} = \frac{1}{4}$$

$(v_{rms})_H$ = 2000 m/s

Q.13 (1)

In an isothermal change, an ideal gas obeys the Boyle's law.

Q.14 (4)

Kinetic energy per gm mole E = $\frac{f}{2}RT$

If nothing is said about gas then we should calculate the translational kinetic energy.

i.e. $E_{trans} = \frac{3}{2}RT = \frac{3}{2}\times 8.31\times(273+0) = 3.4\times 10^3$ J

Q.15 (4)

$$\gamma_{mixture} = \frac{\frac{\mu_1\gamma_1}{\gamma_1-1}+\frac{\mu_2\gamma_2}{\gamma_2-1}}{\frac{\mu_1}{\gamma_1-1}+\frac{\mu_2}{\gamma_2-1}}$$

$$\mu_1 = \text{moles of helium} = \frac{16}{4} = 4$$

$$\mu_2 = \text{moles of oxygen} = \frac{16}{32} = \frac{1}{2}$$

$$\gamma_{mix} = \frac{\frac{4\times 5/3}{\frac{5}{3}-1}+\frac{1/2\times 7/5}{\frac{7}{5}-1}}{\frac{4}{\frac{5}{3}-1}+\frac{1/2}{\frac{7}{5}-1}} = 1.62$$

Q.16 (4)

Q.17 **(4)**

acc to boylies law
at constant temb
PV → constant

Q.18 (3)

$$\rho = \frac{PM}{RT}$$

Density ρ remains constant when P/T or volume remains constant.

In graph (i) volume is decreasing, hence density is increasing; while in graph (ii) and (iii) volume is increasing, hence, density is decreasing. Note that volume would have been constant in case the straight line in graph (iii) has passed through origin.

∴ (3)

Q.19 (2)

At constant pressure

PV = nRT

$V \propto T$

Q.20 **(4)**

T_1 = 27°C = 300 K T_2 = ?

P_1 = P P_2 = 2P

at constant pressure

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \quad T_2 = \frac{P_2\times T_1}{P_1} = \frac{2P\times 300}{P} = 600K$$

T_2 = 327°C

Q.21 (2)

$$\frac{P}{\rho} = \frac{KT}{m}$$

$$\rho = \left(\frac{m}{KT}\right)P$$

y = m x

$$\text{Slope} \propto \frac{1}{T}$$

$\therefore T_2 > T_1$

Q.22 **(1)**

$$PV^{2/3} = \text{constant} \Rightarrow \frac{PV^{2/3}}{PV} = \frac{\text{constant}}{RT}$$

$$\text{or } \frac{1}{V^{1/3}} = \frac{\text{constant}}{RT} \Rightarrow V \propto T^3$$

Temperature increase with increase in volume.

Q.23 (1)

In P – T Graph

PV = μRT

$$T = \left(\frac{V}{\mu R}\right)P$$

y = m x

slope ∝ volume

θ ∝ volume

$\therefore \theta_2 > \theta_1$ therefore $V_2 > V_2$

Q.24 (2)

$PV = nRT = \frac{m}{M_0}RT$

$\Rightarrow V \propto m$

For same p

$V_1 > V_2$

So, $m_1 > m_2$

Q.25 (1)

$$V \propto T \Rightarrow \frac{V_1}{V_2} = \frac{T_1}{T_2} \Rightarrow \frac{200}{V_2} = \frac{(273+20)}{(273-20)} = \frac{293}{253}$$

$$V_2 = \frac{200 \times 253}{293} = 172.6\,ml$$

Q.26 (3)

$$P \propto T \Rightarrow \frac{P_2}{P_1} = \frac{T_2}{T_1} \Rightarrow \frac{P_2}{2} = \frac{360}{300} \Rightarrow P_2 = 2.4 \text{ atm}$$

Q.27 **(4)**

P^6V^5 = const.

$\Rightarrow PV^{\frac{5}{6}}$ = const.

$$\text{Now } C = C_v + \frac{R}{1-x} = \frac{3}{2} + R\frac{R}{1-\frac{5}{6}}\frac{15R}{2}$$

Heat supplied, $Q = nC\Delta T$

$= n\left(\frac{15R}{2}\right)(5) = 37.5\ nR.$

Q.28 (2)

$PV^2 = C$

and $PV = nRT$

$\therefore \frac{1}{V} = \frac{nR}{C} \times T$

or VT = constant

if $V\uparrow$ then $T\downarrow$

Q.29 **(4)**

P = constant

PV = nRT

$V \propto T$

$\frac{V}{T}$ = constant

Q.30 (1)

$TV^{\gamma-1}$ = constant

$\gamma - 1 = 4 \Rightarrow \gamma = 1.4$ diatomic gas

Q.31 (4)

$\Delta U = nC_V\Delta T$

ΔT = Temperature change

$\Delta U = nC_V\Delta T$

$\Delta T = (393\text{ K} - 373\text{ K}) = 20\text{ K}$

$\Delta U = 80$ J, n = 5 mol

$80 = 5 \times C_V \times 20$

$C_V = \frac{80}{100} = 0.8\text{ J mol}^{-1}\text{K}^{-1}$

Q.32 **(1)**

One mole O_2 + 2 mole N_2 at 300k

$V = \frac{fk\rho}{2}$ for a molecule and

For molecules

$u^1 = \frac{nfRT}{2}$ here f = 2 for rotational and T = constant

$\frac{U_1}{U_2} = \frac{1}{1}$

Q.33 (4)

Q.34 (1)

$(KE)_{trans} = \frac{3}{2}nRT$

$= \frac{3}{2} \times 2 \times 8.31 \times 300$

$= 7.48 \times 10^3$J

Q.35 (1)

$E = \frac{3}{2}KT = \frac{3}{2} \times 1.36 \times 10^{-23} \times 800$

$= 1632 \times 10^{-23}$ joule.

Q.36 (3)

for $\gamma = \frac{7}{5}; C_v = \frac{5}{2}R$

For $\gamma = \frac{4}{3}$; $C_v = 3R$

Hence $C_{v\,mix}$ $= \frac{\mu_1 C_{v_1} + \mu_2 C_{v_2}}{\mu_1 + \mu_2}$

$= \frac{\frac{5}{2}R + 3R}{2} = \frac{11}{4}R$

$C_{pmix} = \frac{15}{4}R = C_{v\,min} + R$

$\gamma_{mix} = \frac{C_{p\,mix}}{C_{v\,mix}} = \frac{15}{11}$

Q.37 (1)

Q.38 (4)

Q.39 (2) $U = \frac{f_1}{2}n_1RT + \frac{f_2}{2}n_2RT$

$= \left(\frac{5}{2}\times 8 + \frac{3}{2}\times 2\right)RT$

= (20 + 3) RT = 23 RT

Q.40 (3)

$\frac{E_1}{E_2} = \frac{T_1}{T_2} \Rightarrow \frac{E}{2E} = \frac{(273+27)}{T_2}$

$\Rightarrow T_2$ = 600K = 327ºC

Q.41 (2)

Q.42 (1)

Average $C_v = \dfrac{\frac{3}{2}R + \frac{5}{2}R}{2} = 2R$

Average $C_p = C_v + R = 2R + R = 3R$

$\therefore$ Average $\gamma = \frac{3R}{2R} = \frac{3}{2} = 1.5$

Q.43 (2)

$PV = \frac{M}{M_w}RT \qquad \Rightarrow \frac{PM_w}{M} = \frac{RT}{V} =$ constant

$\frac{P_1M_{w_1}}{M_1} = \frac{P_2M_{w_2}}{M_2} \Rightarrow \frac{5\times 28}{20} = \frac{3\times 2}{M_2}$

$\Rightarrow M_2$ = 0.86 kg

Q.44 (1)

$K.E = \frac{3RT}{2} = \frac{3PV}{2}$

$P = \frac{2K.E}{3V} = \frac{2}{3}E$

Hence answer is (1)

Q.45 (4)

$\gamma = \frac{\mu_1 Cp_1 + \mu_2 Cp_2}{\mu_1 Cv_1 + \mu_2 Cv_2}$

$= \dfrac{1\times\frac{5}{2}R + 2\times\frac{7}{2}R}{1\times\frac{3}{2}R + 2\times\frac{5}{2}R} = \frac{12}{8} = 1.5$

Q.46 **(3)**

$E \propto T \Rightarrow \frac{E_1}{E_2} = \frac{T_1}{T_2} = \frac{300}{350} = \frac{6}{7}$

Q.47 (4)

4 gH_2 means 2 g-moles and 8 g He means 2 g-moles.

Now $M = \frac{n_1M_1 + n_2M_2}{n_1+n_2} = \frac{(2)(2)+(2)(4)}{2+2}$

= 3 g/mol

$\rho = \frac{PM}{RT} = \frac{(1.013\times 10^5)(3\times 10^{-3})}{(8.31)(273)}$

= 0.13 kg/m^3

Q.48 (4)

$f = \frac{2}{\gamma - 1}$

$\boxed{f = \frac{2}{\gamma-1}}$

Q.49 (3)

$U = \frac{nfRT}{2}$ (f = degree of freedom)

$f_1n_1T_1 = f_2n_2T_2$

$\frac{n_1}{n_2} = \frac{f_2T_2}{f_1T_1} = \frac{(3)(2)}{(5)(1)} = \frac{6}{5}$

$\therefore$ (3)

Q.50 (1)

Here $C_p - C_v = R$ and $\frac{C_p}{C_v} = \frac{5}{3}$

$\therefore \ C_p = \frac{5}{3}C_v$

or $C_v = \dfrac{R}{\frac{5}{3}-1} = \frac{8.31}{2/3}$

or C_v = 12.5 J/mol K.

TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Oscillations**

ANSWER KEY

Q.1 (3)	**Q.2** (1)	**Q.3** (4)	**Q.4** (3)	**Q.5** (2)	**Q.6** (1)	**Q.7** (2)	**Q.8** (1)	**Q.9** (1)	**Q.10** (4)
Q.11 (3)	**Q.12** (2)	**Q.13** (1)	**Q.14** (4)	**Q.15** (2)	**Q.16** (3)	**Q.17** (4)	**Q.18** (3)	**Q.19** (4)	**Q.20** (3)
Q.21 (4)	**Q.22** (1)	**Q.23** (1)	**Q.24** (4)	**Q.25** (1)	**Q.26** (4)	**Q.27** (3)	**Q.28** (3)	**Q.29** (1)	**Q.30** (2)
Q.31 (3)	**Q.32** (1)	**Q.33** (1)	**Q.34** (2)	**Q.35** (2)	**Q.36** (4)	**Q.37** (1)	**Q.38** (2)	**Q.39** (4)	**Q.40** (2)
Q.41 (1)	**Q.42** (1)	**Q.43** (3)	**Q.44** (4)	**Q.45** (3)	**Q.46** (2)	**Q.47** (4)	**Q.48** (2)	**Q.49** (2)	**Q.50** (4)

Hints and Solutions

Q.1 (3)

Distance covered in 0 to $\frac{T}{4}$ is A

by symmetry , distance covered in 0 to $\frac{5T}{4}$ is 5A.

Q.2 (1)

Potential energy

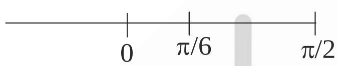
$$u = \frac{1}{2}kx^2$$

$$x = \frac{A}{2}$$

$$u = \frac{1}{2}\frac{kA^2}{4} = \frac{E}{4}$$

Q.3 (4)

Time taken to reach from mean to half of amplitude



$$t = \frac{\theta}{W} = \frac{\pi}{6\times 2\pi}T = \frac{T}{12}$$

$$t = \frac{4}{12} = \frac{1}{3}\text{SEC}$$

Q.4 (3)

On comparing with $\frac{d^2y}{dt^2} + \omega^2 y = 0$

$$25\frac{d^2y}{dt^2} + 9y = 0$$

$$\omega = \sqrt{\frac{9}{25}} = \frac{3}{5}$$

$$T = \frac{2\pi}{\omega}$$

Time taken to travel from y = 0 to $y = \frac{A}{2}$

$$t = \frac{T}{12} = \frac{5\pi}{18}$$

Q.5 **(2)**

$X = A\sin\omega t$

when particle step from m position

$u = A\omega\cos\omega t$

$$K.E. = \frac{1}{2}mv^2$$

$$= \frac{1}{2}m\omega^2A^2\cos^2\omega t$$

$$KE = \frac{1}{2}kA^2\cos^2\omega t$$

So. Ans. (1)

Q.6 **(1)**

T = 0.05 sec, A = 40 cm

$$V_0 = A\omega = 0.4\times\frac{2\pi}{0.05} = 20\times 0.4\times 2\pi = 16\,\pi\ m/s$$

Q.7 **(2)**

T = 8 sec

Phase difference = $\pi/2$

Q.8 **(1)**

If a particle executes SHM, its kinetic energy is given by

$$KE = \frac{1}{2}m\omega^2\left(A^2 - x^2\right)$$

or $$KE = \frac{1}{2}k\left(A^2 - x^2\right)$$

where $k = m\omega^2$ = constant

Its potential energy is given by

$$KE = \frac{1}{2}m\omega^2x^2 = \frac{1}{2}kx^2$$

Thus, total energy of particle

E = KE + PE

$$= \frac{1}{2}k\left(A^2 - x^2\right) + \frac{1}{2}kx^2 = \frac{1}{2}kA^2$$

Hence,

$$PE = \frac{1}{2}kx^2 = \frac{1}{2}k\left(\frac{A}{2}\right)^2$$

$(\because\ x = \frac{A}{2})$

$$= \frac{1}{4}\left(\frac{1}{2}kA^2\right) = \frac{1}{4}E$$

Hence, potential energy is one-fourth of total energy.

Q.9 (1)

$$E = \frac{1}{2}ma^2\omega^2 = \frac{1}{2}ma^2\left(\frac{4\pi^2}{T^2}\right) \Rightarrow E \propto \frac{a^2}{T^2}$$

Q.10 **(4)**

$$v = \omega\sqrt{A^2 - x^2}$$

$$v = \omega\sqrt{A^2 - \frac{A^2}{4}} = \frac{\sqrt{3}}{2}A\omega = \frac{x\sqrt{3}}{2}v_0$$

Q.11 (3)

$a = -bx$

Comparing with

$a = -\omega^2 x$

So, $\omega^2 = b \Rightarrow$

Q.12 (2)

$K_{max} = U_{max} = E =$

Now,

$$\Rightarrow \frac{U_{max}}{4} = \frac{1}{2}m\omega^2x^2$$

$$\Rightarrow \left(\frac{1}{2}m\omega^2A^2\right)\cdot\frac{1}{4} = \frac{1}{2}m\omega^2x^2$$

$$\Rightarrow \frac{A^2}{4} = x^2$$

$$\Rightarrow x = \frac{A}{2}$$

Q.13 (1)

$$P.E. = \frac{1}{2}kA^2$$

$$24 = \frac{1}{2}k(2)^2$$

$$\Rightarrow k = \frac{24\times 2}{(2)^2} = 12\ N/m$$

Q.14 **(4)**

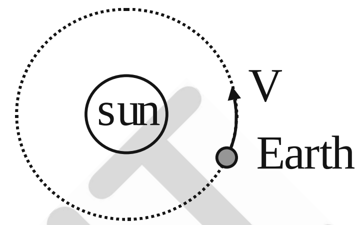
$$K.E. = \frac{1}{2}mv^2$$

$v = a\omega\cos\omega t$

$$P.E. = u_0 + \frac{1}{2}kx^2$$

$x = a\sin\omega t$

Q.15 **(2)**



Motion of earth around Sun is periodic but not oscillatory

For oscillatory motion, there must be to and fro motion.

Q.16 (3)

Amplitude A = 6 cm

When particle is at x = 4 cm,

its |velocity| = |acceleration|

i.e., $\omega\sqrt{A^2 - x^2} = \omega^2 x \Rightarrow \omega = \frac{\sqrt{A^2 - x^2}}{x}$

$$= \frac{\sqrt{(6)^2 - (4)^2}}{4} = \frac{\sqrt{5}}{2}$$

$$T = \frac{2\pi}{\omega} = 2\pi\left(\frac{2}{\sqrt{5}}\right) = \frac{4\pi}{\sqrt{5}} = \frac{4\sqrt{2}\pi}{\sqrt{10}}$$

Q.17 (4)

P.E. is maximum at extreme position and minimum at mean position

Time to go from extreme position to mean position is,

$t = \frac{T}{4}$; where T is time period of SHM. Given that

$$= \frac{T}{4} = 5s$$

$\Rightarrow T = 20$ s

Q.18 (3)

$$T = 2\pi\sqrt{\frac{m}{K}}$$

$$T = 2\pi\sqrt{\frac{2}{72}}$$

$$= \frac{2\pi}{6}$$

$= \frac{\pi}{3}$

Q.19 **(4)**

$A = 5\,cm = 5 \times 10^{-2}\,m$

$x = 4\,cm$

$|\omega^2 x| = \omega\sqrt{A^2 - x^2}$

$\omega^2 = \frac{25-16}{16}$

$T = \frac{8\pi}{3}$ sec

Q.20 (3)

$v = Aw$

$A = 6\sqrt{\frac{2}{288}} = \frac{1}{2}m$

$v = w\sqrt{A^2 - x^2}$

$3\sqrt{3} = 12\sqrt{\left(\frac{1}{2}\right)^2 - x^2}$

$\frac{\sqrt{3}}{4} = \sqrt{\frac{1}{4} - x^2}$

$\frac{3}{16} = \frac{1}{4}\ x^2$

$x = \frac{1}{4}m$

$P = Fv = 288 \times \frac{1}{4} \times 3\sqrt{3} = 216\sqrt{3}$ w

Q.21 **(4)**

$k = m\omega^2 = m(2\pi n)^2$

$= 4\pi^2 mn^2$

Q.22 (1)

If A and ω be amplitude and angular frequency of vibration, then

$\alpha = \omega^2 A$ ....(i)

and $\beta = \omega A$ ....(ii)

Dividing eqn. (i) by eqn. (ii), we get

$\frac{\alpha}{\beta} = \frac{\omega^2 A}{\omega A} = \omega$

$\therefore$ Time period of vibration is

$T = \frac{2\pi}{\omega} = \frac{2\pi}{(\alpha/\beta)} = \frac{2\pi\beta}{\alpha}$

Q.23 **(1)**

$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{0.2}{80}} = 0.31$ sec.

Q.24 (4)

Slop $k = \frac{F}{x} = \frac{8}{2} = 4$

$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{0.01}{4}} = 0.31s$

Q.25 (1)

$\frac{1}{2}KA^2 = (9-5) = 4J$

$K = \frac{8}{A^2} = \frac{8}{(0.01)^2} = 8 \times 10^4\,N/m$

$T = 2\pi\sqrt{\frac{m}{K}} = 2\pi\sqrt{\frac{2}{8\times10^4}} = \frac{\pi}{100}sec.$

Q.26 (4)

Since maximum velocity is $A\omega$ have ω is angular frequency,

$\therefore A_1\omega_1 = A_2\omega_2$ or $\frac{A_1}{A_2} = \frac{\omega_2}{\omega_1}$

But $\omega = \sqrt{\frac{k}{m}}$ $\therefore \frac{A_1}{A_2} = \frac{\sqrt{k_2}}{\sqrt{k_1}} = \frac{\sqrt{k_2}}{\sqrt{k_1}}$

Q.27 (3)

$\frac{f_1}{f_2} = \frac{\frac{1}{2\pi}\sqrt{\frac{K/2}{m}}}{\frac{1}{2\pi}\sqrt{\frac{2K}{m}}} = \frac{1}{2} = 1:2$

Q.28 **(3)**

Let the force constant of 2nd piece be k

As, $k \propto \frac{1}{l}$

$\therefore \frac{k_1}{k_2} = \frac{l_2}{l_1}$

or $\frac{k}{k_2} = \frac{2l/3}{l}$

or $k_2 = \frac{3k}{2}$

Q.29 (1)

$t \propto \frac{1}{\sqrt{9.8}}, t' \propto \frac{1}{\sqrt{12.8}}$

$(\because g' = 9.8 + 3 = 12.8)$

$$\therefore \frac{t'}{t} = \sqrt{\frac{9.8}{12.8}} \Rightarrow t' = \sqrt{\frac{9.8}{12.8}}t$$

Q.30 (2)

$$T = 2\pi\sqrt{\frac{m}{k}}.$$

Also spring constant $(k) \propto \frac{1}{\text{Length}(l)}$

when the spring is half in length, then k becomes twice.

$$\therefore T' = 2\pi\sqrt{\frac{m}{2k}} \Rightarrow \frac{T'}{T} = \frac{1}{\sqrt{2}} \Rightarrow T' = \frac{T}{\sqrt{2}}$$

Q.31 (3)

$$\omega^2 A = \frac{g}{l}.A$$

$= 0.5\ m/s^2$

Q.32 **(1)**

In this case,

$$\text{Stress} = \frac{mg}{A}$$

$\text{Strain} = \frac{l}{L}$ (where l is extension)

Now, Young's modulus Y is given by

$$Y = \frac{\text{stress}}{\text{strain}} = \frac{mg/A}{l/L}$$

$$mg = \frac{YAl}{L}$$

So, $kl = \frac{YAl}{L}$ $(\because mg = kl)$

(k is force constant)

Now, frequency is given by

$$n = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

$$= \frac{1}{2\pi}\sqrt{\left(\frac{YA}{mL}\right)}$$

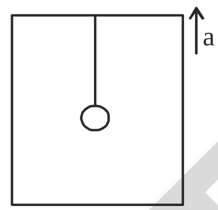
Q.33 (1)

$$T = 2\pi\sqrt{\frac{\ell}{g}}$$

$$T' = 2\pi\sqrt{\frac{\ell}{g + g/4}}$$

$$T' = 2\pi\sqrt{\frac{4\ell}{5g}} = \frac{2T}{\sqrt{5}}$$

Q.34 (2)



$$T = 2\pi\frac{\sqrt{\ell}}{g}$$

$$\frac{T}{2} = 2\pi\sqrt{\frac{\ell}{a+g}}$$

$$\frac{T^2}{4} = 4\pi^2\frac{\ell}{a+g}$$

$$\frac{4\pi^2\ell}{4g} = 4\pi^2\frac{\ell}{a+g}$$

$a + g = 4g \Rightarrow a = 3g$

Q.35 (2)

The frequency of oscillation of potential energy and kenetic energy is twice as that of displace ment or velocity or acceleration of a particle executing SHM.

Q.36 **(4)**

$$T = 2\pi\sqrt{\frac{ML^2 \times 2}{3mgL}} = 2\pi\sqrt{\frac{2L}{3g}}$$

Q.37 **(1)**

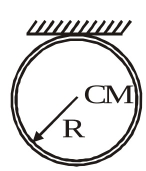
$$T = 2\pi\sqrt{\frac{39.2}{\pi^2 \times .9.8}} = 4 \text{ sec}$$

Q.38 **(2)**

Q.39 (4)

$$g_{Moon} = \frac{g_{Earth}}{6} \quad \therefore T_{Moon} = \sqrt{6}\ T_{Earth}$$

Q.40 (2)



$$T = 2\pi\sqrt{\frac{\ell + \frac{K^2}{\ell}}{g}}$$

Here $\ell = R$, $MK^2 = MR^2$

$\Rightarrow \quad K = R$

$\Rightarrow \quad T = 2\pi\sqrt{\dfrac{R+R}{g}}$

$= 2\pi\sqrt{\dfrac{2R}{g}}$

Q.41 (1)

Q.42 (1)

Q.43 (3)

$T = 2\pi\sqrt{\dfrac{\ell}{g}}$, At high altitude value of g decreases

$\therefore$ length of pendulum must be decreased to keep correct time.

Q.44 (4)

At first COM moves in downward direction then shift back to intial position.

$\therefore$ time period at first increase then decreases.

Q.45 (3)

$T_1 = 2\pi\sqrt{\dfrac{L}{g}}$

$T_2 = 2\pi\sqrt{\dfrac{I}{mgd}} = 2\pi\sqrt{\dfrac{\frac{1}{3}mL^2}{mg\frac{L}{2}}} = 2\pi\sqrt{\dfrac{2L}{3g}}$

$\dfrac{T_1}{T_2} = \sqrt{\dfrac{3}{2}}$

Q.46 (2)

$A_1 = 40$

$A_2 = \sqrt{10^2 + (10c)^2}$

Given $A_1 = A_2$

$\Rightarrow 40 = \sqrt{10^2 + (10c)^2}$

$\Rightarrow 100 + 100c^2 = 1600$

$\Rightarrow 100\,c^2 = 1500$

$\Rightarrow c^2 = \dfrac{1500}{100} \Rightarrow c = \pm\sqrt{15}$

Q.47 (4)

$y_1 = a\sin(\omega t + kx + 0.57)$

$y_2 = -a\sin(\omega t + kx) = a\sin(\omega t + kx + \pi)$

Phase diff. $\phi = \pi - 0.57 = 3.14 - 0.57 = 2.57$ rad

Q.48 (2)

$x_1 = 3\sin wt$

$x_2 = 4\sin(\omega t + \pi/2)$

$\phi = \pi/2$

$A = \sqrt{a_1^2 + a_2^2 + 2a_1a_2\cos\phi}$

$= A = \sqrt{3^2 + 4^2 + 0} = 5$

Q.49 (2)

$x = C\sin\omega t + D\sin(\omega t + \pi/2)$

$A_r = \sqrt{C^2 + D^2 + 2CD\cos\dfrac{\pi}{2}}$ $A_r = \sqrt{C^2 + D^2}$

Q.50 (4)

TOPIC WISE TEST (NEET)

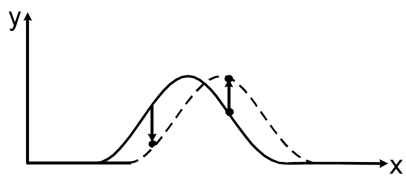
Subject : Physics **Topic : Waves**

ANSWER KEY

Q.1 (2)	**Q.2** (2)	**Q.3** (2)	**Q.4** (1)	**Q.5** (2)	**Q.6** (3)	**Q.7** (3)	**Q.8** (1)	**Q.9** (2)	**Q.10** (4)
Q.11 (2)	**Q.12** (1)	**Q.13** (2)	**Q.14** (3)	**Q.15** (4)	**Q. 16** (4)	**Q.17** (2)	**Q.18** (2)	**Q.19** (1)	**Q.20** (2)
Q.21 (4)	**Q.22** (4)	**Q.23** (2)	**Q.24** (4)	**Q.25** (2)	**Q.26** (4)	**Q.27** (3)	**Q.28** (3)	**Q.29** (3)	**Q.30** (2)
Q.31 (1)	**Q.32** (3)	**Q.33** (2)	**Q.34** (2)	**Q.35** (2)	**Q.36** (1)	**Q.37** (3)	**Q.38** (3)	**Q.39** (4)	**Q.40** (1)
Q.41 (3)	**Q.42** (1)	**Q.43** (3)	**Q.44** (2)	**Q.45** (1)	**Q.46** **(2)**	**Q.47** (3)	**Q.48** (4)	**Q.49** (4)	**Q.50** (4)

Hints and Solutions

Q.1 **(2)**



Dotted shape shows pulse position after a short time interval. Direction of the velocities are decided according to direction of displacements of the particles.
at x = 1.5 slope is +ve
at x = 2.5 slope is –ve

Q.2 (2)
Separation between two adjacent node = $\lambda/2$

$$K = \frac{2\pi}{\lambda} = \pi/3 \Rightarrow \lambda = 6$$

$\therefore$ Separation = 3 cm

Q.3 (2)
$\because$ Comparing given equation with standard format of wave equation, we get
ω = 60 rad/s and k = 2m^{-1}

$$\because \text{ Wave velocity } = \frac{\omega}{K} = 30\,\text{m s}^{-1}$$

$$\because \text{ Wave velocity } = \sqrt{\frac{T}{\mu}}$$

$$30 = \sqrt{\frac{T}{1.5\times10^{-4}}}$$

$\Rightarrow$ T = 1.5× 10^{-4} × 900 = 0.135 N

Q.4 (1)

$$\text{Wave velocity} = \frac{\omega}{K} = \frac{B}{AC}$$

Angular wave No. K = C

$$\text{Maximum particle velocity } = A\omega = B \Rightarrow \omega = \frac{B}{A}$$

Q.5 **(2)**

$$v = \frac{\pi/5}{\pi/9} = \frac{9}{5}\text{cm/sec}$$

$$A = 4\text{ m, } f = \frac{\pi}{5\times2\pi} = 0.1\text{Hz}$$

$$\lambda = \frac{2\pi}{k} = \frac{2\pi}{\pi}\times9 = 18\text{m}$$

Q.6 (3)
Here, Length, L = 10 m
Mass, M = 5g = 5 × 10^{-3} kg
Tension, T = 80 N
Mass per unit length of the wire is

$$\mu = \frac{M}{L} = \frac{5\times10^{-3}\text{kg}}{10\text{m}} = 5\times10^{-4}\text{ kg m}^{-1}$$

Speed of the transverse wave on the wire is

$$v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{80\text{N}}{5\times10^{-4}\text{ kg m}^{-1}}}$$

= 4 × 10^2 ms^{-1} = 400 ms^{-1}

Q.7 (3)
V = f $\lambda \Rightarrow$ 360 m/s = 500 Hz(λ)
λ = 0.72 m

$$\text{Now we know} \Rightarrow \frac{\Delta x}{\lambda} = \frac{\Delta\phi}{2\pi}$$

$$\frac{\Delta x}{0.72} = \frac{\pi/3}{2\pi}$$

Δx = 0.12 m

Q.8 (1)

$$v = \sqrt{\frac{T}{m}},\ T = 0.1\times10 = 1\text{N, } m = \frac{0.1}{2.5}$$

Velocity at upper point v = $\sqrt{1\times25}$
v = 5 m/s
Now velocity at 0.5 m distance from lower point -

$$v = \sqrt{\frac{T}{m}} \qquad T = \frac{1}{2.5}\times0.5 = \frac{1}{5}\text{N, } m = \frac{1}{25}$$

$$v = \sqrt{\frac{1}{5}\times\frac{25}{1}} = \sqrt{5} = 2.24\text{ m/s}$$

Q.9 (2)

$V = n\lambda$

$n = \frac{54}{60}$ per sec

$\lambda = 10m$

$V = \frac{54}{60} \times 10 = 9$ m/s

Hence the correct choice is (2)

Q.10 (4)

$f \propto \sqrt{T}$

$\therefore \frac{f_1}{f_2} = \sqrt{\frac{T_1}{T_2}}$

$\frac{3}{2} = \sqrt{\frac{T+2.5}{T}}$

$\Rightarrow T = 2$ N

Q.11 (2)

Maximum intensity

$= I + 4I + 2\sqrt{I}\sqrt{4I}\cos 0 = 9I$

Minimum intensity

$= I + 4I - 2\sqrt{I}\sqrt{4I} = I$

Q.12 (1)

Answer (1)

$v_{max} = A\omega$

$\frac{v_{1p}}{v_{2p}} = \frac{A_1}{A_2}$

Q.13 (2)

Maximum resultant amplitude = $A_1 + A_2$

Minimum resultant amplitude = $A_1 - A_2$

difference between them

$= A_1 + A_2 - A_1 + A_2 = 2A_2$

Q.14 (3)

$y_1 = 10\sin\left(3\pi t + \frac{\pi}{3}\right)$;

$y_2 = 5\left(\sin 3\pi t + \sqrt{3}\cos 3\pi t\right)$

$= 10\left(\frac{1}{2}\sin 3\pi t + \frac{\sqrt{3}}{2}\cos 3\pi t\right) = 10\sin\left(3\pi t + \frac{\pi}{3}\right)$

$\therefore A_1/A_2 = 10/10 = 1 : 1$

Q.15 (4)

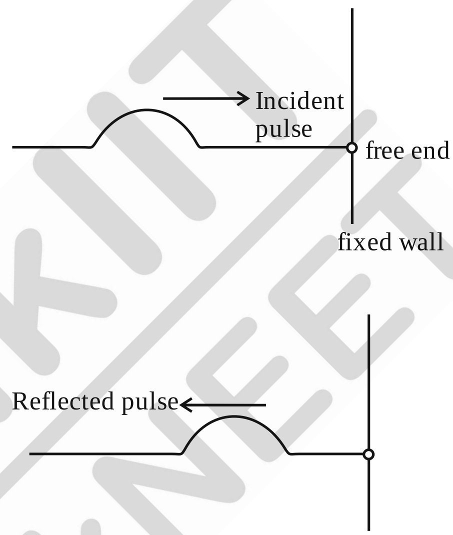
Intensity of sound wave

$I = 2\pi^2 n^2 a^2 \delta v$ or $I \propto n^2 a^2$

$\therefore \frac{I_1}{I_2} = \left(\frac{n_1}{n_1} \times \frac{a_1}{a_2}\right)^2 = \left(\frac{2}{1} \times \frac{1}{2}\right)^2 = 1 : 1$

Hence the correct choice is (4)

Q. 16 **(4)**



Q.17 **(2)**

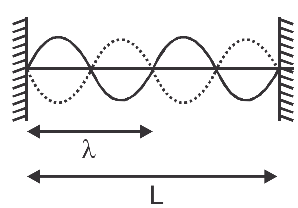
Number of loop P = 4

$y = 0.3 \sin(0.157x)\cos(200\pi t)$

$k = 0.157$

$\frac{2\pi}{\lambda} = 0.157$

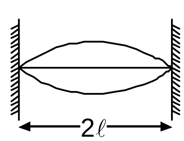
$\lambda = 40$ cm



So length of string $L = 2\lambda = 80$ m

Q.18 (2)

For max. wavelength



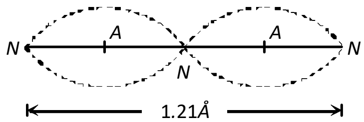
$\frac{\lambda}{2} = L$

$\lambda = 2L$

$\lambda = 80$ cm

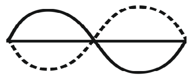
Q.19 (1)

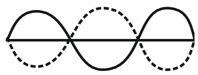
(1) $\lambda = 1.21Å$

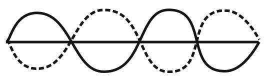


Q.20 **(2)**

(a) Fundamental mode 

(b) Second harmonic 

(c) Third harmonic 

(d) Fourth harmonic 

Q.21 (4)
Sound wave transfers both energy and momentum.

Q.22 **(4)**
Statement-I is correct
because Transverse sound can't propagate in gas medium
Statement-II It is also correct.

Q.23 (2)
audible range for human being –
(20 Hz to 20,000 Hz)

Q.24 **(4)**
Superposition does not takes places between laser waves.

Q.25 **(2)**
'SONAR' emits ultrasonic waves.

Q.26 (4)

$$I = \frac{1}{2}\rho v A^2\omega^2 = 2\rho^2\rho v A^2 f^2$$

Q.27 (3)

$$v_{air} = \sqrt{\frac{\gamma P}{\rho_{air}}}$$

$$v_{H_2} = \sqrt{\frac{\gamma P}{\rho_{H_2}}}$$

$$V_{H_2} = 4v_{air} = 4 \times 332 = 1328 \text{ m/s}$$

Q.28 (3)

$$v = \sqrt{\frac{B}{p}}$$

$$\frac{V_1}{V_2} = \sqrt{\frac{P_2}{P_1}} = \sqrt{\frac{4}{1}} = \frac{2}{1}$$

Q.29 (3)

Velocity of sound = $\sqrt{\frac{\gamma RT}{M}}$,

velocity (rms) = $\sqrt{\frac{3RT}{M}}$

$$\frac{V(rms)}{600} = \sqrt{\frac{3}{\gamma}} = \sqrt{\frac{3}{1.5}} = \sqrt{2}$$

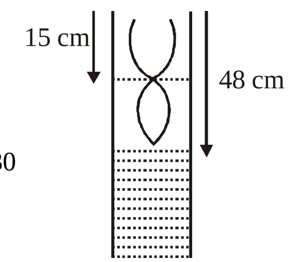
$$\Rightarrow V(rms) = 600\sqrt{2} \text{ m/s}$$

Q.30 (2)

$$V = \sqrt{\frac{\beta}{\rho}} = \sqrt{\frac{2100 \times 10^6}{10^3}} = 1450 \text{ m/s}$$

Q.31 (1)

$$= \frac{\lambda f}{1} = \left(\frac{66}{100}\right)500 = 330$$



Q.32 **(3)**
Velocity of sound in a gas

$$v = \sqrt{\frac{\gamma p}{d}}$$

$$\therefore \frac{v_{H_2}}{v_{He}} = \sqrt{\frac{\gamma_{H_2} \times d_{He}}{d_{H_2} \times \gamma_{He}}}$$

$$\frac{v_{H_2}}{v_{He}} = \sqrt{\frac{7 \times 3 \times 2}{5 \times 5}} \qquad \left[\text{As } \frac{d_{He}}{d_{H_2}} = 2\right]$$

$$\therefore \frac{v_{H_2}}{v_{He}} = \frac{\sqrt{42}}{5}$$

Q.33 **(2)**
For sonometer

$$v \propto \frac{1}{l}$$

$$\therefore \frac{v_1}{v_2} = \frac{l_2}{l_1} \Rightarrow \frac{256}{v_2} = \frac{16}{25}$$

$$v_2 = \frac{256 \times 25}{16} = 400\ Hz$$

Q.34 (2)

If the frequency of fork v, then speed of sound is given by

$$v = 2v(l_2 - l_1)$$

Where l_1 and l_2 are length of air columns.

Given, v=500 cycles/s,

$$l_2 = 52cm = 52 \times 10^{-2}m$$

$$l_1 = 17cm = 17 \times 10^{-2}m$$

$$\therefore v = 2 \times 500(52 - 17) \times 10^{-2}$$

$$\Rightarrow v = 350ms^{-1}$$

Q.35 **(2)**

$$\frac{\lambda}{2} = 2 \times 8.75\text{cm}$$

λ = 35cm

$$n = f = \frac{v}{\lambda} = \frac{350}{35} \times 100 = 100\ \text{Hz}$$

Q.36 (1)

$$I = \frac{4\pi \times 10^{-6}}{4\pi(10)^2} = 10^{-8}$$

$$SL = 10 \log_{10}\left(\frac{10^{-8}}{10^{-12}}\right) = 40$$

Q.37 **(3)**

$$f_1 = \frac{500\pi}{2\pi} = 250\ ;\ f_2 = \frac{506\pi}{2\pi} = 253$$

$\therefore \Delta f = 3\ s^{-1} = 3 \times 60\ \text{min}^{-1} = 180\ \text{min}^{-1}$

Q.38 **(3)**

$$n = \frac{1}{2\ell}\sqrt{\frac{16}{\mu}} \quad \text{....(i)}$$

$$\frac{n}{8} = \frac{1}{2\ell}\sqrt{\frac{T}{\mu}} \quad \text{....(ii)}$$

$$8 = \sqrt{\frac{16}{T}} \Rightarrow 64 = \frac{16}{T}$$

$$T = \frac{16}{64} = \frac{1}{4}$$

So, change in tension is 12 kg weight.

Q.39 **(4)**

$$n \propto \frac{1}{\ell}$$

$n_1 : n_2 : n_3$

1 : 3 : 4

$\ell_1 : \ell_2 : \ell_3$

$$\frac{1}{1} : \frac{1}{3} : \frac{1}{4}$$

12 : 4 : 3

$$\ell_1 = \frac{12}{19} \times 114 = 72\text{cm}$$

$$\ell_2 = \frac{4}{19} \times 114 = 24\text{cm}$$

$$\ell_3 = \frac{3}{19} \times 114 = 18\text{cm}$$

Q.40 **(1)**

$$f = \frac{1}{2\ell}\sqrt{\frac{T}{\mu}} = \frac{1}{2\ell}\sqrt{\frac{T}{M} \times \ell} = \frac{1}{2\ell}\sqrt{\frac{T}{\pi r^2 \ell d}\ell}$$

$$= \frac{1}{2\ell}\sqrt{\frac{T}{\pi r^2 d}} = \frac{1}{2r\ell}\sqrt{\frac{T}{\pi d}}$$

Q.41 (3)

$\because$ Beat frequency = $f_1 - f_2 = \delta$

6 = f – 248 ....(1)

9 = 863 – f ....(2)

(2) – (1)$\Rightarrow$ 3 = 511– 2f

2f = 508

f = 254 Hz

Q.42 (1)

$$f_0 = 220 = \frac{v}{4L}$$

Also, $f = (2n - 1)\frac{v}{4\ell}$

$\therefore$ first overtone (n = 2) for $\frac{3\ell}{4}$

$$f = (2 \times 2 - 1) \times \frac{v}{4 \times \frac{3\ell}{4}}$$

$$= \frac{v}{\ell} = 4 \times 220$$

= 880 Hz

Q.43 (3)

Here only odd harmonics are present. Hence it is a closed pipe.

425 : 595 : 765 = 5 : 7 : 9

Hence $\frac{5v}{4l} = 425$

$$\Rightarrow \frac{5 \times 340}{4l} = 425$$

$\Rightarrow$ l = 1m

Q.44 (2)

$$\frac{2v}{2\ell_0} = \frac{3v}{4\ell_C} \text{ and } \frac{v}{2\ell_0} = 300$$

$$600 = \frac{3v}{4\ell_C}, \qquad \ell_C = \frac{3 \times 300}{600 \times 4} = 41\text{cm}$$

Q.45 **(1)**

ℓ_o = 25 cm, D = 2 cm, R = 1 cm

$$f = \frac{nV}{2(\ell + 1.2r)} = \frac{nV}{2(\ell + 1.2 \times 1)} = \frac{nV}{2(\ell + 1.2)}$$

$$n = 1, \quad f_1 = \frac{V}{2(\ell + 1.2)} \times 100$$

$$f_1 = \frac{330}{2(25 + 1.2)} \times 100 = \frac{330 \times 100}{2 \times 26.2}$$

f_1 = 929.77 Hz

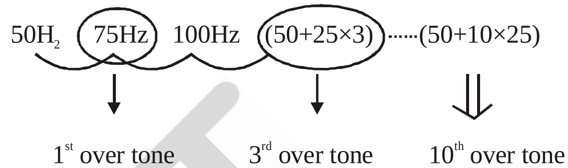
$$n = 2, \quad f_2 = \frac{2 \times V}{2(\ell + 1.2)} \times 100 = 1259.54\,\text{Hz}$$

$$n = 3, \ f_3 = \frac{3 \times V \times 100}{2(\ell + 1.2)} = 1889.31\,\text{Hz}$$

Q.46 **(2)**

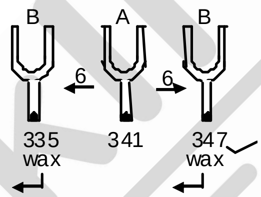
No of maximas heard in one second is called beat frequency. If two sound force of frequency f_2 and f_2 are there, where f_1 and f_2 are close to each other, then beat frequency = | $f_1 - f_2$ |.

Q.47 (3)



f = 50 + 10 × 25 = 5 0 + 250 = 300Hz

Q.48 (4)



Q.49 (4)

number of beats = $\nu_2 - \nu_1$

$$12 = \frac{v}{0.50} - \frac{v}{0.51} \qquad \Rightarrow 12 = \frac{(0.51 - 0.50)v}{0.5 \times 0.51}$$

$$\Rightarrow v = \frac{12 \times 0.5 \times 0.51}{0.01} = 6 \times 51 = 306 \text{ m/s}$$

Q.50 (4)

$$f_1 = \frac{vf_0}{v - vs},$$

$$f_2 = \frac{v.f_0}{v + vs}$$

$$f_1 f_2 = 3 = \frac{2.v.vs.f_0}{v^2 - vs^2} \Rightarrow vs = 1.5$$

TOPIC WISE TEST (NEET)

Subject : Physics **Topic :Electric Charges and Fields**

ANSWER KEY

Q.1 (4)	**Q.2** (2)	**Q.3** (1)	**Q.4 (2)**	**Q.5** (1)	**Q.6** (2)	**Q.7** (4)	**Q.8** (2)	**Q.9** (4)	**Q.10** (1)
Q.11 (4)	**Q.12** (3)	**Q.13** (1)	**Q.14** (4)	**Q.15** (1)	**Q.16** (1)	**Q.17** (3)	**Q.18** (4)	**Q.19** (2)	**Q.20** (3)
Q.21 (4)	**Q.22** (1)	**Q.23** (1)	**Q.24** (3)	**Q.25** (3)	**Q.26** (3)	**Q.27** (4)	**Q.28** (4)	**Q.29** (4)	**Q.30** (2)
Q.31 (2)	**Q.32** (1)	**Q.33** (3)	**Q.34** (1)	**Q.35** (3)	**Q.36** (1)	**Q.37** (2)	**Q.38 (3)**	**Q.39** (3)	**Q.40** (4)
Q.41 (4)	**Q.42** (3)	**Q.43** (1)	**Q.44** (4)	**Q.45** (1)	**Q.46** (3)	**Q.47** (2)	**Q.48** (1)	**Q.49** (1)	**Q.50** (4)

Hints and Solutions

Q.1 (4)

If two charged balls are joined by wire and then removed, then charge equally distributed on both.

So, finally, $q_1 = \frac{Q}{2}$ and $q_2 = \frac{Q}{2}$

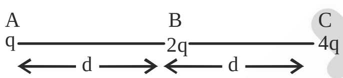
So, $F \propto q_1 q_2$

So, $F_{\text{finally}} \propto \frac{Q}{2} \times \frac{Q}{2}$

$F_{\text{initially}} \propto (Q)(2Q)$

$\Rightarrow \frac{F_{\text{finally}}}{F_{\text{initially}}} = \frac{1}{8} \Rightarrow F_{\text{finally}} = \frac{F}{8}$

Q.2 (2)



$F_A = \frac{k(q)(2q)}{d^2} + \frac{k(4q)(q)}{(2d)^2}; F_A = \frac{3kq^2}{d^2}$

$F_C = \frac{k(4q)(q)}{(2d)^2} + \frac{k(4q)(q)}{d^2}$

$F_C = \frac{9kq^2}{d^2}, \qquad \frac{F_A}{F_C} = \frac{T_{AB}}{T_{BC}} = \frac{1}{3} \Rightarrow 1:3$

Q.3 (1)

$F = \frac{kQ^2}{R^2}$ .....(1)

$F_2 = \frac{k}{R^2}\left(Q - \frac{3}{4}Q\right)\left(Q + \frac{3}{4}Q\right) = \frac{7}{16}\frac{kQ^2}{R^2}$ ....(2)

By (1) & (2)

$F_2 = \frac{7}{16}F$

Q.4 **(2)**

1nc = (no. of e^-) × (charge on one e^-)

10^{-9} C = n × 1.6 × 10^{-19} C

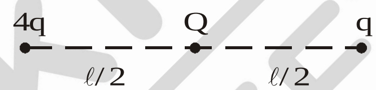
$\Rightarrow n = \frac{1}{1.6} \times 10^{10} = 6.25 \times 10^9$

Q.5 (1)

F_e = conservative force

So, $w_1 = w_2 = w_3$

Q.6 **(2)**

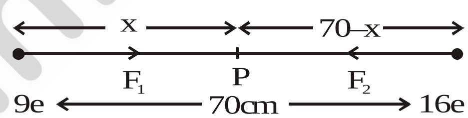


there are two force on q

If force by 4q = force by Q then net force on q = 0 and also Q should be unlike

$\Rightarrow \frac{k.4q.q}{\ell^2} = \frac{kqQ}{(\ell/2)^2} \Rightarrow Q = q$ but Q = –q

Q.7 **(4)**



At point P; the charge is at rest i.e. $F_{net} = 0$

$F_1 = F_2$

$\frac{K(9e)(q)}{x^2} = \frac{K(16e)}{(70-x)^2}q$

$\Rightarrow$ x = 30 cm from 9e or 40 cm from 16e.

Q.8 (2)

From Columb's law

force $F = \frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{R^2}$

$\varepsilon_0 = \frac{q_1q_2}{4\pi F R^2}$

put units

So $\varepsilon_0 = \frac{C^2}{N-m^2} = \frac{[AT]^2}{[MLT^{-2}][L^2]}$

$= [M^{-1}L^{-3}T^4A^2]$

Q.9 (4)

Newton's law of gravitation, $F \propto \frac{1}{r^2}$

Coulomb's law of electrostatics, $F \propto \frac{1}{r^2}$

From conservation of charge, total charge remains constant.

Q.10 (1)

According the conditions of coulomb forces, both the balls repel each other with a force

$$F_e = \frac{q_1 q_2}{4\pi\varepsilon_0 r}$$

Thus, forces F_e and mg are identical on both the balls, hence in static equilibrium $\theta_1 = \theta_2$.

Q.11 (4)

Field lines are perpendicular to conducting surface and field inside conductor is zero.

So option (4)

Q.12 (3)

Inside the sphere

$$E' = \frac{kQr}{R^3} = \frac{kQ \times 3\times10^{-2}}{(10\times10^{-2})^3}$$

Outside the sphere

$$E = \frac{kQ}{(20\times10^{-2})^2}$$

$$\Rightarrow E' = \frac{E\times(20\times10^{-2})^2\times3\times10^{-2}}{(10\times10^{-2})^3}$$

$$= \frac{100\times400\times3}{1000}$$

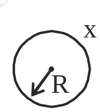
E' = 120 V/m

Q.13 (1)

Surface charge density, $\sigma = \frac{\text{Charge}}{\text{area}}$

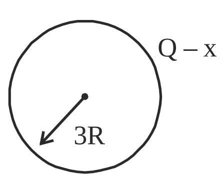
As $\sigma_1 = \sigma_2$

$$\frac{x}{4\pi R^2} = \frac{Q-x}{4\pi(3R)^2}$$



$$\Rightarrow \frac{x}{R^2} = \frac{Q-x}{9R^2}$$

$$\Rightarrow x = \frac{Q-x}{9}$$

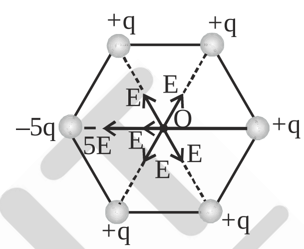


$\Rightarrow 9x = Q - x \Rightarrow 10x = Q$

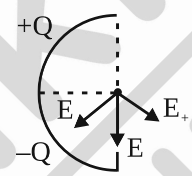
$$\Rightarrow x = \frac{Q}{10} = \text{Charge on smaller one}$$

Q.14 (4)

To obtained net field 6E at centre O, the charge to be placed at remaining sixth corner is –5q. (see following figure)



Q.15 (1)



Q.16 (1)

$$\because E = \frac{KQz}{\left(R^2+z^2\right)^{3/2}}$$

$$\therefore \frac{E_1}{E_2} = \frac{R}{\left(R^2+R^2\right)^{3/2}} \times \frac{\left(R^2+4R^2\right)^{3/2}}{2R} = \frac{5\sqrt{5}}{4\sqrt{2}}$$

Q.17 **(3)**

$$E_1 = \frac{KQ}{R^2}; E_2 = \frac{K(2Q)}{R^2};$$

$$E_3 = \frac{K(4Q)}{(2R)^3}\times R = \frac{KQ}{2R^2}$$

$E_2 > E_1 > E_3$

Q.18 **(4)**

In a hollow metalic cavity if no chage in side the cavity $\Rightarrow E_{in} = 0$

Q.19 **(2)**

$E = \frac{kQ}{R^2}$ where R = 2.5 m radius

Q.20 **(3)**

$mg = qE \quad m = \left(\rho.\frac{4}{3}\pi r^3\right)$

$$E = \frac{\rho \frac{4}{3}\pi r^3 g}{1.6 \times 10^{-19}}$$

Q.21 (4)

Let, net electric field is zero at point P. So at point P

$$|\vec{E}_1| = |\vec{E}_2|$$

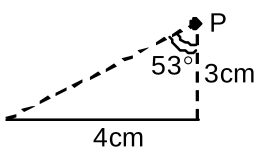
$$\Rightarrow \frac{k.4q}{x^2} = \frac{k \cdot 9q}{(r+x)^2}$$

$$\Rightarrow \frac{r+x}{x} = \frac{3}{2}$$

$\Rightarrow 2r + 2x = 3x$

$\Rightarrow x = 2r$

Q.22 (1)



$$E_x = \frac{k\lambda}{r}[\cos\theta_1 - \cos\theta_2]$$

Here $\theta_1 = 0$ and $\theta_2 = 53°$

$= 36 \times 10^5$ N/C

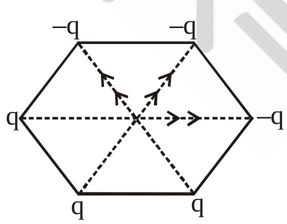
Q.23 (1)

Diverging electric line of force denote non-uniform electric field.

Q.24 (3)

Electric field at O due to each charge is $E = \frac{1}{4\pi\varepsilon_0}\frac{q}{(1)^2}$

So, net electric field (E_{net}) is



$$\Rightarrow E_{net} = 2\sqrt{E^2 + E^2 + 2E^2\cos 120°} + 2E$$

$$\Rightarrow E_{net} = 4E = \frac{q}{\pi\varepsilon_0}$$

Q.25 (3)

$v^2 = u^2 + 2as$

$$v^2 = 2\left[\frac{qE}{m}\right].y$$

Now $\quad KE = \frac{1}{2}mv^2 = qEy$

Q.26 (3)

Electric field inside the uniformly charged sphere varies linearly, $E = \frac{kQ}{R^3}.r, (r \le R)$, while outside the sphere, it varies as inverse square of distance, $E = \frac{kQ}{r^3}; (r \ge R)$ which is correctly represented in option (c).

Q.27 (4)

$F = E \times q$

$$a = \frac{Eq}{m} = \frac{2\times10^4 \times 1.6\times10^{-19}}{9.1\times10^{-31}}$$

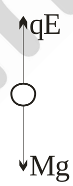
$= 3.5 \times 10^{15}$

$$s = ut + \frac{1}{2}at^2$$

$$\frac{1.5}{100} = \frac{1}{2} \times 3.5\times10^{15} \times t^2$$

$t = 2.9 \times 10^{-9}$ s

Q.28 (4)



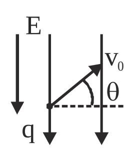
$qE = mg$

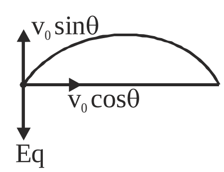
when polarity is reversed net downward force

$= mg + Eq = 2mg$

$$a' = \frac{2mg}{m} = 2g$$

Q.29 (4)





Path will be parabolic.

Q.30 (2)

(a) $E = \frac{2kp}{r^3}$

(b) $E = \frac{kp}{r^3}$

(c) $F = \frac{kq_1q_2}{r^2}$

(d) $E = \frac{kq}{r^2}$

Q.31 (2)

Flux associated with the sheet

$\phi = \vec{E}.\vec{A}$

$= |\vec{E}|.|\vec{A}|.\cos\phi$

$= 2.5 \times 400 \times 10^{-4} \times \cos 53°$

$= 6 \times 10^{-2}$ N m^2 C^{-1}

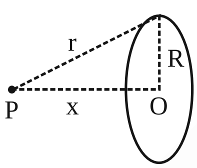
Q.32 (1)

$\frac{2K\lambda}{r} = \frac{\sigma}{\varepsilon_0}$ (x = 3m)

$\sigma = \frac{2\varepsilon_0\lambda}{4\pi\varepsilon_0 r}$

$\sigma = 0.424 \times 10^{-9} \frac{C}{m^2}$

Q.33 (3)



$E = \frac{kQx}{(R^2 + x^2)^{3/2}}$

$r^2 = R^2 + x^2$

$x^2 = r^2 - R^2$

Q.34 (1)

Field lines of q1 passes through surface of hemisphere one time.

Field lines of q_2 passes through surface of hemisphere two time so net flux due to q_2 is zero.

Net flux due to q1 is non zero.

Q.35 (3)

$\phi_{BCGF} = \phi_{\text{due to q}} + \phi_{\text{due to 3q}} + \phi_{\text{due to 2q}}$

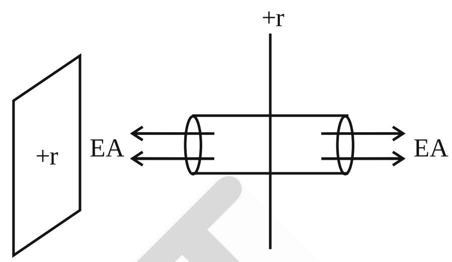
$\phi_{\text{due to q}} = \frac{q}{24\varepsilon_0}$

$\phi_{\text{due to 3q}} = \frac{3q}{24\varepsilon_0}$

$\phi_{\text{due to 2q}} = 0$

$\phi_{BCGF} = \frac{q}{24\varepsilon_0} + \frac{3q}{24\varepsilon_0} + 0 = \frac{4q}{24\varepsilon_0} = \frac{q}{6\varepsilon_0}$

Q.36 (1)



From Gauss law :

$2EA = \frac{\sigma A}{\epsilon_0} \Rightarrow E = \frac{\sigma}{2\epsilon_0}$

Q.37 (2)

$\text{Flux} = \frac{1}{6}\frac{q}{\epsilon_0} \times \frac{4\pi}{4\pi} = \frac{4\pi q}{6(4\pi t_0)}$

Q.38 **(3)**

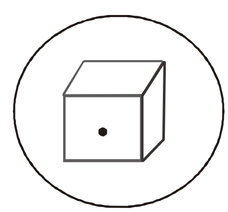
$Q_{\text{piramid}} = \frac{Q}{2\varepsilon_0}$

$Q_{\text{eachface}} = \frac{1}{4}.\frac{Q}{2\varepsilon_0} = \frac{Q}{8\varepsilon_0}$

Q.39 **(3)**

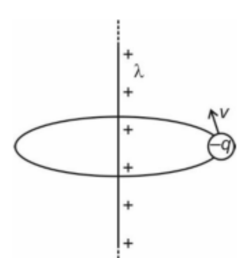
$q_{in} = \Sigma q =$ (1–7–4+10+2–5–3+6) μc

= (19–19) μ= 0



Net flux = 0

Q.40 (4)



$f_c = qE = \frac{mv^2}{r}$

$\frac{q.\lambda}{2\pi\varepsilon_0 r} = \frac{mv^2}{r}$

$$\Rightarrow v = \sqrt{\frac{q\lambda}{2\pi\varepsilon_0 m}}$$

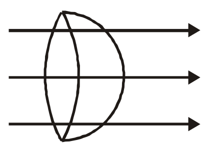
Q.41 (4)

Inward flux is taken as negative while outward flux is taken as positive.

$\Rightarrow$ total flux = $4 \times 10^3 - 8 \times 10^3 = -4 \times 10^{+3}$

$$\Rightarrow \frac{q_{in}}{\varepsilon_0} = -4 \times 10^{+3} \Rightarrow q_{in} = (-4\,\varepsilon_0 \times 10^3)C$$

Q.42 (3)



$\phi_{total} = 0$

$\phi_{circular} + \phi_{hemi} = 0$

$\phi_{hemi} = -\phi_{circular}$

$= -[EA\cos 180°] = -E(\pi R^2)(-1)$

$$\boxed{\phi_{hemi} = \pi R^2 E}$$

Q.43 (1)

Total charge inside gaussian surface A

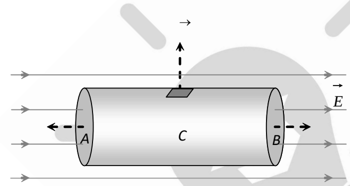
$= q_1 + a_2 + q_3 = (-14 + 78.85 - 56)\ \mu C$

$= 8.85\ \mu C$

$$\text{Flux, } \phi = \frac{q}{\epsilon_0} = \frac{8.85 \times 10^{-9}}{8.85 \times 10^{-12}} = 1000\ Nm^2/C$$

Q.44 (4)

Flux through surface A, $\phi_A = E \times \pi R^2$ and $\phi_B = -E \times \pi R^2$



Flux through curved surface C = $\int \vec{E}.\vec{ds} = \int Eds\cos 90° = 0$

$\therefore$ Total flux through cylinder = $\phi_A + \phi_B + \phi_C = 0$

Q.45 (1)

$$\varphi = \frac{q_{in}}{\varepsilon_0}$$

Now $\varphi' = \frac{q_{in}}{2\varepsilon_0} = \frac{\varphi}{2}$

Q.46 (3)

$$\phi = \int \vec{E}.\vec{ds} = \frac{q_{in}}{\epsilon_0} = \frac{q-q}{\epsilon_0}$$

$= 0$

Hence lines entering and coming out will be same.

Q.47 (2)

Flux through any Gaussian surface is

$$\oint \vec{E}_{net} \cdot d\vec{A} = \frac{q_{in}}{\epsilon_0}$$

The point where electric field to be calculated is on the Gaussian surface.

Q.48 (1)

$$\phi = \frac{q_{in}}{\varepsilon_0}$$

$q_{in} = 0 \quad \therefore \phi = 0$

Q.49 (1)

is same for all.

Q.50 **(4)**

• When there is no net charge resides inside any closed surface then only net electric flux linked with the surface is zero.

• Electric field due to an electric dipole is non uniform

TOPIC WISE TEST (NEET)

Subject : Physics **Topic :Electrostatics Potential and Capacitance**

ANSWER KEY

Q.1 (3)	**Q.2** (1)	**Q.3** (1)	**Q.4** (4)	**Q.5** (3)	**Q.6** (4)	**Q.7** (3)	**Q.8** (2)	**Q.9** (2)	**Q.10** (2)
Q.11 (4)	**Q.12** (2)	**Q.13** (1)	**Q.14** (4)	**Q.15** (3)	**Q.16** (2)	**Q.17** (3)	**Q.18** (3)	**Q.19** (2)	**Q.20** (3)
Q.21 (4)	**Q.22** (1)	**Q.23** (1)	**Q.24** (2)	**Q.25** (2)	**Q.26** (1)	**Q.27** (2)	**Q.28** (4)	**Q.29** (4)	**Q.30** (3)
Q.31 (2)	**Q.32** (1)	**Q.33** (3)	**Q.34** (2)	**Q.35** (3)	**Q.36** (4)	**Q.37** (2)	**Q.38** (4)	**Q.39** (2)	**Q.40** (2)
Q.41 (4)	**Q.42** (1)	**Q.43** (3)	**Q.44** (1)	**Q.45** (2)	**Q.46** (3)	**Q.47** (1)	**Q.48** (3)	**Q.49** (3)	**Q.50** (3))

Hints and Solutions

Q.1 (3)

$$V_0 = \frac{\lambda}{4\pi \in_0}\left(\frac{\pi}{3}\right) = \frac{\lambda}{12 \in_0}$$

Q.2 (1)

$W = Q(V_B - V_A)$

$\Rightarrow 15 = 0.01(V_B - V_A)$

$V_B - V_A = 1500\,V$

Q.3 (1)

$$\frac{Kq}{r} = 500 \Rightarrow r = \frac{Kq}{500} = \frac{9\times10^9\times3\times10^{-6}}{500}$$

$= 27\times2 = 54\,m$

$$\text{Electric field} = \frac{Kq}{r^2} = \frac{500}{r} = \frac{500}{27\times2} = \frac{250}{27}$$

$= 9.259$ (N/C)

Q.4 **(4)**

Q.5 (3)

Heat released = change in potential energy

$$= U_f - U_i = -\frac{PE}{2} - (-PE)$$

$$= \frac{PE}{2}$$

$$= \frac{10^{-26}\times10^{20}\times2\times10^6}{2} = 1\,J$$

Q.6 (4)

$$V = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$$

$$\Rightarrow 50 = 9\times10^9\times\frac{5\times10^{-9}}{r}$$

$\Rightarrow r = 0.9\,m = 90\,cm$

Q.7 (3)

$W_{ext} = q[V_f - V_i]$

$= (2\mu C)\{(-5V) - (+10V)\}$

$= -30\,\mu J$

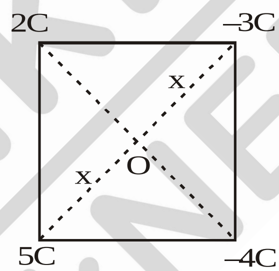
Q.8 (2)

$U = -PE\cos\theta$

Q.9 (2)

$W = qEx = 8\times10\times10\times10^{-2}$]

Q.10 **(2)**



$$V_O = \frac{k(2C)}{x} + \frac{k(-3C)}{x} + \frac{k(-4C)}{x} + \frac{k(5C)}{x}$$ or

V_O = zero, $E_O \neq 0$

Q.11 (4)

$$E_1 = \frac{90}{d}, E_2 = \frac{50}{d}, E_3 = \frac{100}{d}, E_4 = \frac{60}{d}$$

Q.12 **(2)**

$$V_A - V_B = -\vec{E}.\int_B^A d\vec{r} = -\vec{E}.[\vec{r}_A - \vec{r}_B]$$

$$= \vec{E}.(\vec{r}_B - \overrightarrow{rA}) = 50\sqrt{2}\left[\frac{\hat{i}+\hat{j}}{\sqrt{2}}\right].(-4\hat{i} - 2\hat{j})$$

$= -300$ volt

Q.13 (1)

$$E = -\frac{dV}{dr}$$

$$= -\left(\frac{0-\frac{5}{2}}{6-5}\right)$$

$= 2.5$ V/cm

Q.14 **(4)**

$$V = -\frac{dV}{dx} = -(4x)\hat{i}$$

$$V = -4(2) = -8\hat{i}$$

Q.15 **(3)**

Potential $(V) = 3x^2 + 5$

Intensity of the electric field $= -\frac{dV}{dx} = -6x$

$\therefore$ E at x = – 2 = 6 (–2) = – 12 Vm^{-1}

Q.16 (2)

Torque $\vec{\tau} = \vec{p} \times \vec{E} = pE\sin\theta$

or $4 = p \times 2 \times 10^5 \sin 30°$

or $p = \frac{4}{2\times10^5\times\sin 30°} = 4\times10^{-5}\,c-m$

Dipole moment, $p = q\ell$

$\therefore\ q = \frac{p}{\ell} = \frac{4\times10^{-5}}{0.02} = 2\times10^{-3}C = 2mC.$

Q.17 **(3)**

Q-same

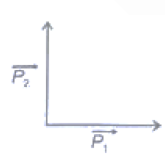
$$U' \propto \frac{1}{C}$$

$$C' = KC$$

$$U' = \frac{C}{C'}U_0 = \frac{U_0}{K}$$

Q.18 (3)

system can be looked upon as a combinatin of two different dipoles



So, $\vec{P}_{net} = \vec{P}_1 + \vec{P}_2$

$$\vec{P}_{net} = 2qr\hat{i} + qr\hat{j}$$

$$\left|\vec{P}_{net}\right| = \sqrt{5}qr$$

Q.19 (2)

$$E_{axis} = \frac{2kP}{r^3}$$

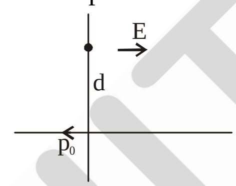
$$E_{eq.} = \frac{kP}{r^3}$$

Q.20 (3)

Q.21 (4)

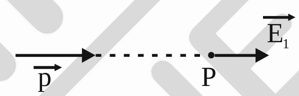
$V = 0$

$E = -\frac{K\vec{P}}{r^3}$

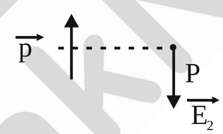


$$= -\frac{\vec{p}}{4\pi\varepsilon_0 d^3}$$

Q.22 (1)



Position(1)



Q.23 (1)

$U = -\vec{P}.\vec{E} = -PE\cos\theta$

At $\theta = \pi$

$U = -PE\cos\pi = -PE \times -1$

$= +PE$

Q.24 **(2)**

12×10^{-3} Nm

Maximum torque $= \tau = |\bar{P}\times\bar{E}| = PE\sin\theta$

$\tau_{max} = PE$

$= 0\times2\times10^{-6}\times10^{-2}\times2\times10^5$

$= 12\times10^{-3}$ Nm

Q.25 (2)

$U = -\vec{P}\cdot\vec{E}$

$= -PE\cos\theta$

$= -(10^{-29})(10^3)\cos 45^o$

$= -0.707\times10^{-26}$ J

$= -7\times10^{-27}$ J

Q.26 **(1)**

With change in shape of conductor its capacitance changes

$\therefore$ potential changes

as $V = \dfrac{Q}{C}$

Q.27 (2)

field just outside the conductor is

$E = \dfrac{\sigma}{\varepsilon_0}$ so

$E_A = E_B = \dfrac{\sigma}{\varepsilon_0}$

Q.28 (4)

Q.29 (4)

$Q = CV$

$C \to$ does not depend on Q and V

$Q\uparrow$ $V\uparrow$

Q.30 **(3)**

Potential same at both spheres $V_1 = V_2$

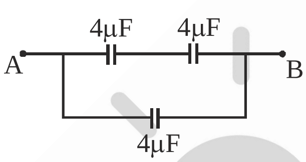
$$\therefore \frac{kQ_1}{R_1} = \frac{kQ_2}{R_2} \Rightarrow \frac{Q_1}{Q_2} = \frac{R_1}{R_2}$$

surface charge density $\sigma = \dfrac{Q}{4\pi R^2}$

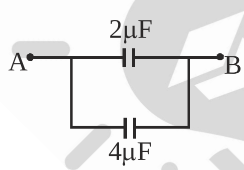
$$\therefore \frac{\sigma_1}{\sigma_2} = \frac{Q_1}{4\pi R^2} \times \frac{4\pi R_2^2}{Q_2} = \frac{Q_1}{Q_2} \times \left(\frac{R_2}{R_1}\right)^2 = \left(\frac{R_1}{R_2}\right)\left(\frac{R_2}{R_1}\right)^2$$

$$= \frac{R_2}{R_1} = \frac{20}{10} = \frac{2}{1}$$

Q.31 (2)



$\Rightarrow$



$C_{AB} = 2 + 4 = 6\mu F$

Q.32 (1)

C and C are in parallel and in series with 2C.

Therefore resultant of these three will be

$$= \frac{(C + C) \times 2C}{C + C + 2C} = C$$

This equivalent system is in parallel with C.

Its' equivalent capacitance = C + C = 2C

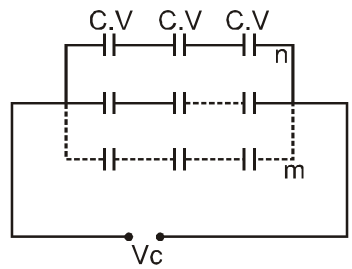
Now, 2C and 2C are in series and in parallel with 2C.

So, $C_{net} = C + 2C = 3C$

Q.33 (3)

$C = 1\ \mu F$, $C' = 3\mu F$

$V = 500\ V$, $V' = 2000\ V$



Suppose m rows of given capacitors are connected in parallel and each row now contains n capacitors then potential difference across each capacitor $V = \dfrac{V'}{n}$ and equivalent capacitance of network $C' = \dfrac{mC}{n}$ on putting values.

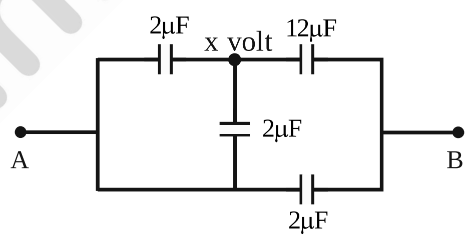
$\Rightarrow$ $V = \dfrac{V'}{n}$ $\Rightarrow$ $500 = \dfrac{2000}{n}$

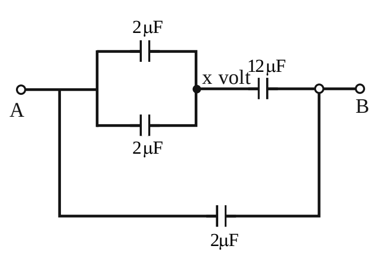
$n = 4$ $\Rightarrow$ $C' = \dfrac{mC}{n}$

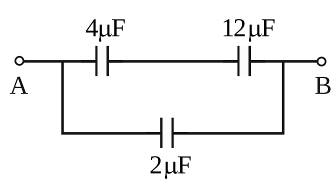
$3 = \dfrac{m \times 1}{4}$ $\Rightarrow$ $m = 12$

$\therefore$ total capacitors = m × n = 48

Q.34 (2)

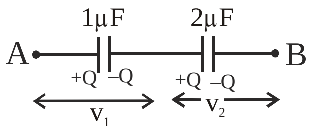






$\Rightarrow C_{AB} = 5\mu F$

Q.35 (3)



$(Q)_{1\mu F} = (Q)_{2\mu F}$

$1 \times v_1 = 2v_2$ ...(1)

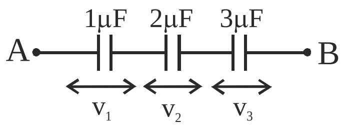
$v_1 + v_2 = 120$ ....(2)

From Eq (1) and (2)

$v_1 = 80$ volts

$v_2 = 40$ volts

Q.36 (4)



$v_1 + v_2 + v_3 = 11$ volts ...(1)

$1\,v_1 = 2v_2 = 3v_3$ ...(2)

from (1) and (2)

$$v_1 + \frac{v_1}{2} + \frac{v_1}{3} = 11\text{volts}$$

$$\frac{6v_1 + 3v_1 + 2v_1}{6} = 11\text{volts}$$

$$\boxed{v_1 = 6\text{volts}}$$

Q.37 **(2)**

By charge conservation

$Q_1 = Q_2 + Q_3$

Q.38 **(4)**

$(V_B - V_A) \times 2\mu + (V_B - V_A) \times 3\mu = 0$

$(V_B - 1000) \times 2 + (V_B - 0) \times 3 = 0$

$2V_B - 2000 + 3V_B = 0$

$5V_B = 2000$

$V_B = 400$ volt

Q.39 *(2)*

$$V_B - \frac{q}{2} - 12 - \frac{q}{4} + 24 = V_A$$

$$\frac{3q}{4} = 12$$

$q = 16\ \mu C$

$$V_B - \frac{16}{2} = V_A$$

$V_B - V_A = 8$ V

Q.40 (2)

$$U = \frac{Q^2}{2C};$$ in given case C increases so U will decrease

Q.41 (4)

$$\text{Area} = \frac{1}{2} QV = \text{Energy}$$

Q.42 **(1)**

$$Q = \frac{Q^2}{2C} = \frac{1}{2}CV^2$$

Assume the plates to be moved in isolated manner.

So Q = constant and $C' = \dfrac{C}{2}$

So $U_f = 2U_i$

$$W = \Delta U = 2U_i - U_i = \frac{1}{2}CV^2$$

Q.43 **(3)**

$$U = \frac{1}{2}CV^2$$

$\because$ when a dielectric is inserted then C↑ So U↑

Q.44 **(1)**

Energy stored = Energy density × volume

$$= \frac{1}{2}\epsilon_0 E^2 Ad$$

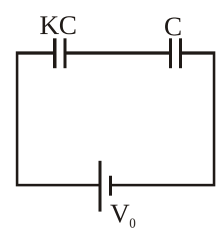
$$= \frac{1}{2}\epsilon_0 \left(\frac{q}{A\epsilon_0}\right)^2 Ad$$

$$= \frac{q^2 d}{2A\epsilon_0}$$

Q.45 **(2)**

potential divides in the inverse ratio of capacitance

$$V_1 = \frac{V_0 KC}{C + KC}$$



$$V_1 = \frac{V_0 K}{1 + K}$$

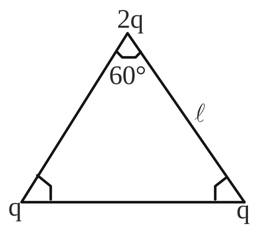
Q.46 (3)

Q.47 **(1)**

$$\frac{Q_1}{Q_2} = \frac{C_1 V}{C_2 V} = \frac{C_1 V}{KC_1 V} \quad (\because V = \text{const.})$$

$$K = \frac{Q_2}{Q_1} = \frac{100}{40} = 2.5$$

Q.48 (3)

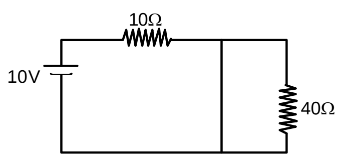


$P_R = 2P.\cos 30°$

$= \frac{2P\sqrt{3}}{2}$

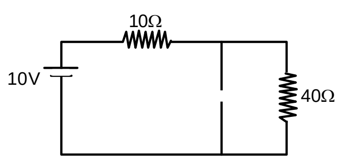
$= \sqrt{3}q\ell$

Q.49 (3)



$i = \frac{10}{10} = 1A$

at $t \to \infty$



$i = \frac{10}{50} = 0.2\,A$

Q.50 (3)

Heat produced in the resistance

H = Energy of the condenser $= \frac{1}{2}CV^2$

where, C = capacitance of the condenser

$= 2\mu F = 2 \times 10^{-6} F$

V = potential difference between the plates of the condenser = 500 V

$\therefore\ H = \frac{1}{2} \times 2 \times 10^{-6} \times (500)^2$

$= 1 \times 10^{-6} \times 25 \times 10^4$

$= 0.25\,J$

TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Current Electricity**

ANSWER KEY

Q.1 (1)	**Q.2** (4)	**Q.3** (2)	**Q.4** (2)	**Q.5** (4)	**Q.6** (4)	**Q.7** (2)	**Q.8** (3)	**Q.9** (1)	**Q.10** (2)
Q.11 (1)	**Q.12** (4)	**Q.13** (2)	**Q.14** (2)	Q.15 (3)	**Q.16** (3)	**Q.17** (2)	**Q.18** (4)	**Q.19** (2)	**Q.20** (4)
Q.21 (3)	**Q.22** (2)	**Q.23** (3)	**Q. 24** (4)	**Q.25** (4)	**Q.26** (4)	**Q.27** (3)	**Q.28** (3)	**Q.29** (4)	**Q.30** (3)
Q.31 (3)	**Q.32** (1)	**Q.33** (3)	**Q.34** (2)	**Q.35** (2)	**Q.36** (2)	**Q.37** (3)	**Q.38** (2)	**Q.39** (4)	**Q.40** (2)
Q.41 (2)	**Q.42** (2)	**Q.43** (1)	**Q.44** (2)	**Q.45** (4)	**Q.46** (4)	**Q.47** (2)	**Q.48** (2)	**Q.49** (3)	**Q.50** (4)

Hints and Solutions

Q.1 (1)

$J = \frac{I}{A}$ Here current is same through cross-section A and B

area at A < area at B

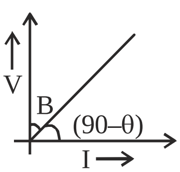
$J_A > J_B$

We know that $J = \sigma E$

$E_A > E_B$

Q.2 **(4)**

$R = \frac{V}{I} = \tan(90 - \theta)$



$R = \cot\theta$

Q.3 (2)

$\sigma_v = \frac{\theta}{V} = \frac{\theta}{iG}$

$\sigma_v = \frac{\sigma_i}{G}$

Q.4 **(2)**

$E = \rho J$

$\Rightarrow J = \frac{E}{\rho}$

Slope $= \frac{1}{\rho}$

As temperature increases and ρ also increases.

Slope at T_1 = Slope at T_2

$\left(\frac{1}{\rho_1}\right) > \frac{1}{\rho_2}$

$\Rightarrow \rho_1 < \rho_2$

$\Rightarrow T_1 < T_2$

Q.5 (4)

$Q = 2 \times 10^{-2}$ C, $\omega = 30$, $r = 0.40$ m

$T = \frac{2\pi}{\omega} = \frac{6.28}{30} = 0.209 = 2 \times 10^{-1}$

$I = \frac{2 \times 10^{-2}}{2 \times 10^{-1}} = 0.1A$

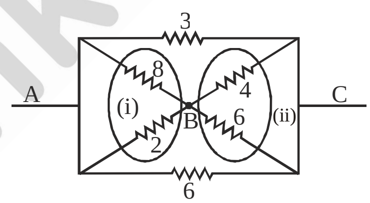
Q.6 (4)

$R = \frac{\rho \ell}{A}$,

ρ = specific resistance depends on material of wire

Q.7 (2)

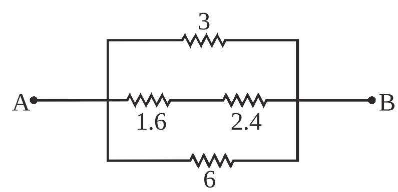
(a)



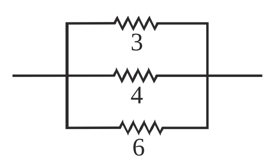
$R_i = \frac{16}{10} = 1.6$

$R_{ii} = \frac{24}{10} = 2.4$

(b)



(c)



$\frac{1}{R_{eq}} = \frac{1}{3} + \frac{1}{4} + \frac{1}{6} = \frac{3}{4}$

$R_{eq} = \frac{4}{3}$

Q.8 (3)

$\frac{R}{\ell} = 0.5\Omega m^{-1}$

Perimeter of circle = $2\pi R = 2\pi \times 1 = 2\pi$

Total R = $0.5 \times 2\pi = \pi\Omega$

Resistance of upper & lower semi circle = $\frac{\pi}{2}\Omega$

Resistance of diameter = 1 Ω

All three are in parallel, hence

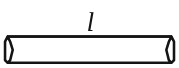
$$\frac{1}{R_{AB}} = \frac{1}{\pi/2} + \frac{1}{\pi/2} + 1$$

$$= \frac{2}{\pi} + \frac{2}{\pi} + 1$$

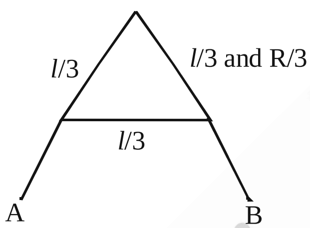
$$\Rightarrow \frac{1}{R_{AB}} = \frac{4+\pi}{\pi}$$

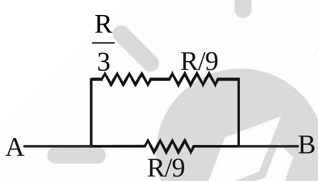
$$\boxed{R_{AB} = \frac{\pi}{4+\pi}\Omega}$$

Q.9 **(1)**



resistance R = 12 Ω





$$R_{AB} = \frac{\frac{2R}{3} \times R/3}{R} = \frac{2R}{9} = \frac{2}{9} \times 12 = \frac{8}{3}\ \Omega$$

Q.10 **(2)**

$$\Delta U = \frac{(\text{Stress})^2(\text{volume})}{2Y}$$

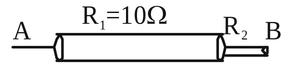
$$= \frac{\left(\frac{50}{10^{-4}}\right)^2 (10^{-4} \times 0.2)}{2 \times (1 \times 10^{11})}$$

$= 2.5 \times 10^{-5}$ J

Q.11 (1)

Two wires A and B

Ratio of area $\frac{a_1}{a_2} = \frac{3}{1}$



$$R = \rho \frac{l}{A}$$

$$\frac{R_1}{R_2} = \frac{A_2}{A_1} = \frac{1}{3}$$

$$\frac{10}{R_2} = \frac{1}{3}$$

$R_2 = 30$

$R_{AB} = 10 + 30 = 40\Omega$

Q.12 (4)

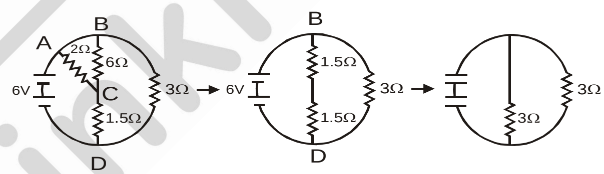
$V_A = IR$

$V_B = \left(\frac{2I}{3}\right) 1.5\,R = IR \quad V_C = \left(\frac{I}{3}\right) 3R = IR$

$\therefore \quad V_A = V_B = V_C$

Q.13 **[2]**

6Ω and 2Ω are in parallel combination

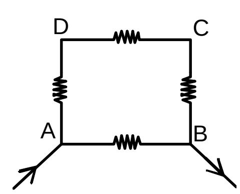


$$Req = \frac{3 \times 3}{3+3} = \frac{9}{6} = 1.5\ \Omega$$

$$I = \frac{V}{R} = \frac{6}{1.5} = 4A$$

Hence the correct answer will be (2).

Q.14 (2)



$$R_{eq} = \frac{3R \times R}{4R} = \frac{3R}{4}$$

$$i = \frac{V}{R_{eq}} = \frac{V}{3R/4} = \frac{4V}{3R}$$

Q.15 (3)

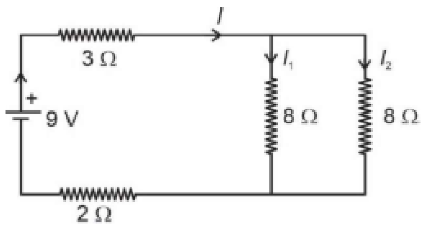
$V_{BC} = V_{BE} + V_{EC}$

$\Rightarrow 12 = (+10) + I_2 \times 2$

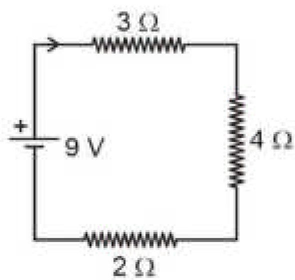
$\Rightarrow I_2 = 1$

So, $I_1 = 2 + 1 = 3A$

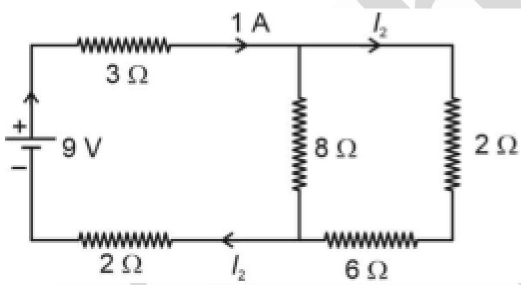
Q.16 (3)



Current from battery



$$I = \frac{9}{3+4+2} = 1A$$

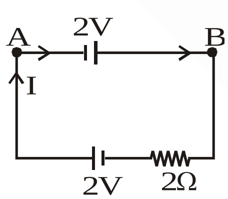


$$I_2 = \left(\frac{8}{3+8}\right) \times 1A$$

$= 0.5\,A$

Q.17 **(2)** Circuit can be redrawn as

Total emf $= 2 + 2 = 4V$



$$\text{so } I = \frac{4}{2} = 2A$$

Q.18 **(4)**

Q.19 **(2)** Kirchhoff 's first law is junction rule, according to which the algebraic sum of the currents into any junction is zero. The junction rule is based on conservation of electric charge. No charge can accumulate at a junction, so the total charge entering the junction per unit time must equal to charge leaving per unit time.

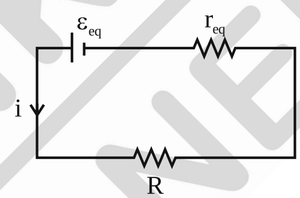
Kirchhoff's second law is loop rule according to which the algebraic sum of the potential difference in any loop including those associated emf's and those of resistive elements, must equal to zero.

This law is basically the law of conservation of energy.

Q.20 **(4)**

The branch ab containing the 3 Ω resistor is NOT a part of the closed circuit, If current flows in this branch then Kirchoff's first law will be violated. So no current flows through the 3 Ω resistr.

Q.21 (3)



$\varepsilon_{eq} = 5 \times 4 = 20$ V

$r_{eq} = 5 \times 0.4 = 2\,\Omega$

$$i = \frac{\varepsilon_{eq}}{R + r_{eq}} = \frac{20}{2+2} = 5A$$

Q.22 (2)

Let the internal resistance of cell be r, then

$$i = \frac{E}{R+r} \Rightarrow 15 = \frac{1.5}{0.04+r} \Rightarrow r = 0.06\Omega$$

Q.23 (3)

$$I = \frac{V}{R}$$

P.D. across 2Ω = 4 volt

$$I = \frac{4}{2} = 2\text{Amp.}$$

Q. 24 (4)

Applying junction law at O

$$\frac{(V_0 - 6)}{4} + \frac{(V_0 - 8)}{2} + \frac{(V_0 - 10)}{4} = 0$$

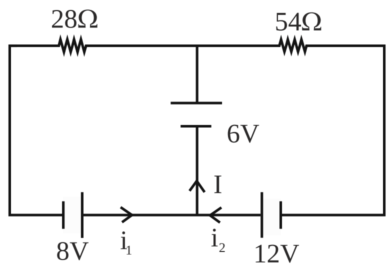
$\Rightarrow 2V_0 - 16 + 2V_0 - 16 = 0$

$\Rightarrow 4V_0 = 32$

$\Rightarrow V_0 = 8$ volt

$i_{2\Omega} = \frac{V_0 - 8}{2}$ = zero

Q.25 (4)

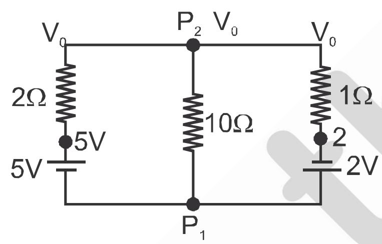


$28 i_1 = -6 - 8 \Rightarrow i_1 = -1/2$ A
$54 i_2 = -6 - 12 \Rightarrow i_2 = -1/3$ A
$I = i_1 + t_2 = -5/6$ A.

Q.26 **(4)**

Q.27 (3)

Let potential of P_1 is 0 V and potential of P_2 is V_0. Now, apply KCL at P_2.



$$\frac{V_0 - 5}{2} + \frac{V_0 - 0}{10} + \frac{V_0 - (-2)}{1} = 0$$

$$\Rightarrow V_0 = \frac{5}{16}$$

So, current through 10Ω resistor is $\frac{5/16}{10} = 0.03$ to P_2 to P_1.

Q.28 (3)

$$\frac{1}{r_{eq}} = \frac{1}{r_1} + \frac{1}{r_2} \text{ \& } E_{eq.} = \frac{\frac{E_1}{r_1} + \frac{E_2}{r_2}}{\frac{1}{r_1} + \frac{1}{r_2}}$$

Q.29 (4)

Q.30 **(3)**

According to Kirchoof's first law

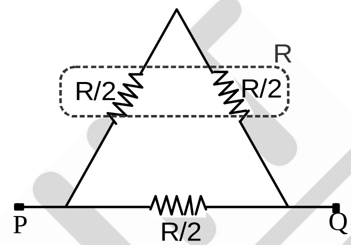
$I_1 + I_2 + I_3 = 0$

$$\frac{V_0 - 10}{10} + \frac{V_0 - 6}{20} + \frac{V_0 - 5}{30} = 0 \text{ or } V_0 = 8 \text{ volt}$$

Q.31 **[3]**

The potential difference between the point p and the earth (E_1) is 15 volt. there fore, the potential difference between p and E_2 is also 15 volt. As current through 5Ω resistance is 2 A, there fore potential difference between Q and E_2= 5 × 2 =10 V. Hence total potential difference between P and Q=5 volt

Q.32 (1)



$$R_{PQ} = \frac{R \times R/2}{R + R/2}$$

$$R_{PQ} = \frac{R}{3}$$

Q.33 (3)

$$R = \rho \frac{l}{A}$$

$$R = \rho \frac{l}{\pi \left(\frac{d}{2}\right)^2}$$

$$\frac{R_1}{R_2} = \frac{\rho_1}{\rho_2} \times \frac{l_1}{l_2} \times \frac{d_2^2}{d_1^2}$$

$$= \frac{1}{3} \times \frac{1}{3} \times \left(\frac{3}{1}\right)^2$$

$= 1$

$R_1 : R_2 = 1 : 1$

$R_1 = R_2 = 15\Omega$

Q.34 (2)

$$\frac{d_I}{d_A} = \frac{1}{R} = \tan\theta$$

$\theta_1 > \theta_2$

$\tan \theta_1 > \tan \theta_2$

$T_1 < T_2$

Q.35 (2)

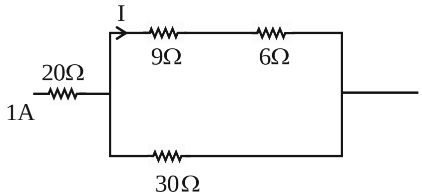
As voltmeter is ideal

∴ No current flows through 10Ω.

∴ Equivalent resistance in the ckt.

$$R = 20 + \frac{15 \times 30}{(15 + 30)} = 30\Omega.$$

$I = \frac{30}{30} = 1A$



Current through 9Ω.

$I = \left(\frac{30}{9+6+30}\right) \times 1$

$I = \frac{2}{3} A$

$\therefore P_9 = I^2 R$

$= \left(\frac{2}{3}\right)^2 \times 9 = 4W$

Q.36 (2)

According to joules law of heating.

$H_1 = \frac{V^2}{R} t \Rightarrow H_2 = \frac{V^2}{R/2} t$

$\therefore \frac{H_2}{H_1} = 2 \Rightarrow H_2 = 2H_1$

Q.37 **(3)**

Resistance of bulb = $\frac{V_{rated}^2}{P_{rated}}$

$\Rightarrow R = \frac{200 \times 200}{100} = 400\Omega$

For given voltage, $P = \frac{V_{supply}^2}{R}$

$\Rightarrow P = \frac{160 \times 160}{400} = 64W$

Q.38 (2)

$R = \frac{V^2}{P}$

$R \propto \frac{1}{P}$

$\frac{R_A}{R_B} = \frac{P_B}{P_A}$

$= \frac{100}{25} = \frac{4}{1}$

Q.39 (4)

All the bulbs are identical, here in bulb D, current is maximum so brightness of bulb D will be maximum.

D > C > A > B

Q.40 (2)

$P_1 = 25\,W, V_1 = 220\,V$

$P_2 = 100\,W, V_2 = 220\,V$

$I_1 = \frac{25}{220} = \frac{5}{44} A$

$I_2 = \frac{100}{220} = \frac{5}{11} A$

$R_1 = \frac{V_1^2}{P_1} = \frac{220 \times 220}{25} = 484 \times 4\Omega$

$R_2 = \frac{V_2^2}{P_2} = \frac{220 \times 220}{100} = 484\Omega$

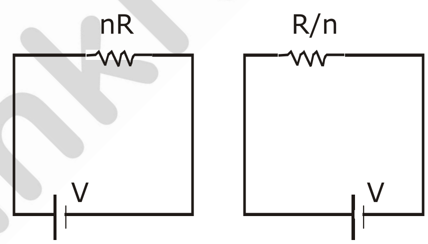
$R_{eq} = 484 \times 5$

$R_{eq} = 2420\Omega$

$I = \frac{440}{2420} = \frac{2}{11} A$

since $I > I_1$ Hence, bulb of 25 W will fuse.

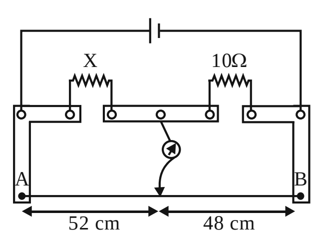
Q.41 (2)



$\frac{Heat_1}{Heat_2} = \frac{1}{n^2}$

Q.42 (2)

At Null point



$\frac{X}{\ell} = \frac{10}{\ell_2}$

Here $\ell_1 = 52 +$ End correction

$= 52 + 1 = 53$ cm

$\ell_2 = 48 +$ End correction $= 48 + 2 = 50$ cm

$\therefore \frac{X}{53} = \frac{10}{50}$

$\therefore \quad X = \frac{53}{5} = 10.6\Omega$

Q.43 (1)

$\frac{40}{60} = \frac{R}{S},$

$\frac{2}{3} = \frac{R}{S}$ ...(1)

$\frac{64}{36} = \frac{R(12+S)}{12S}$

$\frac{16}{9} = \frac{R(12+S)}{12S}$ ...(2)

(1)/(2)

$S = 20\Omega, R = \frac{40}{3}\Omega$

Q.44 (2)

$I_g = \frac{0.2}{20} = 0.01A$

Required shunt,

$S = \frac{I_g \times G}{I - I_g} = \frac{1.01 \times 20}{10 - 0.01} \simeq 0.02\Omega$

Q.45 (4)

Resistance of the device would be largest for the case of voltmeter.

$V = i_g(R + r_g)$

Device resistance is $R_x = R + r_g$

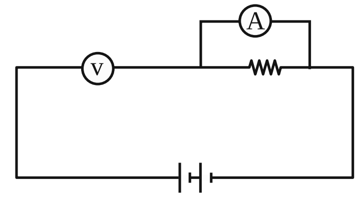
Given $I_g = 1 \times 10^{-3}$ mA

$V = i_g \times R_x = 1 \times 10^{-3} \times R_x$

$R_x = 1000$ A

Maximum value will correspond to voltmeter of reading 10V

Q.46 **(4)**



As voltmeter has very high resistance, therefore resistance of circuit will increase resulting into very small flow of current.

Q.47 (2)

For balanced wheatstone bridge

$$\frac{100}{400} = \frac{200R}{(200+R)\times 400}$$

Solving we get $\quad R = 200\Omega$

Q.48 (2)

Q.49 (3)

The bridge is balanced and the current in the part ADC is larges than in the part ABC. Also $I_3 = 0$

Q.50 **(4)**

$\frac{10}{\ell} = \frac{30}{(100-\ell)}$

$\ell = 25$

$\frac{30}{\ell^1} = \frac{10}{(100-\ell^1)}$

$\ell^1 = 75$

$\therefore \Delta \ell = \ell^1 - \ell = 50$ cm

TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Moving Charges and Magnetism**

ANSWER KEY

Q.1 (2)	**Q.2** (2)	**Q.3** (1)	**Q.4** (3)	**Q.5** (4)	**Q.6** (2)	**Q.7** (3)	**Q.8** (1)	**Q.9** (1)	**Q.10** (1)
Q.11 (1)	**Q.12** (1)	**Q.13** (2)	**Q.14** (3)	**Q.15** (4)	**Q.16 (1)**	**Q.17** (4)	**Q.18 (2)**	**Q.19** (2)	**Q.20 (2)**
Q.21 (4)	**Q.22** (3)	**Q.23 (3)**	**Q.24** (3)	**Q.25 (2)**	**Q.26** (1)	**Q.27** (1)	**Q.28** (4)	**Q.29 (2)**	**Q.30** (1)
Q.31 (3)	**Q.32** (4)	**Q.33 (3)**	**Q.34** (3)	**Q.35** (1)	**Q.36** *(3)*	**Q.37** (2)	**Q.38** (4)	**Q.39** (3)	**Q.40** (2)
Q.41 (2)	**Q.42** (4)	**Q.43** (1)	**Q.44** (3)	**Q.45** (1)	**Q.46** (4)	**Q.47** (4)	**Q.48** (2)	**Q.49** (3)	**Q.50** (3)

Hints and Solutions

Q.1 (2)

$B_{in} \propto r$

$B_{out} \propto \frac{1}{r}$

Q.2 (2)

$$B = \frac{\mu_0 I}{4\pi R} \times \theta$$

Here, $\theta = 2\pi - \frac{2\pi}{3} = \frac{4\pi}{3}$

Q.3 (1)

$B_{in} \propto r$

$B_{out} \propto \frac{1}{r}$

Q.4 (3)

Hint: $\vec{B}$ due to circular are, $B = \frac{\mu_0}{4\pi}\frac{I\theta}{R}$.

$B = B_1 + B_2 + B_3 + B_4$

$B_1 = \frac{\mu_0}{4\pi}\frac{I}{r_1} \otimes, B_4 = 0$

$B_2 = \frac{\mu_0}{4\pi}\frac{\pi I/2}{r_1} \otimes$

$B_3 = \frac{\mu_0}{4\pi}\frac{\pi I/2}{r_2} \odot$

$$B = \frac{\mu_0}{4\pi} I\left[\frac{\pi}{2r_2} - \frac{\pi}{2r_1} + \frac{1}{r_1}\right] \odot$$

Q.5 At any ponit

$B = \frac{\mu_0 I}{2\pi x}$ for $|x| > R$

$B = \frac{\mu_0 I x}{2\pi R^2}$ for $|x| > R$, and direction is given by Right hand thumb rule.

Magnetic filed inside conductor by Ampere `s circuital theorem

$$B = \left(\frac{\mu_0 I}{2\pi R^2}\right) x \text{ for } x \le R$$

$\therefore B \propto x$ graph will be straight line.

Outside the surface

$B = \frac{\mu_0 I}{2\pi x}$ $\therefore B \propto \frac{1}{x},$ graph will be rectangular hyperbola

Q.6 (2)

$$B = \frac{\mu_0}{4\pi}\frac{i}{a}\frac{\pi}{2} + \frac{i}{a} + \frac{\mu_0}{4\pi}\frac{i}{a}$$

Q.7 (3)

$$\frac{\mu_0 i_1}{4R} = \frac{\mu_0 i_2}{2\left(\frac{R}{2}\right)} \Rightarrow \frac{i_1}{i_2} = 4$$

Q.8 (1)

Gauss is C.G.S. unit of magnetic field.

Q.9 (1)

Magnetic field due to current carrying will at centre is [FT-10]

$$B = \frac{\mu_0 iN}{2R} = \frac{4\pi\times10^{-7}\times6\times50\times100}{2\times10}$$

$B = 2\pi \times 10^{-7} \times 25 \times 180 = 50\,\pi \times 10^{-5}$

$= 1.57 \times 10^{-3}$ T = 1.57 mT

Q.10 (1)

Current not depends on area of cross section of wire

So $I_A = I_B = I_C = I$

Q.11 (1)

From Ampere's circuital law

$$\oint \vec{B}\cdot\vec{dl} = \mu_o I_{inside}$$

Where I_{inside} = Current inside loop

Here, I_{inside} = 2A – IA = 1A

$\Rightarrow \oint \vec{B}\cdot d\vec{l} = \mu_o (1) = \mu_o$

Q.12 (1)

Q.13 (2)

Use $\oint \vec{B}\cdot \vec{dl} = \mu_0 I_{enclosed}$

Net current enclosed by path a is zero
Net current enclosed by path c is A
Net current enclosed by path d is 3 A
Net current enclosed by path b is 5 A

Q.14 (3)

It will move in helical path
Maximum separation = $2R_1 + 2R_2$

$= \frac{4mv}{qB}$

Q.15 (4)

Magnetic field due to the solenoid is along its length so $\theta = 0°$

$\phi = B.A.$
$= 200 \times 15 \times 10–4$
$= 0.3$ Wb

Q.16 **(1)**

$\oint \vec{B}d\vec{\ell} = \mu_0 \Sigma I$

Q.17 (4)

$B = \mu_0 ni$

$= 4\pi \times 10^{-7} \times \frac{1}{0.1\times10^{-3}} \times 1$

$= 4\pi \times 10^{-3}$ J

Q.18 **(2)** N = 200/cm, i = 2.5

$B = m_0 . ni$

$= 4\pi \times 10^{-7} \times \frac{200}{\frac{1}{100}} \times 2.5 = 6.28 \times 10^{-2}$ Wb/m^2

Q.19 (2)

Q.20 **(2)** $B = \mu_0 ni$

$\frac{B_2}{B_1} = \frac{n_2\ i_2}{n_1\ i_1} = \frac{100 \times (i/3)}{200 \times i}$

$B_2 = \frac{1}{6} \times 6{\cdot}28 \times 10^{-2} = 1{\cdot}05\ 10^{-2}$ Wb/m^2

Q.21 **(4)**

$T = \frac{2\pi m}{Bq} \quad \therefore\ a = \frac{T_1}{T_2} = 1$

$r = \frac{mv\sin\theta}{Bq} \quad \therefore\ b = \frac{r_1}{r_2} = \frac{\sin 30°}{\sin 60°} = \frac{1}{\sqrt{3}}$

p = (T) (v cos θ)

$\therefore\ c = \frac{p_1}{p_2} = \frac{\cos 30°}{\cos 60°} = \sqrt{3}$

Therefore a = bc

Q.22 (3)

As force is ⊥ to speed.

Q.23 **[3]**

$E_{K\alpha} = \frac{q_\alpha^2 r^2 B^2}{2m_\alpha}$

$\therefore\ E_K \propto \frac{q^2}{m}$

$\therefore\ \frac{E_{k_\alpha}}{E_{k_p}} = \frac{q_\alpha^2}{q_p^2} \times \frac{m_p}{m_\alpha}$

or $\frac{E_{k_\alpha}}{E_{k_p}} = \frac{4}{1} \times \frac{1}{4} = 1$

$E_{k_\alpha} = 8$eV

Q.24 (3)

Magentic force = $|q(\vec{V}\times\vec{B})| = q\ V\ B\sin\theta$
Force will be maximum if $\theta = 90°$
⇒ Velocity and magnetic field are perpendicular

Q.25 **[2]**

As magnetic field in directed vertically downwards, hence according to Fleming's left hand rule. the force on positive charge acts towards left and on negative charge towards right.
Hence particle P will be positive, Q will be netural and R will be negative.
Hence the correct answer will be (2)

Q.26 (1)

$R = \frac{mV}{qB}$, $q_{proton} = e$, $q_{\alpha\text{-particle}} = 2q = 2e$

$m_{porton} = m$, $m_{\alpha\text{-particle}} = 4m$

$\frac{R_1}{R_2} = \frac{m}{q}\left(\frac{2q}{4m}\right) = \frac{1}{2}$

Q.27 (1)

$r = \frac{\sqrt{2mq\Delta v}}{qB}$

$r \propto \sqrt{\frac{m}{2}}$

Q.28 (4)

Velocity changes but speed remains constant.

Q.29 **(2)**

For a charged particle to move in a circular path in a magnetic field, the magnetic force on charge particle provides the necessary centripetal force.

hence, magnetic force = centripetal force

i.e., $qvB = \frac{mv^2}{r}$

or $qvB = mr\omega^2 \quad (v = r\omega)$

or $\omega^2 = \frac{qvB}{mr} = \frac{q(r\omega)B}{mr}$

or $\omega = \frac{qB}{m}$

If n is the frequency of rotation, then

$\omega = 2\pi n \Rightarrow n = \frac{\omega}{2\pi} = \frac{qB}{2\pi m}$

Q.30 (1)

$\vec{F} = q(\vec{v} \times \vec{B})$

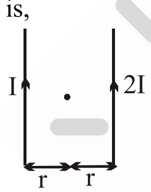
$1 \rightarrow$ +ve

$2 \rightarrow$ neutral

$3 \rightarrow$ –ve

Q.31 (3)

When two parallel wires are carrying current I and 2I in same direction, then magnetic field at the midpoint is,



$B = \frac{\mu_0 2I}{2\pi r} - \frac{\mu_0 I}{2\pi r} = \frac{\mu_0 I}{2\pi r}$

When current 2I is switched off the magnetic field due to wire carrying current I is :

$B' = \frac{\mu_0 I}{2\pi r} = B$

Q.32 (4)

$F = 12\hat{i} - 8\hat{j} = q(\vec{v} \times \vec{B})$

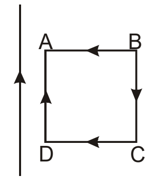
$= 2\hat{i} - 3\hat{j} \times B_0\hat{k}$

$= -2B_0\hat{j} = -3B_0\hat{i}$

$B_0 = 4T$

Q.33 **(3)**

There will be no force on the



loop due to horizontal current because forces acting on these wires will be equal and oppsite.

Futher $F_{AD} < F_{BC}$.F_{AD} is directed towards right hand side and F_{BC} towares left hand side (according to rigth hand rule).

Therefore the net force acting on loop will be away from wire.

Q.34 (3)

Given, $l_1 = l_2 = l = 9$ m,

$r = 0.15$ m, $i_1 = i_2 = i$

$F = 30 \times 10^{-7}$ N

Force exerted between two parallel current carrying wires

$F = \frac{\mu_0}{2\pi} \frac{i_1 i_2}{r} l$

$30 \times 10^{-7} = 2 \times 10^{-7} \frac{i \cdot i}{0.15} \times 9$

$i^2 = \frac{30 \times 0.15}{2 \times 9} = \frac{4.5}{18} = \frac{1}{4}$

$i = \sqrt{\frac{1}{4}} = \frac{1}{2} = 0.5A$

Q.35 (1)

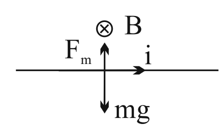
In case of electron beams; electrostatic force much stronger than magnetic force between them.

Q.36 *(3)*

For tension = 0

$mg = ilB$

$\Rightarrow \frac{10 \times 10}{1000} = \frac{i \times 60}{100} \times \frac{4}{10}$



$\Rightarrow i = \frac{10}{24} = \frac{5}{12} = 0.4157$ A ($\rightarrow$)

Q.37 (2)

Initially $F_1 = mg + IaB$ (downwards)

When direction of current is reversed then

$F_2 = mg - IaB$ (downwards)

$\Delta F = F_1 - F_2 = 2IaB$

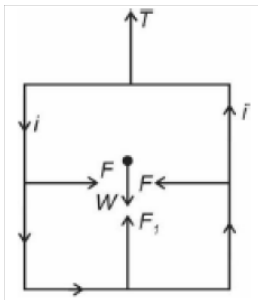
Q.38 (4)

$M = nIA = nI(\pi r^2) \Rightarrow M \propto r^2$

Q.39 (3)

FBD

When current is anti-clock wise



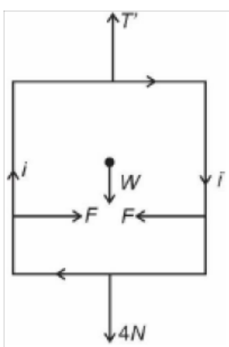
$$F_1 = i l B = 4 \times \frac{25}{100} \times 4 = 4\text{N(upwards)}$$

Thus $T + F_1 = W$

$T = W - 4$ ...(i)

For clock-wise current

FBD



$\Rightarrow T' = W + 4$ ...(ii)

Thus using (i) & (ii)

$T' - T = 8N$

$\therefore \quad \Delta T = 8N$

Q.40 (2)

$$T = \frac{\pi m}{qB}$$

$$\frac{T_p}{T_\alpha} = \left(\frac{m_p}{m_\alpha}\right)\left(\frac{q_\alpha}{q_p}\right) = \left(\frac{1}{4}\right)\left(\frac{2}{1}\right) = \frac{1}{2}$$

Q.41 (2)

$w = \mu B(\cos\theta_1 - \cos\theta_2)$

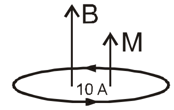
$= 2\mu B$

$= 2NIAB$

$= 2NI\pi R^2 B$

Q.42 (4)

Q.43 (1)



$\vec{\tau} = \vec{M} \times \vec{B} = 0$

Q.44 (3)

$U = -\vec{M} \cdot \vec{B}$

$\Rightarrow U = -Ni\vec{A} \cdot \vec{B}$

$\Rightarrow U = -12(15)(-0.008) = +1.44$ J

Q.45 (1)

$M = iA$

$= 1 \times \pi (1)^2$

$= \pi$

Q.46 (4)

For equilibrium,

Torque = zero

$\Rightarrow \vec{M} \times \vec{B} = 0$

$\Rightarrow MB\sin\theta = 0$

$\Rightarrow \sin\theta = 0$

$\Rightarrow \theta = 0$ and π

two orientation exist

At stable equillibrium, potential energy is minimum $U = -\vec{p}.\vec{E} = -pE$ (at $\theta = 0°$)

At unstable equilibrium, potential energy is maximum

$\Rightarrow U = -\vec{p}.\vec{E} = +pE$ (at $\theta = \pi$)

Q.47 (4)

From result,

$$\frac{\text{Magnetic moment}}{\text{Angular momentum}} = \frac{q}{2m}$$

$$\frac{\vec{\mu}}{\vec{L}} = \frac{q}{2m}$$

and $\vec{L} = \vec{r} \times \vec{p} = \vec{r} \times m\vec{v}$

$|\vec{L}| = mvr$

$$\Rightarrow |\vec{\mu}| = \mu = \frac{qvr}{2}$$

Q.48 (2)

$|\vec{\tau}| = |\vec{M} \times \vec{B}|$

$\tau = NI \times A \times B \times \sin 45°$

$\tau = 0.27$ Nm

Q.49 (3)

Here,

For small circular coil,

Number of turns, N =10, Area,

$A=1mm^2=1\times10^{-6}\ m^2$

Current, $I_1 = \frac{21}{44}A$

For a long solenoid,

Number of turns per meter, $n = 10^3$ per m

Current, $I_2 = 2.5$ A

Magnetic field due to a long solenoid on its axis is

$B = \mu_0 n I_2$ ....(i)

Magnetic moment of a circular coil is

$M = NAI_1$ ....(ii)

Torque, $\vec{\tau} = \vec{M}\times\vec{B}$

$\vec{\tau} = MB\sin\theta = MB\ (\because \theta = 90°(\text{Given}))$

$(\because \theta = 90°(\text{Given}))$ (Using (i) and (ii))

$\tau = 10\times1\times10^{-6}\times\frac{21}{44}\times4\times\frac{22}{7}\times10^{-7}\times10^{3}\times2.5$

$=1.5\times10^{-8}$ N m

Q.50 (3) Magnetic moment M = iA

$\therefore \frac{M_1}{M_2} = \left(\frac{i_1}{i_2}\right)\left(\frac{A_1}{A_2}\right) = \left(\frac{i_1}{i_2}\right)\left(\frac{\pi r_1^2}{\pi r_2^2}\right)$

Here, current is halved, so, $i_1 = 2i_2$

and radius is double so, $r_2 = 2r_1$

$\therefore \frac{4}{M^2} = \left(\frac{2i_2}{i_2}\right)\left(\frac{r_1}{2r_1}\right)^2$

$= 2\left(\frac{1}{2}\right)^2 = 2\times\frac{1}{4}$

$\frac{4}{M_2} = \frac{1}{2}$

$\therefore M_2 = 4\times2 = 8$ unit

TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Electromagnetic Induction**

ANSWER KEY

Q.1 (3)	**Q.2** (1)	**Q.3** (1)	**Q.4** (1)	**Q.5** (3)	**Q.6** (1)	**Q.7** (4)	**Q.8** (3)	**Q.9** (4)	**Q.10** (1)
Q.11 (2)	**Q.12** (1)	**Q.13** (3)	**Q.14** (4)	**Q.15** (1)	**Q.16** (2)	**Q.17** (4)	**Q.18** (2)	**Q.19** (4)	**Q.20** (4)
Q.21 (2)	**Q.22** (1)	**Q.23** (3)	**Q.24** (3)	**Q.25** (1)	**Q.26** (4)	**Q.27** (1)	**Q.28** (2)	**Q.29** (3)	**Q.30** (1)
Q.31 (1)	**Q.32** (4)	**Q.33** (1)	**Q.34** (1)	**Q.35** (3)	**Q.36** (2)	**Q.37** (2)	**Q.38** (2)	**Q.39** (2)	**Q.40** (2)
Q.41 (3)	**Q.42** (2)	**Q.43** (1)	**Q.44** (1)	**Q.45** (1)	**Q.46** (4)	**Q.47** (1)	**Q.48** (3)	**Q.49** (4)	**Q.50** (4)

Hint amd Solutions

Q.1 (3)

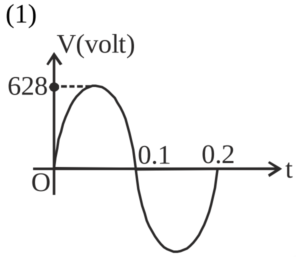
$\phi = 8t^2 + 2t + 20$

$\varepsilon = \dfrac{d\phi}{dt} = 16t + 2$

$\varepsilon_{t = 2\text{ sec}} = 16 \times 2 + 2 = 32 + 2 = 34.$

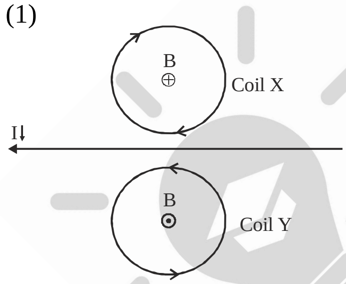
Q.2 (1)

Q.3 (1)

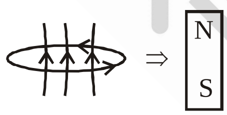


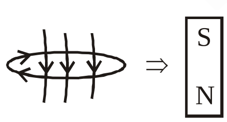
Average value of half cycle = $\dfrac{2E_0}{\pi} = \dfrac{2 \times 628}{3.14} = 400\text{V}$

Q.4 (1)



Q.5 (3)

A  $\Rightarrow$ N S $\Rightarrow$ both magnet repel each other.

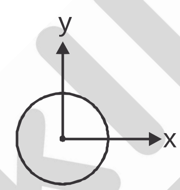
B  $\Rightarrow$ S N

current will induce in loop B such that oppose change in will A. And magnetic moment for coils can be taken as for bar magnet. Both magnets repel each other.

Q.6 (1)

Ba^2

Q.7 (4)



$\phi = BA \cos 90°$

$\phi = 0$

Total magnetic flux passing through whole of the X-Y plane will be zero,because magnetic lines from a closed loop. So as many lines will move in -Z direction same will return to + Z direction from the X-Y plane.

Q.8 (3)

Total change in flux = Total charge flown through the coil × resistance

$= \left(\dfrac{1}{2} \times 4 \times 0.1\right) \times \text{Resistance}$

= 0.2 × 10 = 2 Webers

Q.9 (4)

$\phi = BA \cos \theta$

$= 2.0 \times 0.5 \times \cos 60°$

$= 2.0 \times 0.5 \times \dfrac{1}{2} = 0.5 \text{ wb}$

Q.10 (1)

$i = \dfrac{e}{R} = \dfrac{A}{R} \cdot \dfrac{dB}{dt} = \dfrac{(1 \times 10^{-2})^2}{16} \times 20 \times 10^{-3}$

$= 1.25 \times 10^{-7}$ A (Anti - clockwise)

Q.11 (2)

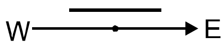
$V = B v \times \ell$

$= 2 \times 10–4 \times 720 \times \dfrac{5}{8} \times 50$

= 2 × 10–4 × 200 × 50 = 2 × 5 × 2 ×10–1

= 2 × 10 × 10–1 = 2 volt

Q.12 (1)



$\varepsilon_{ind} = Bv\ell$
$= 0.3 \times 10^{-4} \times 5 \times 20$
$= 3 \times 10^{-3}$ v $= 3$ mv.

Q.13 (3)
$\omega = 2\pi \times f = 60\pi$ rad/s
$V = V_0 \sin\omega t$
$V = NAB\omega \sin\omega t$
$V_{max} = NAB\omega$
$= 60 \times 200 \times 10^{-4} \times 0.5 \times 60\pi$
$= 6 \times 2 \times 0.5 \times 6\pi = 36\pi = 36 \times 3.14 = 113$ V

Q.14 (4)
l = 2m ,v = 1m/s , B = 0.5 wb/m^2
$v = Bvl = 2 \times 1 \times 0.5$
$= 1.0$ volt

Q.15 (1)
Induce emf $\propto$ Relative velocity
So more in (a)

Q.16 (2)
A $\rightarrow$ negatively charged
$\varepsilon = (\vec{v} \times \vec{B}).d\vec{l}$

Q.17 (4)
Motional emf induced in the semicircular ring PQR is equivalent to the motional emf induced in the imaginary conductor PR.
i.e., $\varepsilon_{PQR} = \varepsilon_{PR} = Bvl = Bv(2r)$ (as l = PR = 2r)
Therefore, potential difference developed across the ring is 2rBv with R is at higher potential.

Q.18 (2)
The induced emf in the coil is

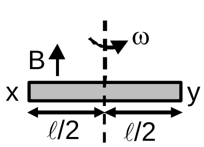
$$\varepsilon = -N\frac{d\phi}{dt} = -N\frac{d(BA)}{dt} = -NA\left(\frac{dB}{dt}\right)$$

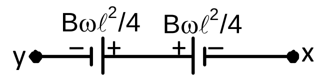
$$\varepsilon = -200 \times \left(10 \times 10^{-4}\right) \times \frac{(0-0.1)}{0.1} = 0.2\,V$$

Q.19 (4)
F = BId = ma

$a = \frac{BId}{m} \Rightarrow v = a \times t$

Q.20 (4)





$$v_x + \frac{B\omega\ell^2}{4} - \frac{B\omega\ell^2}{4} - v_y = 0 \Rightarrow v_x - v_y = 0$$

Q.21 **(2)**

$$\frac{V_S}{V_P} = \frac{I_P}{I_S}$$

$$\frac{24}{240} = \frac{0.7}{I_S}$$

$I_s = 7$ A

Q.22 (1)
EMF can be induced by moving a conductor in magnetic field and this is called motional emf. Changing magnetic field also leads to the change in magnetic flux and thus emf is induced.

Q.23 (3)
R = 5 Ω , i = 0.2A,

$$V = -\frac{d\phi}{dt} = i \times R = 5 \times 0.2 = 1\text{volt}$$

Rate of change of magnitic flow = 1volt = $1\,\frac{wb}{s}$

Q.24 (3)

Q.25 (1)
$N\phi = Li$

$$\phi = \frac{Li}{N} = \frac{8 \times 10^{-3} \times 5 \times 10^{-3}}{400} = 10^{-7}\text{ Wb} = \frac{\mu_0}{4\pi}\text{Wb}$$

Q.26 (4)
Mutual inductance is defiend for system or piar of coils. It is not defiend for an individual coil.
$\Rightarrow$ $M_{12} = M_{21}$
Also $\phi_{secondary} = M\, i_{primary}$
$\Rightarrow$ Mutual inductance can be increased by increasing ϕ
$\Rightarrow$ M can be increased by brining the coils closer.

Q.27 (1)

. $U_L = \frac{1}{2}Li^2$

For $(U_L)_{Max}$, i in the circuit will be maximum

$$i_{max} = \frac{\varepsilon}{R}$$

$$(U_L)_{Max} = \frac{1}{2}Li_{Max}^2 = \frac{L\varepsilon^2}{2R^2}$$

Q.28 (2)

$N_A = 300$ $N_B = 600$

$I_A = 3A$, $I_B = ?$

$\phi_A = 1.2 \times 10^{-4}$ wb $\qquad \phi_B = 9.0 \times 10^{-5}$ wb

$\because = \mu \times I_A = \phi_B$

$$M = \frac{\varphi_B}{I_A} = \frac{9.0 \times 10^{-5}}{3} = 3 \times 10^{-5} \text{ H}$$

Q.29 (3)

$$E = \frac{1}{2}Li^2 \quad \frac{dE}{dt} = \frac{1}{2}.2.Li\frac{di}{dt} = Li\frac{di}{dt}$$

$= 2 \times 2 \times 4 = 16$ J/sec.

Q.30 (1)

In parallel

Q.31 (1)

(a) Self-induction is a property of emf induced due to own change in current

(b) Mutual-induction is property of emf induced in primary coil if current in secondary coil is changed.

(c) S.I. unit of inductance is Henry.

(d) S.I. unit of magnetic flux is Weber.

Q.32 **(4)**

The number of turns N of the coil.

The area of cross-section A and length ℓ of the coil.

The permeability of the core of the coil.

Q.33 (1)

M = 0.5 H

$R_p = 20\Omega$, $R_s = 5\Omega$

$$\frac{M.di_p}{dt} = V_s = R_s \times i_s$$

$$0.5 \times \frac{di_p}{dt} = 0.4 \times 5$$

$$.5\frac{di_p}{dt} = 5 \times 0.4 \quad = \frac{di_p}{dt} = 4 \text{ A/s}$$

Q.34 (1)

An inductor always stores magnetic field energy in the form of magnetic field lines , $E = \frac{Li^2}{2}$

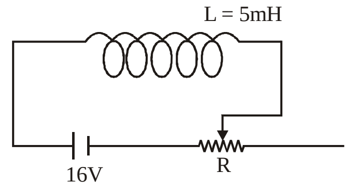
Q.35 (3)

$$\varepsilon_2 = -M\frac{di,}{dt}$$

$$= -4\frac{(0-5)}{10^{-3}} = 2 \times 10^4 \text{ V.}$$

Q.36 (2)

As Resistance, R is increasing, So, steady state current is decreasing $\Rightarrow$ i, current is decreasing.



Applying kirchoff's law

$$+E - \frac{L\,di}{dt} - iR = 0 \Rightarrow 16 + \left|\frac{L\,di}{dt}\right| = iR = 8\,i$$

$$\Rightarrow i = \frac{16 + \left|\frac{L\,di}{dt}\right|}{8} = \text{greater than 2A.}$$

Q.37 (2)

Q.38 (2)

$$\text{As } \varepsilon = -L\frac{dI}{dt} \quad \therefore \quad 5 = -\frac{L(2-3)}{1 \times 10^{-3}}$$

$L = 5 \times 10^{-3}$ H = 5 mH

Q.39 (2)

$$e = -\frac{LdI}{dt} \quad \Rightarrow \quad L = -\frac{e}{(dI/dt)}$$

$$L = -\frac{8}{(2/0.05)} = -0.2\text{H}$$

= 0.2 H (only positive value)

Q.40 (2)

Time constants :

$$\lambda_{L_1} < \lambda_{L_2} \quad \frac{L_1}{R_1} < \frac{L_2}{R_2} \qquad (R_1 = R_2)$$

$L_1 < L_2$

Q.41 (3)

Q.42 (2)

$$I = \frac{20}{5}$$

$I = 4$A

$$U = \frac{1}{2}LI^2 = \frac{1}{2} \times 2 \times (4)^2 = 16 \text{ J}$$

Q.43 (1)

$I = I_0 e^{-t/z}$

$$I_0 = \frac{E}{R} = \frac{100}{100} = 1\text{A}$$

$$\tau = \frac{L}{R} = \frac{100 \times 10^{-3}}{100} = 1\text{ ms}$$

$$I = I.e^{-1} = \frac{1}{e}\text{ A}$$

Q.44 (1)

$$\frac{1}{2}CV^2 = \frac{1}{2}Li^2$$

$$\frac{1}{2} \times 4 \times 10^{-6} \times C^2 = \frac{1}{2} \times 2 \times (2)^2$$

$\Rightarrow C^2 = 2 \times 10^6 \Rightarrow C = \sqrt{2} \times 10^3$V

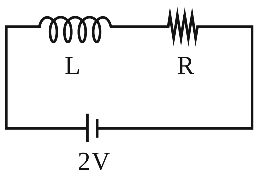
Order is 10^3 V

Q.45 (1)

Current in the circuit will be zero rate of charge of current will be maximum therefore emf induced will be not zero.

Q.46 (4)

L = 40 H, R = 8 Ω

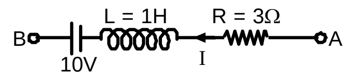


time constant

$$\tau = \frac{L}{R} = \frac{40}{8}$$

τ = 5 sec

Q.47 (1)



$$V_A - 3\,(10t + 5) - 1\,\frac{d(10t+5)}{dt} + 10 - V_B = 0$$

at t = 0

$V_A - 3 \times 5 - 10 + 10 - V_B = 0$

$V_A - V_B = 15$ V

Q.48 (3)

Q.49 (4)

$W = \frac{1}{2}LI^2$ (Lesa Energy stored)

$= \frac{1}{2} \times 5 \times (10)^2 = 250$ J

Q.50 (4)

TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Alternating Current**

ANSWER KEY

Q.1 (3)	**Q.2** (4)	**Q.3** **(3)**	**Q.4** (4)	**Q.5** (2)	**Q.6** (2)	**Q.7** (1)	**Q.8** (2)	**Q.9** (4)	**Q.10** (1)
Q.11 (3)	**Q.12** (4)	**Q.13** (1)	**Q.14** (4)	**Q.15** (2)	**Q.16** (4)	**Q. 17** (2)	**Q.18** (4)	**Q.19** (1)	**Q.20** (4)
Q.21 (1)	**Q.22** (4)	**Q.23** (2)	**Q.24** (3)	**Q.25** (1)	**Q.26** (2)	**Q.27** (2)	**Q.28** (1)	**Q.29** (3)	**Q.30** (3)
Q.31 (4)	**Q.32** (1)	**Q.33** (1)	**Q.34** (4)	**Q.35** (2)	**Q.36** (2)	**Q.37** (3)	**Q.38** (2)	**Q.39** (2)	**Q.40** (2)
Q.41 (1)	**Q.42** (1)	**Q.43** (2)	**Q.44** (4)	**Q.45** (2)	**Q.46** (3)	**Q.47** (4)	**Q.48** (2)	**Q.49** (4)	**Q.50** (3)

Hints and solutions

Q.1 (3) $q = \frac{\Delta\phi}{R} = \frac{B(\pi r^2) - 0}{R} \propto r^2$

Q.2 (4) $(I_0)_R = 2I_0 \cos\frac{\theta}{2}$

$= 2 \times 4 \times \cos\frac{\pi}{3} \left[\theta = \frac{2\pi}{3}\right]$

$= 4$

Q.3 (3)

Q.4 (4) $\left[\frac{L}{R}\right]$ = [Time] $\Rightarrow \left[\frac{R}{L}\right] = [M^0L^0T^{-1}] = [T^{-1}]$

Q.5 (2) At t = 0

$I = 4 \times \frac{1}{2} = 2A$

Q.6 (2) $i = 4\cos(\omega t + \phi)$

$i_{rms} = \frac{4}{\sqrt{2}}A = 2\sqrt{2}A$

Q.7 (1) $I_{rms} = \frac{I_0}{\sqrt{2}} = \frac{6}{\sqrt{2}} = 3\sqrt{2}$ amp

Q.8 (2) $i_{av} = \frac{\int_0^2 i\,dt}{\int_0^2 dt} = \frac{\int_0^2 kt\,dt}{\int_0^2 dt} = \frac{k\left[\frac{t^2}{2}\right]_0^2}{[t]_0^2}$

$= \frac{k\left(\frac{2^2 - 0^2}{2}\right)}{(2-0)} = k$

Q.9 (4) $\phi = \omega t$

$t = \frac{\pi}{3 \times 120\pi} = \frac{1}{360}$ sec.

Q.10 (1) $i = i_0 \sin\omega t$

$= \sqrt{2}i_{rms} \sin\omega t$

$= \sqrt{2} \times 3 \times \sin\left(2\pi \times 50 \times \frac{1}{600}\right)$

$= 3\sqrt{2}\sin\frac{\pi}{6}$

$= 3\sqrt{2} \times \frac{1}{2} = \frac{3}{\sqrt{2}}A$

Q.11 (3) Power factor

$\cos\phi = \frac{R}{\sqrt{R^2 + \omega^2L^2}}$

$= \frac{30}{\sqrt{(30)^2 + (100)^2 \times (400 \times 10^{-3})^2}}$

$= \frac{30}{\sqrt{900 + 1600}} = \frac{30}{50} = 0.6$

Q.12 (4) Wattless power = V I sinϕ ,

Wattless power $= \frac{100}{\sqrt{2}} \times \frac{100}{\sqrt{2}} \times \sin\frac{\pi}{6}$ $\begin{cases} V = \frac{100}{\sqrt{2}}V \\ I = \frac{100}{\sqrt{2}}A \\ \phi = \frac{\pi}{6} \end{cases}$

$= 2.5 \times 10^3$ Watt

Q.13 (1) On comparing $V = 200\sqrt{2}\sin(100t)$ with

$V = V_0 \sin\omega t$, we get $V_0 = 200\sqrt{2}$ V, $\omega = 100$ rad/s

$$\therefore V_{rms} = \frac{V_0}{\sqrt{2}} = \frac{200\sqrt{2}V}{\sqrt{2}} = 200\,V$$

The capacitive reactance is

$$X_C = \frac{1}{\omega C} = \frac{1}{100\times1\times10^{-6}} = 10^4\Omega$$

ac ammeter reads the rms value of current. Therefore, the reading of the ammeter is

$$I_{rms} = \frac{V_{rms}}{X_C} = \frac{200\,V}{10^4\Omega} = 20\times10^{-3}\,A = 20\,mA$$

The average power consumed in the circuit,

$P = I_{rms} V_{rms} \cos\phi$

In an pure capacitive circuit, the phase difference between current and voltage is $\frac{\pi}{2}$.

$\therefore \cos\phi = 0$

$\therefore P = 0$

Q.14 (4)

Q.15 (2) $P = \frac{v^2}{z^2}R = \frac{v^2R}{\left(\sqrt{R^2+\omega^2L^2}\right)^2}$

$$P = \frac{V^2R}{R^2+\omega^2L^2}$$

Q.16 (4) $I_{RMS} = 10A$; $V_{RMS} = 25V$

so, Power $= I_{RMS} V_{RMS} \cos\phi$

$\Rightarrow$ Power $= 10 + 25 \times \cos\phi$

$\Rightarrow$ Power $= 250 \cos\phi$

$\Rightarrow$ Power $= 250 \cos\phi$

as $\cos\phi \le 1$

$\Rightarrow$ Power ≤ 250 W

Q. 17 (2)

Q.18 (4) Power, $P = \frac{V_0 I_0}{2}\cos\frac{\pi}{2} = 0$

Q.19 (1) $P_{av} = V_{rms} I_{rms}$

$$= \frac{5}{\sqrt{2}}\times\frac{2}{\sqrt{2}} = \frac{10}{2}$$

$P_{av} = 5W$

Q.20 (4) Sol. $i = 5\sin(100t - \frac{\pi}{2})$

$v = 200\sin(100t)$

$P = v_{rms} I_{rms} \cos\phi$

$$P = \frac{200}{\sqrt{2}}.\frac{5}{\sqrt{2}}\cos\pi/2 = 0$$

Q.21 (1) $\tan\phi = \left(\frac{X_L}{R}\right)$

$X_L = \omega L = (2\pi\upsilon L) = (2\pi)(50)(0.01) = \pi\ \Omega$

Also, $R = 1\Omega$

$\therefore \phi = \tan^{-1}(\pi)$

Q.22 (4) Current $I = \frac{E}{Z}$

Where $E = \sqrt{V^2_R + (V_L - V_C)^2}$

and $Z = \sqrt{R^2 + (X_L - X_C)^2}$

At resonance, $X_L = X_C$,

At resonance, $V_L = V_C$,

$\therefore I = \frac{V_R}{R} = \frac{100}{1\times10^3} = 100$ A

Voltage across inductance is V_L

$\therefore V_L = V_C = I \times X_C = \frac{1}{\omega C}$

$= \frac{100}{200\times2\times10^{-6}} = 25\times10^4$ volt

Q.23 (2) $I = \frac{V}{Z}$

$$11 = \frac{220}{\sqrt{(X_L - X_C)^2 + (20)^2}}$$

Solving

$X_L = X_C \Rightarrow V_L = V_C$

$V_L = 200$ V

Q.24 (3)

Q.25 (1)

$x_L = \omega_L = 2\pi fL$

$20 = 2\pi(50)L$ ....(1)

$x'_L = 2\pi[50\times2]L$

$x'_L = 40\Omega$ [from eq. (1)]

$z = \sqrt{(x'_L)^2 + R^2}$

$z = \sqrt{(40)+(30)^2} = 50\ \Omega$

Current flowing in the coil is

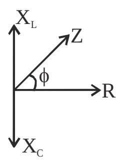
$$I = \frac{200}{Z} = \frac{200}{50} = 4A$$

Q.26 (2)

Q.27 (2)

$$Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{R^2 + \left(X_L - \left(\frac{X_L}{2}\right)\right)^2}$$

$$= \sqrt{R^2 + \frac{X_L^2}{4}}$$



$$\tan p = \frac{X_L - X_C}{R} = \frac{X_L - \frac{X_L}{2}}{2} = \frac{1}{2}$$

$\Rightarrow \phi$ phase difference = $\tan^{-1}\left(\frac{1}{2}\right)$

Q.28 (1) $V_S = \sqrt{V_R^2 + V_L^2}$

$V_S = \sqrt{(70)^2 + (20)^2}$ $V_S = \sqrt{5300}$

$V_S = 72.8$ V

Q.29 (3) The reciprocal of impedance is admittance.

Q.30 (3) $V = \sqrt{V_R^2 + (V_L - V_C)^2}$

$$250 = \sqrt{V_3^2 + (V_1 - V_2)^2}$$

$$250^2 = V_3^2 + (300 - 150)^2$$

$$V_3^2 = 250^2 - (150)^2$$

$$V_3 = \sqrt{(250 + 150)(250 - 150)}$$

$$= \sqrt{400 \times 100} = 200 \text{ V}$$

Q.31 (4) $V_{LB} = \sqrt{V_L^2 + V_R^2}$

$$\sqrt{(50)^2 + (50)^2}$$

$$= 50\sqrt{2}$$

Q.32 (1) $R = \frac{100}{1} = 100\ \Omega$

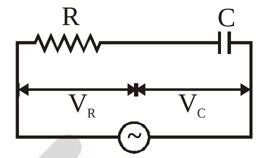
$$Z = \frac{100}{0.5} = 200\ \Omega$$

$X_L^2 + R^2 = (200)^2$

$\omega^2 L^2 + R^2 = 40000$

$$L = \sqrt{\frac{40000 - 10000}{(314)^2}} = \frac{173.2}{314} = 0.55 \text{ H}$$

Q.33 (1) Let the applied voltage be V volt.

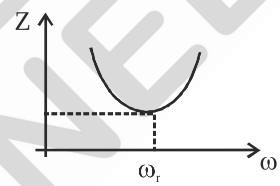


Here, $V_R = 12$ V, $V_C = 5$ V

$$\therefore \quad V = \sqrt{V_R^2 + V_C^2} = \sqrt{(12)^2 + (5)^2}$$

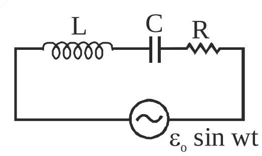
$$= \sqrt{144 + 25} = \sqrt{169} = 13\text{V}$$

Q.34 (4) $Z = \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$



From graph, Z decreases first,
becomes minimum and then increases.

Q.35 (2) For any L < R circuit
power = V_{rms} Irms cos ϕ



and $\cos\phi = \frac{R}{Z}$

where R = Resistance
Z = impedance

and $Z = \sqrt{R^2 + \left(wL - \frac{1}{wC}\right)^2}$

$\Rightarrow$ Power will be maximum for $\cos\phi = 1$

$$\Rightarrow Z = R \Rightarrow \omega L - \frac{1}{wc} = 0$$

$$\Rightarrow \quad wL = \frac{1}{wc}$$

Above condition is called resonance condition.

Q.36 (2) $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$ or $L = (QR)^2C$

$\therefore L = (0.4 \times 2 \times 10^3)^2 \times 0.1 \times 10^{-6} = 0.064$ H

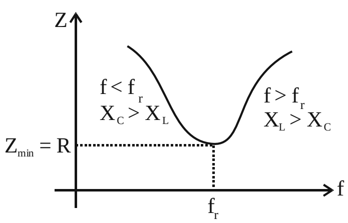
Q.37 (3)

Q.38 (2)

Q.39 (2) $f = \frac{1}{2\pi\sqrt{LC}}$

voltage on capacitor is more than that os supply voltage because the phase difference between V_L an V_C is 180º (i.e. out of phae)

Q.40 (2)



If $f > f_r$, $X_L > X_C$
⇒ inductive circuit
⇒ voltage leads current
If $f < f_r$ ⇒ $X_L < X_C$
⇒ capacitve circuit
⇒ current leads voltage

Q.41 (1)

Q.42 (1) For maximum average power
$X_L = X_C$

$250\pi = \frac{1}{2\pi(50)C}$

$C = 4 \times 10^{-6}$
Option (1)

Q.43 (2) $\frac{N_1}{N_2} = \frac{V_1}{V_2} = \frac{200}{5} = \frac{40}{1}$

Q.44 (4) $\frac{V_2}{V_1} = \frac{N_2}{N_1} = \frac{8}{1}$

$V_2 = 8 \times 120 = 960$ volt

$I = \frac{960}{10^4} = 96$ mA.

Q.45 (2) Efficiency of transformer is given by

$$\eta = \frac{\text{Output power}}{\text{Input power}} = \frac{E_sI_s}{E_pI_p}$$

Here, $P_{output} = 8$ kW, $\eta = 90\%$

$$P_{input} = \frac{8 \times 100}{90} = \frac{80}{9}\text{kW} = 8.89\text{kW}$$

Q.46 (3)
As losses occured in transformer are neglected
⇒ whatever energy is given as input, same is taken as out put.
⇒ Input energy = output energy
⇒ Input power = output power

Q.47 (4)
Potential difference per turn of primary and secondary coil are same and

$= \frac{80}{1000} = 0.08$ volt
∴ (4)

Q.48 **(2)**

Q.49 (4)
Induced emf in primary coil

$E_p = \frac{d\phi}{dt} = \frac{d}{dt}(40 + 8t) = 8\text{volt}$

Induced emf in secondary coil

$\frac{E_s}{E_p} = \frac{N_s}{N_p} \Rightarrow \frac{E_s}{8} = \frac{1500}{150} \Rightarrow E_s = 80\text{volt}$

Q.50 (3)

$P_{out\ put} = \frac{90}{100} P_{input}$

$900 = \frac{9}{10} \times 3300 \times I_P$

$I_P = \left(\frac{100}{330}\right) = \frac{10}{33}$ A

TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Ray Optics and Optical Instruments**

ANSWER KEY

Q.1 (2)	**Q.2** (1)	**Q.3** (2)	**Q.4** (4)	**Q.5** (1)	**Q.6** (1)	**Q.7** (2)	**Q.8** (3)	**Q.9** (1)	**Q.10** (3)
Q.11 (1)	**Q.12** (1)	**Q.13** (2)	**Q.14** (4)	**Q.15** (1)	**Q.16** (3)	**Q.17** (1)	**Q.18** (1)	**Q.19** (2)	**Q.20** (4)
Q.21 (3)	**Q.22** (3)	**Q.23** (3)	**Q.24** (4)	**Q.25** (2)	**Q.26** (1)	**Q.27** (3)	**Q.28** (2)	**Q.29** (1)	**Q.30** (2)
Q.31 (2)	**Q.32** (1)	**Q.33** (1)	**Q.34** (2)	**Q.35** (4)	**Q.36** (2)	**Q.37** (1)	**Q.38** (1)	**Q.39** (3)	**Q.40** (1)
Q.41 (1)	**Q.42** (2)	**Q.43** (4)	**Q.44** (2)	**Q.45** (1)	**Q.46** (1)	**Q.47** (3)	**Q.48** (2)	**Q.49** (2)	**Q.50** (2)

Hints and Solutions

Q.1 (2)

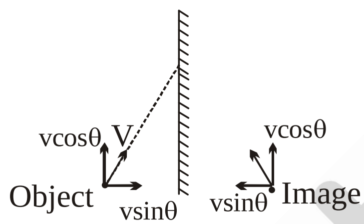
When $\theta = 90°$

then $\frac{360}{\theta} = \frac{360}{90} = 4$ is an even number.

The number of images formed is given by

$$n = \frac{360}{\theta} - 1 = \frac{360}{90} - 1 = 4 - 1 = 3$$

Q.2 (1)



Q.3 (2)

As parallel rays gets converge after reflection from a mirror, hence mirror is converging mirror.

Q.4 (4)

As shown in the ray diagram the final reflected ray is parallel to the original ray.

Q.5 (1)

Height of man = 180 cm

$\therefore$ Min. length of plane mirror for him to see his full length image = $\frac{h}{2}$ = 90 cm

Q.6 (1)

u = –4f, O =6cm, I = ?

By mirror formula $\frac{1}{-f} = \frac{1}{v} + \frac{1}{-4f} \Rightarrow v = -\frac{4}{3}f$

Also

$$\frac{I}{O} = -\frac{v}{u} \Rightarrow \frac{I}{(+6)} = -\frac{\left(\frac{-4}{3}f\right)}{(-4f)} \Rightarrow I = -2\text{cm}$$

Q.7 (2)

Given u = – 15 cm, f = – 10 cm, O = 1 cm

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}, \frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-10} - \frac{1}{-15}$$

$\therefore$ v = – 30 cm $\frac{I}{O} = -\frac{v}{u} = -\frac{-30}{-15} = -2$

I = – 2 × 1 = – 2 cm Image is inverted and on the same side (real) of size 2 cm.

Q.8 (3)

|m| = 3

$$m = \frac{f}{f-u}$$

$$-3 = \frac{-15}{-15-u}$$

– 15 – u = + 5

u = –20 cm

Q.9 (1)

f = – 50 m = – 2

$\frac{-v}{u} = -2$ $\Rightarrow$ v = 2u

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{3}{2u} + \frac{1}{u}$$

$$u = \frac{3f}{2} = \frac{3}{2} \times -50 = -75 \text{ cm}$$

Q.10 (3)

$$R = 2f = \frac{2vu}{v+u}$$

$$= 2 \times \frac{(+15)\times(-10)}{(+15)+(-10)} = 2 \times \left(\frac{-150}{5}\right) = -60 \text{ cm}$$

Q.11 (1)

$\mu_1 = 1,\quad \mu_2 = \mu,\quad i = i,\quad r = \frac{i}{2}$

$\mu_1 \sin i = \mu_2 \sin r$

$1 \times \sin i = \mu \times \sin\left(\frac{i}{2}\right)$

$= \sin 2\times\left(\frac{i}{2}\right) = \mu \times \sin \times \frac{i}{2}$

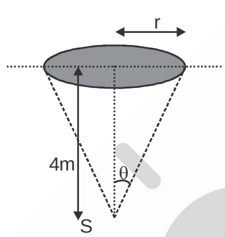
$= 2\sin\left(\frac{i}{2}\right)\times\cos\left(\frac{i}{2}\right) = \mu \times \sin\left(\frac{i}{2}\right)$

$= 2\cos\left(\frac{i}{2}\right) = \mu \quad \Rightarrow \cos\left(\frac{i}{2}\right) = \left(\frac{\mu}{2}\right)$

$\frac{i}{2} = \cos^{-1}\left(\frac{\mu}{2}\right) \Rightarrow i = 2\cos^{-1}\left(\frac{\mu}{2}\right)$

Q.12 (1)

Q.13 (2)
θ is the critical angle.
∴ $\theta = \sin^{-1}(1/\mu) = \sin^{-1}(3/5)$
or, $\sin\theta = 3/5$.
∴ $\tan\theta = 3/4 = r/4$ or $r = 3m$.



Hence, the correct answer is option (2).

Q.14 (4)

Q.15 (1)

Time taken $T = \frac{\text{distance}}{\text{speed}} = \frac{t}{V}$

and refractive index = $\mu = \frac{C}{V} \Rightarrow V = \frac{C}{\mu}$

$\Rightarrow T = \frac{t\mu}{C} \Rightarrow C = \frac{\mu t}{T}$

Q.16 (3)
Optical fibers are based on total internal reflection.

Q.17 (1)

$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$

$\Rightarrow \frac{1}{v} - \frac{4}{3\times 15} = \frac{1-\frac{4}{3}}{10} \Rightarrow \frac{1}{v} = \frac{4}{45} - \frac{1}{30}$

$\Rightarrow v = 18cm$

Q.18 (1)
Rainbow is formed due to dispersion of light where all component clours got splitted into 7 colours.

Q.19 (2)
Velocity of light in medium

$V_{med} = \frac{3cm}{0.2ns} = \frac{3\times10^{-2}m}{0.2\times10^{-9}s} = 1.5m/s$

Refractive index of medium

$\mu = \frac{V_{air}}{V_{med}} = \frac{3\times10^8}{1.5} = 2$

As $\mu = \frac{1}{\sin C}$ ∴ $\sin C = \frac{1}{\mu} = \frac{1}{2} = 30°$

Condition of TIR is angle of incidence i must be greater than critical angle. Hence ray will suffer TIR in case of (B) (i = 40° > 30°) only.

Q.20 (4)
T.I.R can occur from A to B i.e. $\mu_A > \mu_B$,
B to C i.e. $\mu_B > \mu_C$
$\mu_A > \mu_B > \mu_C$

$\frac{1}{\sin C_1} > \frac{1}{\sin C_2} > \frac{1}{\sin C_3}$

$\sin C_1 < \sin C_2 < \sin C_3$
$C_1 < C_2 < C_3$

Q.21 (3)
i = e

$r_1 = r_2 = \frac{A}{2} = 30°$

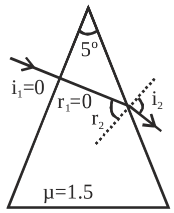
by Snell's law

$1 \times \sin i = \sqrt{3}\times\frac{1}{2} = \frac{\sqrt{3}}{2}$

i = 60

Q.22 (3)
$\delta_m = 2i - A$
$= 2 \times 38 - 40 = 36°$

Q.23 (3)



$A = r_1 + r_2$

$5^o = 0^o + r_2$

$r_2 = 5^o$

$\mu \times \sin r_2 = 1 \times \sin i_2$

$1.5 \times 5^o = i_2$

$i_2 = 7.5^o$

Q.24 (4)

$_a\mu_g = \frac{3}{2}$ $\quad$ $_a\mu_w = \frac{4}{3}$

$$_w\mu_g = \frac{_a\mu_g}{_a\mu_w} = \frac{3}{2} \times \frac{3}{4} = \frac{9}{8}$$

$$\therefore \text{ ratio} = \frac{(3/2-1)}{(9/8-1)} = \frac{1}{2} \times \frac{8}{1} = 4$$

Q.25 (2)

$A = 30^o$

$i = 60^o$

$\delta = 30^o$

$\delta = i + e - A$

$30^o = 60^o + e - 30^o$

$e = 0$

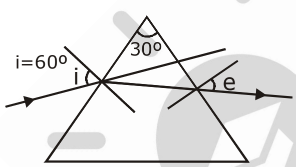
$\therefore r_2 = 0$

$\therefore r_1 = A - r_2 = 30^o = 1.\sin 60^o = \mu \sin 30^o$

$$\frac{1}{2}\mu = \frac{\sqrt{3}}{2}$$

$\mu = \sqrt{3}$

Q.26 (1)



$\delta = 30^o = i + e - A$

$60 + e - 30 = 30$

$e = 0$

Q.27 (3)

Angle of prism, $A = 60^o$

Angle of minimum deviation, $\delta_m = 40^o$

Angle of incidence, $i = \frac{A + \delta_m}{2} = \frac{60^o + 40^o}{2}$

$= 50$

Q.28 (2)

$\sin\theta = \sqrt{3}\ \sin\theta/2$

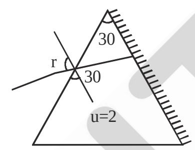
$$2\sin\frac{\theta}{2}\cos\frac{\theta}{2} = \sqrt{3}\ \sin\frac{\theta}{2}$$

$$\cos\frac{\theta}{2} = \frac{\sqrt{3}}{2}$$

$$\frac{\theta}{2} = \cos^{1}\left(\frac{\sqrt{3}}{2}\right) = 30$$

$\theta = 60°$

Q.29 (1)



from snell 's law 1 sini = μ sin A small angle

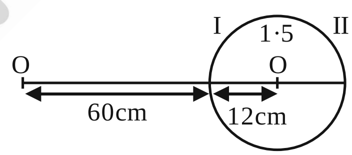
$$\frac{i = uA}{i = nA} \qquad [\mu = n]$$

Q.30 (2)

$$\mu = \frac{\sin\frac{(A + \delta_m)}{2}}{\sin\left(\frac{A}{2}\right)} = \frac{\sin\frac{(60° + 46°)}{2}}{\sin\left(\frac{60°}{2}\right)}$$

$$\frac{\sin 53°}{\sin 30°} = \frac{\frac{4}{5}}{\frac{1}{2}} = \frac{8}{5} = 1.6$$

Q.31 (2)



for I refracting surface

$$\frac{1\cdot5}{v} - \frac{1}{-60} = \frac{(1\cdot5 - 1)}{12}$$

solving, we get

v = 60 cm

∴ for II refracting surface

v = + (60 – 24) = + 36 cm

$$\frac{1}{v} - \frac{1.5}{36} = \frac{(1 - 1\cdot5)}{-12}$$

Solving, we get

v = 12 cm

∴ distance from the centre is 12 + 12 = 24 cm

Q.32 (1)

$$\frac{1.5}{V} = \frac{1}{-15} = \frac{(1.5 - 1)}{30} = \frac{1}{60}$$

$$\frac{1.5}{V} = -\frac{1}{20}$$

V = – 30 cm

Q.33 (1)

$$\omega_{CG} = \frac{(1.5318 - 1.5140)}{(1.5170 - 1)} = 0.034$$

$$\omega_{PG} = \frac{(1.6852 - 1.6934)}{(1.6499 - 1)} = 0.064$$

Q.34 (2)

$m_2 = 1$ $\mu_1 = 1.5$ R = – 5 cm

u = – 3

$$\frac{1}{v} - \frac{1.5}{-3} = \frac{1-1.5}{-5} \Rightarrow v = -2.5 \text{ cm}$$

Q.35 (4)

$$P \propto ({}_s\mu_g - 1)$$

$$\frac{P_L}{P_a} = \frac{({}_L\mu_g - 1)}{({}_a\mu_g - 1)}$$

$$= \frac{\left(\frac{3}{4} - 1\right)}{(3-1)} = \frac{-1}{8}$$

$$P_L = -\frac{P}{8}$$

Q.36 (2)

$$\frac{1}{f_a} = k(\mu_g - 1) = 0.5k = \frac{k}{2}$$

$$\frac{1}{f_w} = k\left(\frac{\mu_g}{\mu_w} - 1\right) = \left(\frac{9}{8} - 1\right)k = \frac{1}{8k}$$

$\therefore f_w = 4f_a$ $\quad\quad \therefore P_w = \frac{P_a}{4}$

Q.37 (1)

Lens Maker's formula

$$\frac{1}{f} = (\mu - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

where, $R_2 = \infty, R_1 = 0.3\text{m}$

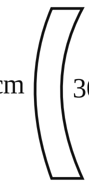
$$\therefore \frac{1}{f} = \left(\frac{5}{3} - 1\right)\left(\frac{1}{0.3} - \frac{1}{\infty}\right) \Rightarrow \frac{1}{f} = \frac{2}{3} \times \frac{1}{0.3}$$

or f = 0.45 m

Q.38 (1)

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$= (1.5 - 1)\left(\frac{1}{20} - \frac{1}{30}\right)$$



$$= \left(\frac{1}{2}\right)\left(\frac{3-2}{60}\right) \Rightarrow \frac{1}{f} = \frac{1}{120} \Rightarrow f = 120 \text{ cm}$$

Q.39 (3)

Q.40 (1)

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

For double convex lens, $R_1 = R$, $R_2 = -R$

$$\therefore \frac{1}{5} = (1.5 - 1)\left(\frac{1}{R} + \frac{1}{R}\right)$$

or $\frac{1}{5} = 0.5 \times \frac{2}{R}$

or R = 5 cm

Q.41 **(1)**

Q.42 **(2)**

$$v = \frac{u}{u+f}$$

As the image is virtual.

$\therefore$ Intensity decreases continuously.

Q.43 (4)

Here, u = – 10

v = + 20

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$P = 100\left[\frac{1}{v} - \frac{1}{u}\right] \text{ (in D)}$$

$$= 100\left[\frac{1}{20} + \frac{1}{10}\right]$$

$$= 100 \times \frac{3}{20}$$

P = +15 D

Q.44 (2)

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right), \text{ Let } \mu = \frac{3}{2} \text{(lens)}$$

In air $\frac{1}{20} = (\mu - 1)k$ ....(i)

In water

$\frac{1}{f} = \left(\frac{\mu}{\mu_w} - 1\right)k$ ....(ii)

Divide $\frac{(i)}{(ii)} \Rightarrow \frac{f}{20} = \frac{(\mu-1)\mu_w}{(\mu - \mu_w)} = \frac{\left(\frac{3}{2}-1\right)\frac{4}{3}}{\left(\frac{3}{2}-\frac{4}{3}\right)}$

$\Rightarrow \frac{f}{20} = \frac{2/3}{\frac{9-8}{6}} = \frac{\frac{2}{3}}{\frac{1}{6}} = 4 \quad \Rightarrow f = 80$

Q.45 (1)

Power and focal length of lens will change thus image position will change but intensity will remain unchanged since size of aperture doesn't change.

Q.46 (1)

for eye-piece $\frac{1}{-25} - \frac{1}{u_e} = \frac{1}{10}$

$U_e = -7.1$ cm

so length of the tube

$L = |f_0| + |u_e|$

$L = 20 + 7.1 = 27.1$ cm

Q.47 (3)

Both the lens forms magnified image and magnification is the purpose of microscope. First image is real and inverted. Second image is virtual and erect.

Q.48 (2)

The eye is least strained, the final image is formed at infinite.

$L = v_0 + f_e$

$7 = v_0 + 5$

$v_0 = 2$ cm

For objective

$\mu_0 = \frac{f_0 \times v_0}{f_0 - v_0} = \frac{0.5 \times 2}{0.5 - 2} = -\frac{2}{3}$cm

Q.49 (2)

By compound microscope for image formed atleast distance of vision, $m = \frac{L}{f_0}\left(1 + \frac{D}{f_e}\right)$

(where, length of tube L = 30 cm, focal length of objective lens f_0 = 1 cm, focal length of eye-piece f_e = 6 cm, D = 25 cm)

$= \frac{30}{1}\left(1 + \frac{25}{6}\right) = 30 \times \frac{(6+25)}{6}$

$= 5 \times 31 = 155$ cm $\cong$ 150

Q.50 (2)

$f_0 = 75$ cm, $f_e = 5$ cm

$m = \frac{f_0}{f_e} = \frac{75}{5} = 15$

TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Wave Optics**

ANSWER KEY

Q.1 (1)	**Q.2** (1)	**Q.3** (2)	**Q.4** (1)	**Q.5** (4)	**Q.6** (4)	**Q.7** (3)	**Q.8** (4)	**Q.9** (4)	**Q.10** (4)
Q.11 (1)	**Q.12** (1)	**Q.13** (4)	**Q.14** (3)	**Q.15** (3)	**Q.16** (1)	**Q.17** (2)	**Q.18** (3)	**Q.19** (3)	**Q.20** (4)
Q.21 (4)	**Q.22** (1)	**Q.23** (1)	**Q.24** (2)	**Q.25** (1)	**Q.26** (4)	**Q.27** (3)	**Q.28** (3)	**Q.29** (3)	**Q.30** (3)
Q.31 (4)	**Q.32** (3)	**Q.33** (2)	**Q.34** (3)	**Q.35** (1)	**Q.36** (2)	**Q.37** (3)	**Q.38** (3)	**Q.39** (2)	**Q.40** (1)
Q.41 (2)	**Q.42** (2)	**Q.43** (1)	**Q.44** (4)	**Q.45** (1)	**Q.46** (4)	**Q.47** (1)	**Q.48** (4)	**Q.49** (3)	**Q.50** (1)

Hints and Solutions

Q.1 (1) $\frac{5\lambda_1 D}{d} = (4\frac{1}{2})\frac{\lambda_2 D}{d}$

$5 \times 44 = \frac{9}{2}\lambda_2$

$\lambda_2 = 440$ nm

Q.2 (1)

$c = \nu\lambda \Rightarrow \nu\lambda = \text{constant}$

$\Rightarrow \nu \propto \frac{1}{\lambda}$ $\beta = \frac{\lambda D}{d} \Rightarrow \beta \propto \lambda$

Since ν becomes double

So λ becomes half

Thus $\beta' = \frac{\beta}{2}$

Q.3 (2)

Constructive interference occurs when the path difference ($S_1P - S_2P$) is an integral multiple of λ.

or $S_1P - S_2P = n\lambda$

where n = 0, 1, 2, 3,......

Q.4 (1)

Q.5 (4)

Q.6 (4) $n_1\lambda_1 = n_2\lambda_2$ $n \times 7800 = (n + 4) \times 5200$

$n \times 3 = (n + 4) \times 2$

taking n = 8

then (n +4) = 8 + 4 = 12

& 8 × 3 = (8 + 4) × 2 satified.

Q.7 (3) Intensity at any points on the screen is

$I = 4 I_0 \cos^2 \frac{\phi}{2}$

where I_0 is the intensity of either wave and ϕ is the phase difference between two waves.

Phase difference, $\phi = \frac{2\pi}{\lambda} \times$ Path difference

When path difference is λ, then

$\phi = \frac{2\pi}{\lambda} \times \lambda = 2\pi$

$\therefore\ I = 4 I_0 \cos^2\left(\frac{2\pi}{4}\right) = 4 I_0 \cos^2(\pi) = 4 I_0 = K$...(i)

When path difference is $\frac{\lambda}{4}$, then

$\phi = \frac{2\pi}{\lambda} \times \frac{\lambda}{4} = \frac{\pi}{2}$

$\therefore\ I = 4 I_0 \cos^2\left(\frac{\pi}{4}\right) = 2 I_0 = \frac{K}{2}$ [Using (i)]

Q.8 (4) Fringe width, $\beta = \frac{\lambda D}{d}, D = \frac{\beta d}{\lambda}$

$$D = \frac{4 \times 10^{-3} \times 0.1 \times 10^{-3}}{4 \times 10^{-7}} = 1\text{m}$$

Q.9 (4) At β distance from central maxima, first mxaima lies

$\Rightarrow$ at distance $\frac{\beta}{2}$ ------- first maxima

first minima lies $\beta/2 \uparrow$ –first minima
---------central maxima

$\Rightarrow$ intensity is zero

Q.10 (4) $\beta = \frac{\lambda D}{d} \Rightarrow \frac{\beta_2}{\beta_1} = \frac{\lambda_2 D_2 d_1}{\lambda_1 D_1 d_2}$

$\Rightarrow \beta_2 = 2.5 \times 10^{-4}$m

Q.11 (4) $\beta = \frac{\lambda D}{d}$

$\beta' = \frac{\lambda(2D)}{d/2} = 4\frac{\lambda D}{\alpha} = 4\beta$

Q.12 (1)

Q.13 (4) $\beta_1 = \beta_2$

$$\lambda_1 \frac{D_1}{d_1} = \lambda_2 \frac{D_2}{d_2}$$

$$\Rightarrow \frac{d_1}{d_2} = \frac{\lambda_1 D_1}{\lambda_2 D_2} = \frac{3}{5}$$

Q.14 (3) Position of first maxima $= \frac{\lambda D}{d}$

Position of fifth minima $= \frac{(2n-1)\lambda D}{2d}$

$= \frac{9\lambda D}{2d}$ (n = 5)

$$\Rightarrow \text{separation} = \frac{9\lambda D}{2d} - \frac{\lambda D}{d} = 7\times10^{-2}$$

$$\frac{7}{2}\times \frac{\lambda\times50\times10^{-2}}{15\times10^{-6}} = 7\times10^{-2}$$

λ = 600 nm

Q.15 (3)

Q.16 (1) $\frac{(\mu-1)tD}{d} = \frac{5\lambda D}{d}$

$$t = \frac{5\times5000\text{Å}}{(1.5-1)} \Rightarrow 50{,}000\ \text{Å}$$

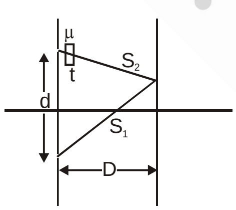
Q.17 (2) $\frac{\text{Shift}}{D} = \frac{\text{Path difference}}{d}$

$$\text{Shift} = \frac{t(\mu-1)D}{d}$$

$$= \frac{2.5\times10^{-5}(1.5-1)\times100}{0.5\times10^{-3}}$$

$= 2.5 \times 10^{-2}$ m = 2.5 cm

Q.18 (3)



Extra path taken due to slab = $(\mu - 1)t$

$S_1 > S_2$ (geometrally)

$\Rightarrow \sin\theta = (\mu - 1)t$

$$\frac{dy}{D} = (\mu-1)t \Rightarrow y = \frac{D(\mu-1)t}{d}$$

(shift towards slit which is covered)

Q.19 (3)

$$\lambda = \frac{(\mu-1)t}{n} \quad \ldots 1$$

According to question

n=7 $\mu = 1.6$, t= 7×10^{-6} meter

From eqs. (1) and (2), $\lambda = 6\times10^{-7}\ meter$

Q.20 (4) The positions of all fringes are shifted up by same distance. So no change in fringe width.

$\therefore$ (4)

Q.21 (4) Position of 8^{th} bright fringe in medium,

$x = \frac{8\lambda_m D}{d}$ Position of 5^{th} dark fringe in air,

$$x' = \frac{\left(5-\frac{1}{2}\right)\lambda_{air}D}{d}$$

$$x' = \frac{4.5\lambda_{air}D}{d}$$

Given x = x′

$$\therefore \frac{8\lambda_m D}{d} = \frac{4.5\lambda_{air}D}{d}$$

$$\mu_m = \frac{\lambda_{air}}{\lambda_m} = \frac{8}{4.5} = 1.78$$

Q.22 (1) $t(\mu - 1) = n\lambda$

$$t = \frac{n\lambda}{\mu-1} = \frac{4\times6\times10^{-7}}{0.5}$$

t = 4.8 μm

$\therefore$ (1)

Q.23 (1) Number of fringes = $\frac{(\mu-1)t}{\lambda}$

Q.24 (2) As the thin glass plate is introduced in the path of light S_1, therefore, fringe pattern is shifted laterally towards S_1.

Q.25 (1) Change in optical path diff $\Delta x = (\mu - 1)t$

Phase diff $\Delta\phi = \frac{2\pi}{\lambda}\Delta x$

$= \frac{2\pi}{600\times10^{-9}} \times 0.4 \times 5 \times 10^{-6} = \frac{20\pi}{3}$

$I_{res} = I_0 \cos^2\left(\frac{\Delta\phi}{2}\right) = I_0\cos^2\left(\frac{10\pi}{3}\right) \Rightarrow I_{res} = \frac{I_0}{4}$

Q.26 (4) For central fringe

$$\Delta x_{total} = 0$$

$d\sin\theta + (\mu - 1)t + y\frac{xd}{D} = 0$

Value of y depends on

$$\theta \ \& \ t$$

Q.27 (3) Let intensity of light coming from each slit of a coherent source is I.

As first slit has width 4 times the width of the second slit, so

$I_1 = 4I$ and $I_2 = I$

$\therefore \ \frac{I_{max}}{I_{min}} = \frac{(\sqrt{I_1}+\sqrt{I_2})^2}{\left(\sqrt{I_1}-\sqrt{I_2}\right)^2} = \frac{\left(\sqrt{4I}+\sqrt{I}\right)^2}{\left(\sqrt{4I}-\sqrt{I}\right)^2} = \frac{9}{1}$

Q.28 (3) $\beta = \frac{\lambda D}{d}$

$\beta' = \frac{\lambda' D}{d}$

$\frac{\beta'}{\beta} = \frac{\lambda'}{\lambda} = \frac{\mu}{\lambda} = \frac{1}{\mu}$

$\beta' = \frac{\beta}{\mu} = \frac{0.6\text{mm}}{1.5} = 0.4\text{mm}$

Q.29 (3) $I_{net} = I_1 + I_2 + 2\sqrt{I_1 I_2}\ \cos\delta$ for central maxima.

$I_{max} = I_0 + I_2 + 2I_0 \times 1 = 4\ I_0$

Q.30 (3) Fringe width $\beta \propto \lambda$. Therefore, λ and hence β decreases 1.5 times when immersed in liquid.

Q.31(4) Only transverse waves undergo polarisation. As sound waves are longitudinal in nature, so they can't be polarised

Q.32 (3) $y = \frac{n\lambda D}{d}$

$1.6\times10^{-2} = \frac{2\times\lambda\times2}{0.14\times10^{-3}}$

$\lambda = 5600Å$

Q.33 (2) (a) Interference is observed only for coherent source.

(b) Brewster's law is $\mu = \tan\theta_p$ where μ = refractive index and θ_p is angle of polarisation

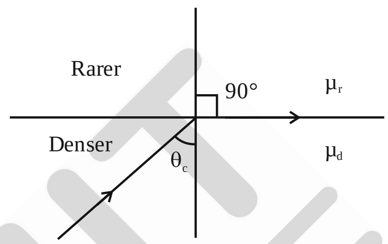
(c) Intensity of light after polarisation is given by Malus law, $I = I_0\cos^2\theta$

where I_0 is incident intensity

I is transmitted intensity

θ is angle between transmission axis and plane of polarizer

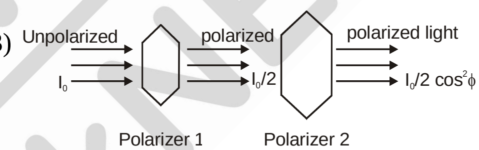
(d)



$\mu_d\sin\theta_C = \mu_r\sin 90$

$\Rightarrow \ \mu = \frac{\mu_d}{\mu_r} = \frac{1}{\sin\theta_C} = \frac{1}{\sin C}$

Q.34 (3)



From Malus law

$I = \frac{I_0}{2}\cos^2\phi$

where ϕ is the angle between transmission axis

Q.35 (1)

Q.36 (2) Water is a polar molecule.

When light ray passes through water droplet, it gets partially polarised.

Q.37 (3) A sin 30° = λ

A = 2λ

Q.38 (3) $I = I_0\cos^2\theta$

Intensity of polarized light = $\frac{I_0}{2}$

$\therefore$ Intensity of untransmitted light

$= I_0 - \frac{I_0}{2} = \frac{I_0}{2}$

Q.39 (2) At the polarising angle, the reflected ray is fully polarised while the transmitted ray is partially polarised. In fact a method to produce plane polarised light is by reflection at the polarising angle.

Q.40 (1) Assertion $\rightarrow$ Correct
Reason $\rightarrow$ In YDSE no. of sources = 2
In differeaction from single slit there may be ∞ sources so this is correct reason

Q.41 (2) $I = \frac{I_0}{2}\cos^2\theta$

$= \frac{32}{2}\cos^2 30^o$

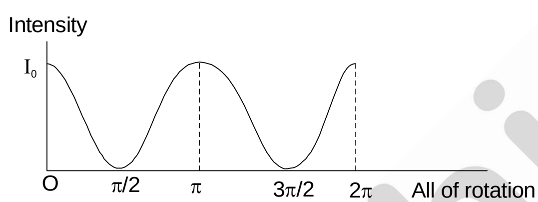
= 12W/m^2

Q.42 (2)

Q.43 (1) $\beta = \frac{\lambda D}{d} \Rightarrow \beta \propto \lambda$

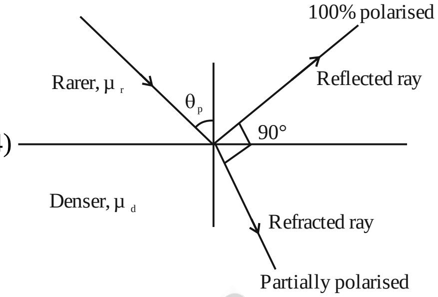
since λ – less
So, β – less

Q.44 (4)



Q.45 (1)

Q.46 (4)



If angle of incidence = θ_p = angle of polarisation

then, $\mu = \frac{\mu_d}{\mu_r} = \tan\theta_p$

Q.47 (1) $\mu = \tan i_p$

$\mu = \tan 53° = \frac{4}{3}$

$\mu = \frac{c}{v}$

$\mu = \frac{c}{\mu} = \frac{3\times10^8}{\left(\frac{4}{3}\right)} = \frac{9}{4}\times10^8$.

Q.48 (4) $\frac{2\lambda D}{a} = 2\times10^{-3}$

$D = \frac{2\times10^{-3}\times1\times10^{-3}}{2\times6\times10^{-7}} = \frac{5}{3}m$

Q.49 (3)

Q.50 (1) $d\sin\theta = \lambda$
$\Rightarrow$ d = 2λ
= 1.2 μm

TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Dual Nature of Matter and Radiation**

ANSWER KEY

Q.1 (2)	**Q.2** (4)	**Q.3** (4)	**Q.4** (1)	**Q.5** (4)	**Q.6** (3)	**Q.7** (2)	**Q.8** (1)	**Q.9** (3)	**Q.10** (3)
Q.11 (1)	**Q.12** (3)	**Q.13** (2)	**Q.14** (1)	**Q.15** (2)	**Q.16** (1)	**Q.17** (3)	**Q.18** (3)	**Q.19** (3)	**Q.20** (4)
Q.21 (3)	**Q.22** (1)	**Q.23** (1)	**Q.24** (1)	**Q.25** (3)	**Q.26** (2)	**Q.27** (1)	**Q.28** (1)	**Q.29** (2)	**Q.30** (3)
Q.31 (1)	**Q.32** (3)	**Q.33** (4)	**Q.34** (3)	**Q.35** (4)	**Q.36** (1)	**Q.37** (4)	**Q.38** (2)	**Q.39** (1)	**Q.40** (4)
Q.41 (2)	**Q.42** (1)	**Q.43** (4)	**Q.44** (1)	**Q.45** (2)	**Q.46** (4)	**Q.47** (1)	**Q.48** (4)	**Q.49** (2)	**Q.50** (1)

Hints and Solutions

Q.1 (2) From Einstein's photoelectric equation the maximum kinetic energy of photoelectrons emitted from metal surface is E_K and W is work function, then

$E_K = h\nu - W$

If ν_0 is threshold frequency, then

$W = h\nu_0$

$\therefore \quad E_K = h\nu - h\nu_0 = h(\nu - \nu_0)$

From the above equation, it is clear that maximum kinetic energy of electron will increases almost linearly with increase in the frequency of the incident light.

Q.2 (4) Energy of one photon $= \dfrac{hc}{\lambda}$

Total energy $= 3{\cdot}2 \times 10^{-3}$ W

$\Rightarrow$ No. of photons $= \dfrac{\text{total energy}}{\text{energy of one photon}}$

$= \dfrac{3{\cdot}2\times10^{-3}}{\left(\dfrac{hc}{\lambda}\right)} = \dfrac{3{\cdot}2\times10^{-3}\times6{\cdot}21}{1240\times1{\cdot}6\times10^{-19}}$

$= 0{\cdot}01 \times 10^{16} = 10^{14}$ photons

Q.3 (4) The photon may absorb in matter then new photon may created by photon number may change.

Q.4 (1) $\phi = \dfrac{12400}{5400\text{Å}} \cong 2.3\,\text{eV}$

Q.5 (4)

Q.6 (3) If energy of photon is doubled then $K.E._{max}$ of e^- will become more then doubled.

Q.7 (2) Emission of photo electron is independent of external factor. It depends only on the nature of the material and wavelength of incident light

Q.8 (1) According to Einstein's quantum theory, light propagates in the form of bundles (packet or quanta) of energy, each bundle is called a photon. The photoelectric effect represents that light has a particle nature.

Q.9 (3) From Einstein photo electric equation

$h\nu_1 = eV_1 + \phi_0$

if frequency is doubled,

$h.2\nu_1 = eV_2 + \phi_0$

$\Rightarrow eV_2 = 2(eV_1 + \phi_0)$

$V_2 > 2V_1$.

Q.10 (3) Stopping potential depends on the K.E. of emitted electron. The K.E. of emitted electron depends on the frequency of the photon, not on the intensity of the photon.

Q.11 (1) Energy of photon

$E = \dfrac{hc}{\lambda}$

$= \dfrac{6.6\times10^{-34}\times3\times10^{8}}{5000\times10^{-10}}$

$= 3.96 \times 10^{-19}$ J

$= \dfrac{3.96\times10^{-19}}{1.6\times10^{-19}}$ eV

$= 2.475$ eV ≈ 2.5 eV

Q.12 (3) $P = \dfrac{nE}{t}$

$\dfrac{n}{t} = \dfrac{P}{E} = \dfrac{2\times10^{-3}}{2.48\times1.6\times10^{-19}} = 0.5 \times 10^{16}$

$= 5 \times 10^{15}$

Q.13 (2)

Q.14 (1) The number of photoelectrons emitted depends on the number of photon incident per sec i.e., on the intensity of incident radiation.

Q.15 (2) R is not correct explanation of A because R is not considering when energy of incident radiation is less than work function of metal, then also kinetic energy of photoelectrons is zero.

Q.16 (1)

Q.17 (3) **Statement – I** photon should have suitable energy for photo electric effect.

Statement – II one photon one electron energy transfer.

Q.18 (3)
Current doesn't depends on frequency of incident light.

Q.19 (3) use, $h\nu = \phi + E_K$

Q.20 (4)

Q.21 (3) Work function $\Rightarrow$ the minimum energy for the electrons to come out from metal surface.

Q.22 (1)

Q.23 (1) Let $\phi_1 = 4eV$, then $\phi_2 = 2eV$
$(E - \phi)$ represent kinetic energy of most energetic electron.
$E - \phi_2 = 2(E - \phi_1)$
$\Rightarrow E = 6$ eV

Q.24 (1) $eV_0 = h\nu - \phi_0 = 4eV - 2eV$
$V_0 = 2V$

Q.25 (3) $eV_s = h\nu - h\nu_0$

$eV_s = h(\nu - \nu_0)$

$= h[5.2 \times 10^{14} - 2 \times 10^{14}]$

$$v_s = \frac{h}{e} \times 3.2 \times 10^{14}$$

$$= \frac{6.6 \times 10^{-34} \times 2 \times 10^{14}}{10^{-19}}$$

$= 1.32$ volt

Q.26 (2) $KE_{max} = h\nu - \phi$

$$KE_1 = \frac{1}{2} mv_1^2 = 1 - 0.5 = 0.5 \text{ eV}$$

$$KE_2 = \frac{1}{2} mv_2^2 = 2.5 - 0.5 = 2 \text{ eV}$$

$$\Rightarrow \frac{v_1^2}{v_2^2} = \frac{0.5}{2} = \frac{1}{4}$$

$$\Rightarrow \boxed{\frac{v_1}{v_2} = \frac{1}{2}}$$

Q.27 (1) Saturation current is proportional to intensity while stopping potential increases with increase in frequency. Hence,
$v_a = v_b$ while $I_a < I_b$

Q.28 (1) $f_0 = 2.14$ eV
$K_{max.} = eV_0$
$f = f_0 + K_{max}$
$f = 2.1x + 0.60e$

$$\frac{hc}{\lambda} = 2.74 \times 1.6 \times 10^{-19}$$

$$\lambda = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{2.74 \times 1.6 \times 10^{-19}}$$

$\lambda = 4.54 \times 10^{-7} = 454$ nm

Q.29 (2) $E = W_0 + K_{max}$
$\Rightarrow hf = W_A + K_A$ ....(i)
and $2hf = W_B + K_B = 2W_A + K_B$ .....(ii)

$$\left(\because \frac{W_A}{W_B} = \frac{1}{2} \right)$$

Dividing equation (i) by (ii)

$$\frac{1}{2} = \frac{W_A + K_A}{2W_A + K_B} \Rightarrow \frac{K_A}{K_B} = \frac{1}{2}$$

Q.30 (3) $P = \frac{nE}{t} \Rightarrow E = \frac{Pt}{n}$

$$E = \frac{5 \times 10^{-3}}{8 \times 10^{15}} J = \frac{5 \times 10^{-3}}{8 \times 10^{15}} \times \frac{1}{1.6 \times 10^{-19}} eV$$

$E = 3.9$ eV
$(K.E)_{max} = E - \phi$
$\phi = 3.9 - 2$

$\boxed{\phi = 1.9 \text{ eV}}$

Q.31 (1) The work function has no effect on current so long as $h\nu > W_0$. The photoelectric current is proportional to the intensity of light. Since there is no change in the intensity of light, therefore $I_1 = I_2$.

Q.32 (3) $\frac{hc}{\lambda} = \phi$

$$\Rightarrow \lambda_{max} = \frac{hc}{\phi} = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{4 \times 1.6 \times 10^{-19}} = 310\text{nm}$$

Q.33 (4) Case (i) $\frac{hc}{\lambda} = \phi + E$

$$\text{Case (ii)} \quad \frac{hc}{\left(\frac{\lambda}{3}\right)} = \frac{3hc}{\lambda} = \phi + 4E$$

Solving, ϕ = work fuction $= \frac{hc}{3\lambda}$

Q.34 (3) Energy of incident photon $= h\nu$
Minimum energy required = W
or work function = W
Maximum K.E. $= h\nu - W$
So, K.E. $\le KE_{max}$
$\Rightarrow$ K.E. $\le (h\nu - W)$

Q.35 (4) $V_2 > V_1 \Rightarrow f_2 > f_1 \Rightarrow \lambda_2 < \lambda_1$

Q.36 (1) De – broglie wavelength ,

$$\lambda = \frac{h}{mu} \Rightarrow \lambda \propto \frac{1}{m}$$

$M_{electron} << M_{proton} < M_{deutron} < M_{alpha}$

Q.37 (4)

$\lambda = \frac{h}{p}$ or $L = \frac{h}{p}$ ie, $L \propto \frac{1}{p}$. The curve (4) is correct.

Q.38 (2) $\lambda \propto 1/\sqrt{T}$

$$\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{T_2}{T_1}} = \sqrt{\frac{127+273}{927+273}}$$

$$\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{400}{1200}} \Rightarrow \boxed{\lambda\sqrt{3} = \lambda_2}$$

Q.39 (1)

Q.40 (4) Given $\lambda_{Pn} = \lambda_e = \frac{12.27}{\sqrt{1.5}}$ Å

$$E_{Pn} = \frac{12400}{12.27}\sqrt{1.5} = 1.24 \text{ KeV}$$

Q.41 (2) Bohr postulated that the angular momentum of the electron momentum of the electron is conserved and

$$L = \frac{nh}{2\pi}$$

Q.42 (1) The wavelength associated with a particle of charge q, mass m and accelerated through a potential difference V is given by

$$\lambda = \frac{h}{\sqrt{2mqV}}$$

or $$V = \frac{h^2}{2mq\lambda^2}$$

for proton $$V = \frac{h^2}{2m_p q_p \lambda^2}$$

For α-particle : $$V' = \frac{h^2}{2m_\alpha q_\alpha \lambda^2}$$

$$\therefore \frac{V'}{V} = \frac{m_p}{m_\alpha} \times \frac{q_p}{q_\alpha} = \frac{1}{4} \times \frac{1}{2} = \frac{1}{8}$$

($\because$ $m_\alpha = 4p_p$ and $q_\alpha = 2q_p$)

Thus V' = V/8

Q.43 (4) $\lambda = \frac{h}{\sqrt{2mE}}$, $\frac{\lambda'}{\lambda} = \sqrt{\frac{E}{E'}} \Rightarrow \frac{E}{E'} = \left(\frac{0.5}{1}\right)^2$

$$\Rightarrow E' = \frac{E}{0.25} = 4E$$

The energy should be added to decrease wavelength = E'–E = 3E

Q.44 (1) $\lambda_{neutron} \propto \frac{1}{\sqrt{T}} \Rightarrow \frac{\lambda_1}{\lambda_2}\sqrt{\frac{T_2}{T_1}}$

$$\Rightarrow \frac{\lambda}{\lambda_2}\sqrt{\frac{(273+927)}{(273+27)}} = \sqrt{\frac{1200}{300}} = 2 \Rightarrow \lambda_2 = \frac{\lambda}{2}$$

Q.45 (2) $E = \frac{hc}{\lambda}$

Also $p = \frac{h}{\lambda}$

Q.46 (4)

Q.47 (1) de Broglie wavelength, $\lambda = h / p = h / \sqrt{(2mK)}$

$\therefore \lambda = \frac{h}{\sqrt{2mK}}$; where K = kinetic energy of particle

$$\therefore \frac{\lambda_2}{\lambda_1} = \sqrt{\frac{K_1}{K_2}} = \sqrt{\frac{K_1}{2K_1}} = \frac{1}{\sqrt{2}}$$

Q.48 (4) $\lambda = \frac{h}{p}$

if p = same

then λ = same

Q.49 (2)

$$\lambda = \frac{h}{\sqrt{3mkT}} \therefore \frac{\lambda_H}{\lambda_{He}} = \sqrt{\frac{m_{He}}{m_H} \times \frac{T_{He}}{T_H}}$$

$$= \sqrt{\frac{4}{2} \times \frac{127+273}{27+273}} = \sqrt{\frac{4\times 400}{2\times 300}} = \sqrt{\frac{8}{3}}$$

Q.50 (1) Power = Total energy emitted per second

Total energy = (No. of photons) × (Energy of one photons)

$$\Rightarrow P = \frac{N\left(\frac{hc}{\lambda}\right)}{t}$$

$$\Rightarrow 60 = \frac{N \times (6\cdot6\times10^{-34}) \times (3\times10^{8})}{5000\times10^{-10}\times1}$$

$\Rightarrow$ N = $1\cdot5151 \times 10^{20}$ photons per second

TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Atoms**

ANSWER KEY

Q.1 (3)	**Q.2** (1)	**Q.3** (2)	**Q.4** (2)	**Q. 5** (4)	**Q.6** (1)	**Q.7** (4)	**Q.8** (4)	**Q.9** (4)	**Q.10** (2)
Q.11 (4)	**Q.12** (2)	**Q.13** (4)	**Q.14** (1)	**Q.15** (4)	**Q.16** (4)	**Q.17** (3)	**Q.18** (2)	**Q.19** (2)	**Q.20** (4)
Q.21 (2)	**Q.22** (3)	**Q.23** (4)	**Q.24** (2)	**Q.25** (4)	**Q.26** (3)	**Q.27** (1)	**Q.28** (4)	**Q.29** (1)	**Q.30** (3)
Q.31 (2)	**Q.32** (1)	**Q.33** (4)	**Q.34** (2)	**Q.35** (4)	**Q.36** (1)	**Q.37** (3)	**Q.38** (2)	**Q.39** (1)	**Q.40** (1)
Q.41 (4)	**Q.42** (4)	**Q.43** (4)	**Q.44** (2)	**Q.45** (1)	**Q.46** (3)	**Q.47** (1)	**Q.48** (3)	**Q.49** (4)	**Q.50** (4)

Hints and Solutions

Q.1 (3) Energy of H-like atoms,

$$E_n = -\frac{Z^2Rhc}{n^2} = -\frac{Z^2 \times 13.6\,eV}{n^2}$$

For ground state

n = 1

$E_1 = -54.4$ eV (given)

$$\therefore\ -54.4\,eV = \frac{Z^2 \times 13.6}{(1)^2}\,eV$$

$\Rightarrow Z^2 = 4$

or Z = 2

Z = 2 is for helium.

Q.2 (1)

Q.3 (2) $E = \frac{-13\cdot6\,Z^2}{n^2}$

for first excited state of a He^+ ion.

Z = 2, n = 2

$$\Rightarrow E = \frac{-13\cdot6 \times 2^2}{2^2}$$

$= -13\cdot6$ eV

Q.4 (2) $E = \frac{-13.6z^2}{n^2}$

$E = -13.6 \times (2)^2$

$= -54.4$ eV

$K.E._{Max} = 70 - 54.4$

$= 15.6$ eV

Q. 5 (4) When electron jump from lower to higher energy level, energy absorbed so statement-I incorrect.

When electron jump from higher to lower energy level, energy of emitted photon

$E = E_2 - E_1$

$hf = E_2 - E_1 \Rightarrow f = \frac{E_2 - E_1}{h}$

So statement-II is correct.

Q.6 (1) $mvr = \frac{nh}{2\pi} = \frac{h}{\pi}$

$\frac{h}{mv} = \pi r =$ de-Broglie wavelength $= 6.64$ Å

$\therefore$ (1)

Q.7 (4) Potential energy = 2 × total energy

= 2 (–1.5) eV = – 3.0 eV

Q.8 (4) for emission of e^-

$h\nu > \phi$

here $\phi > h\nu$

So no. emission of e^-

Q.9 **(4)** E_0 is energy when photoelectric effect is possible

now n = 3 to n = 2

$$E_0 = 13.6\left[\frac{1}{4} - \frac{1}{9}\right]$$

$$E_0 = 13.6\left[\frac{5}{36}\right] = 1.88\text{ ev}$$

$E_0 = 0.14E$ [E = 13.6]

option (1) n = 2 to n = 1

$$E' = 13.6\left[\frac{1}{1} - \frac{1}{4}\right]$$

$$= E \times \frac{3}{4} = 0.75\text{ ev}$$

$E' > E_0$ P_{EE} possible

option (2) n = 3 to n = 1

$$E' = 13.6\left[1 - \frac{1}{9}\right]$$

$$= 13.6\left[\frac{8}{9}\right] = E \times \frac{8}{9}$$

$E' > E_0$ P_{EE} possible

option (3)

$$E' = 13.6\left[\frac{1}{4} - \frac{1}{25}\right]$$

$= 13.6\left[\frac{21}{100}\right]$

$= E \times 0.21$

$E' > E_0$

option (4)

$E' = 13.6\left[\frac{1}{9} - \frac{1}{16}\right]$

$= E\left[\frac{7}{9\times16}\right]$

$= E[0.04]$

$E' < E_0$ so P_{EE} not possible.

Q.10 (2) $E_3 = -\frac{13.6}{9} = -1.51\text{eV}$

Q.11 (4)

Q.12 (2) PE = 2 TE

PE = 2 (–54.4)eV

= –108.8 eV

Q.13 (4) $r \propto n^2$

Q.14 (1)

Q.15 (4) Theory Based.

Q.16 (4)

Q.17 (3)

Q.18 (2) Angular momentum = $\frac{nh}{2\pi}$

Angular momentum difference between two successive orbits of hydrogen atom = $\frac{h}{2\pi}$

Q.19 (2) $\Delta E = \frac{hc}{\lambda}$; $E = \frac{hc}{\lambda_1}$ ...(i)

$-E + \frac{4}{3}E = \frac{hc}{\lambda_2}$

$\Rightarrow \frac{E}{3} = \frac{hc}{\lambda_2}$

$\Rightarrow \lambda_2 = \frac{3hc}{E}$; $\lambda_1 = \frac{hc}{E}$

$\frac{\lambda_1}{\lambda_2} = r = \frac{1}{3}$

Q.20 (4) **Assertion :** $\frac{1}{\lambda} = R(z)^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$v = Rcz^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$v_1 = Rcz^2$

$v_2 = Rcz^2\left[\frac{1}{1} - \frac{1}{4}\right]$

$v_2 = \frac{3}{4}Rcz^2$

$v_3 = \frac{1}{4}Rcz^2$

$v_1 - v_2 = v_3$

Reason : for lyman series

$n_1 = 1, n_2 = 2, 3 \ldots$

$v = Rc\left[\frac{1}{1^2} - \frac{1}{n^2}\right]$

Q.21 (2) The energy of electron in n^{th} Bohr orbit

$E = -\frac{13.6}{n^2}$

Energy absorbed by electron in transition from $n = 1 \rightarrow$ **n = 2**

$\therefore E = -\frac{13.6}{2^2} - \left(-\frac{13.6}{1^2}\right)$

$= -\frac{13.6}{4} + \frac{13.6}{1}$

$= -3.4 + 13.6$

$= 10.2$ eV

Q.22 (3)

Five structure of the spectrum of hydrogen atoms we must consider spin angular momentum.

Q.23 (4) $(n+1)^2a_0 - n^2a_0 = (n-1)^2a_0$

$n^2 + 2n + 1 - n^2 = (n-1)^2$

$2n + 1 = n^2 - 2n + 1$

$4n = n^2$

$n = 4$

Q.24 (2) Energy of hydrogen atom = $13.6\left(\frac{1}{3^2} - \frac{1}{4^2}\right)$

eV = $13.6 \times \frac{7}{144}$ eV

= .66 eV

The ionisation potential of hydrogen

= 13.6 eV

$E_n \propto Z^2$

$\therefore\ Z^2 = \frac{66}{0.66} = 100,\ \ Z = 10$

Q.25 (4)

Q.26 (3) As U = 2E, K = – E

Also, $E = -\frac{13.6}{n^2}eV$ Hence, Kand U change as four fold each.

Q.27 (1)

$$\frac{1}{\lambda} = RZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_3^3}\right) \qquad \frac{1}{6561} = R(1)^2\left[\frac{1}{2^2} - \frac{1}{3^2}\right]$$

and $\frac{1}{\lambda} = R(2)^2\left[\frac{1}{2^2} - \frac{1}{4^2}\right]$

Therefore λ = 1215 Å

Q.28 (4) Number of spectral lines obtained due to transition of an electron from n^{th} line.

$$N = \frac{n(n-1)}{2}$$

In the first case, N = 6 $\therefore 6 = n\frac{(n-1)}{2} \Rightarrow n = 4$

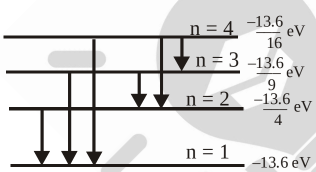
In the second case, N = 3 $\therefore 3 = n\frac{(n-1)}{2} \Rightarrow n = 3$

Velocity of an electron in hydrogen atom in n^{th} orbit is

$$\nu_n = \frac{2\pi e^2}{4\pi\varepsilon_0 nh}\ ;\ \nu_n \propto \frac{1}{n} \quad \therefore \frac{\nu_4}{\nu_3} = \frac{3}{4}$$

Q.29 (1)

Q.30 (3)



The maximum wavelength emitted here corresponds to the transition n = 4 → n = 3 (Paschen series 1st line)

Q.31 (2) Initial momentum of surface

$$p_i = \frac{E}{c}$$

where c = velocity of light (constant). Since, the surface is perfectly reflecting so, the same momentum will be reflected completely

Final momentum

$p_f = \frac{E}{c}$ (negative value)

∴ Change in momentum

$$\Delta p = p_f - p_i = -\frac{E}{c} - \frac{E}{c} = -\frac{2E}{c}$$

Thus, momentum transferred to the surface is

$$\Delta p = |\Delta p| = \frac{2E}{c}$$

Q.32 (1) Wave lengths in Balmer series for hydrogen are given by

$$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$$

$$= R\left(\frac{1}{4} - \frac{1}{n^2}\right);\ n = 3, 4, 5....$$

The second line is Balmer series corresponds to n = 4

$$\frac{1}{\lambda_2} = R\left(\frac{1}{4} - \frac{1}{16}\right) = \frac{3R}{16} \text{ or } \lambda_2 = \frac{16}{3R}$$

The wavelength of the first line (n = 2) in Lyman series is

$$\frac{1}{\lambda_1} = R\left(1 - \frac{1}{2^2}\right) = R\left(1 - \frac{1}{4}\right) = \frac{3R}{4}$$

or $\lambda_1 = \frac{4}{3R}$

$$\therefore \frac{\lambda_1}{\lambda_2} = \frac{4}{4R} \times \frac{3R}{16} = \frac{1}{4}$$

or $\lambda_1 = \frac{\lambda_2}{4} = \frac{486.4}{4} = 121.6\text{nm}$

Q.33 (4)

$$\frac{1}{\lambda} = R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$ .For first wavelength, n_1

$= 2, n_2 = 3$

$\Rightarrow \lambda_1 = 6563$ For first wavelength, n_1

2, $n_2 = 4 \Rightarrow \lambda_2 = 4861$Å

Q.34 (2)

$$\frac{1}{\lambda} = R\left[\frac{1}{n_2^2} - \frac{1}{n_1^2}\right]$$

For lowest 'λ', n = 4 to n = 3

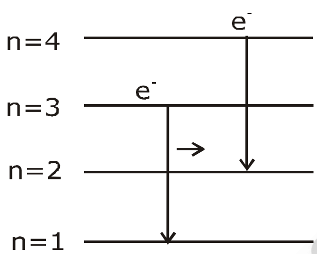
Q.35 **(4)** T.E. $= -13.6 - \frac{Z^2}{b^2}$

Q.36 (1) $E_{1\to\infty} = E_{1\to 2} + E_{2\to\infty}$
$hf_1 = hf_2 + hf_3$
$f_1 = f_2 + f_3$
$f_1 - f_2 = f_3$

Q.37 (3) Energy gap is maximum between
n = 2 to n = 1.

Q.38 (2) –3eV to –7eV is not possible.

Q.39 (1)



$$\frac{1}{\lambda} = Rz^2\left[\frac{1}{1} - \frac{1}{3^2}\right] \quad .....(1)$$

$$\frac{1}{\lambda'} = Rz^2\left[\frac{1}{2^2} - \frac{1}{4^2}\right] \quad .....(2)$$

eq (1) / eq. (2)

$$\frac{\lambda}{\lambda'} = \frac{8}{9} \times \frac{16}{3} = \frac{128}{27}$$

$$\lambda' = \frac{128}{27}\lambda$$

Q.40 (1) According to Bohr's second postulate

Angular moment, $L = \frac{nh}{2\pi}$

Angular momentum is also called a moment of momentum.

For second orbit, n = 2

$$L = \frac{2h}{2\pi} = \frac{h}{\pi}$$

Q.41 (4) T.E. $= \frac{1}{2}mv^2 - \frac{kZe^2}{r}$

Q.42 (4)

$$\Delta E = \frac{hc}{\lambda} = \frac{12400}{6200} = 2eV$$

Hence D transition.

Q.43 (4)

Q.44 (2)

Q.45 (1) As $mvr = \frac{nh}{2\pi}$ and $\lambda = \frac{h}{mv}$

$$\Rightarrow r = \frac{n}{2\pi}\frac{h}{mv} \Rightarrow 2\pi r = n\lambda$$

for n = 1 ; $\lambda = 2\pi r$

Q.46 (3) n - 1 = 5
n = 6

No. of briught lines $= \frac{n(n-1)}{2} = \frac{6 \times 5}{2} = 15$

Q.47 (1)

Q.48 (3) H-spectrum

Q.49 .(4)The radius of Bohr orbit, $r \propto n^2$

$$\therefore \frac{r_1}{r_2} = \left(\frac{n_1}{n_2}\right)^2$$

$$\Rightarrow r_2 = r_1\left(\frac{n_2}{n_1}\right)^2 \quad \ldots(1)$$

Given : $r_1 = 0.5$ Å, $n_1 = 1$, $n_2 = 4$ putting given values in eq. (1)

$$\therefore r_2 = 0.5\left(\frac{4}{1}\right)^2$$

$$\Rightarrow r_2 = 0.5 \times 16$$

$$\therefore r_2 = 8 \text{ Å}$$

Q.50 Because most of the electrons goes undeflected

TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Nuclei**

ANSWER KEY

Q.1 (1)	**Q.2** (2)	**Q.3** (3)	**Q.4** (2)	**Q.5** (1)	**Q.6** (1)	**Q.7** (4)	**Q.8** (2)	**Q.9** (3)	**Q.10** (3)
Q.11 (3)	**Q.12** (4)	**Q.13** (1)	**Q.14** (2)	**Q.15** (1)	**Q.16** (4)	**Q.17** (1)	**Q.18** (4)	**Q.19** (4)	**Q.20** (2)
Q.21 (4)	**Q.22** (4)	**Q.23** (4)	**Q.24** (3)	**Q.25** (2)	**Q.26** (4)	**Q.27** (3)	**Q.28** (2)	**Q.29** (3)	**Q.30** (2)
Q.31 (1)	**Q.32** (2)	**Q.33** (2)	**Q.34** (4)	**Q.35** (2)	**Q.36** (3)	**Q.37** (2)	**Q.38** (3)	**Q.39** (4)	**Q.40** (2)
Q.41 (1)	**Q.42** (4)	**Q.43** (1)	**Q.44** (4)	**Q.45** (2)	**Q.46** (4)	**Q.47** (2)	**Q.48** (3)	**Q.49** (3)	**Q.50** (4)

Hints and Solutions

Q.1 (1)

Q.2 (2) Nuclear density is independent of mass number.

Q.3 (3) Gamma rays are packets of energy. They carry no charge and no mass. Therefore, in gamma ray emission, there is no change in proton number and neutron number.

Q.4 (2) ${}^{24}_{12}Mg + {}^{4}_{2}He \longrightarrow {}^{x}_{14}Si + {}^{1}_{0}n$

According to mass number conservation, we get

$24 + 4 = x + 1$

or $x = 27$.

Q.5 (1)

Q.6 (1) ${}_{Z}X^{A} \rightarrow {}_{Z+1}y^{A} + {}_{-1}\beta^{0} + \bar{\nu}$

Here , $n \rightarrow p + e^{-} + \bar{\nu}$

$\therefore$ no of neutrons decreases

& no.of protons increases

Q.7 (4) When an α-particle is emitted, mass number of nuclide X is reduced to 4, and its charge number is reduced to 2, But when a β-particle is emitted, mass number of remains the same and its charge number is increased by 1. Hence, the resulting nuclide has alomic mass $A - 4$ and atomic number $Z - 1$.

Q.8 (2) Nuclear density is independent of mass number.

Q.9 (3) Radius of nucleus is given by $R=(1.3\times10^{-15})A^{1/3}$m, where A is mass number.

So, we can say that radius of nucleus is directly proportional to $A^{1/3}$.

i.e.,

$$R \propto A^{\frac{1}{3}}$$

$$\therefore \frac{R_1}{R_2} = \left(\frac{A_1}{A_2}\right)^{\frac{1}{3}}$$

$$\Rightarrow \frac{R_1}{R_2} = \left(\frac{4}{3}\right)^{\frac{1}{3}}$$

$$\left(\frac{R_1}{R_2}\right)^3 = \left(\frac{4}{3}\right)$$

$$\Rightarrow \rho \propto A^{o}$$

$$\therefore \frac{\rho_1}{\rho_2} = \frac{1}{1}$$

Q.10 (3) $A \xrightarrow{\alpha} A_1 \xrightarrow{\beta-} A_2 \xrightarrow{\alpha} A_3 \xrightarrow{\gamma} A_4$

$${}^{180}_{72}A \xrightarrow{\alpha} {}^{176}_{70}A_1$$

$$\xrightarrow{\beta-} {}^{176}_{71}A_2 \xrightarrow{\alpha} {}^{172}_{69}A_3 \xrightarrow{\gamma} {}^{172}_{69}A_4$$

Q.11 (3)

Q.12 (4) A radioactive nucleus decays only if the resulting nucleus has higher specific energy.

$\therefore E_2 > E_1$

Q.13 (1)

$$B.E_H = \frac{2.22}{2} = 1.11$$

$$B.E_{He} = \frac{28.3}{4} = 7.08$$

$$B.E_{Fe} = \frac{492}{56} = 8.78 = \text{maximum}$$

$$B.E_U = \frac{1786}{235} = 7.6$$

${}^{56}_{26}Fe$ is most stable as it has maximum binding energy per nucleon.

Q.14 (2)

Q.15 (1) Energy of each γ- ray photon = E = mc^2 = 0.0016 × 931.5 MeV = 1.5 MeV

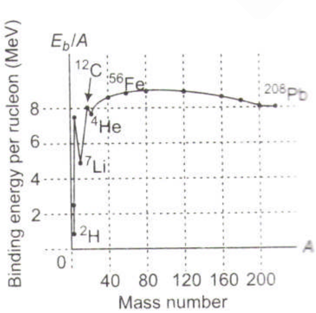
Q.16 (4)
$P + P + e \rightarrow Q$
$2E_P + e \rightarrow E_Q$

Q.17 (1)
For A mass number = 34
Total binding energy = 1.2 × 34 = 40.8 MeV
For B mass number = 26
total binding energy = 1.8 × 26 = 46.8 MeV
Difference of BE = 6 MeV

Q.18 (4)
$r = r_0(A)^{1/3}$
r increase with increasing A mass number So, $r_A < r_B$ as mass number of A is smaller
E_{bn} decrease with increasing A for A > 56, ^{56}Fe has highest E_{bn} value.
so, E_{bn} for nucleus with A = 125
$E_{bnA} > E_{bnB}$

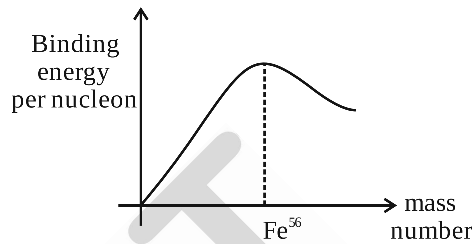
Q.19 (4)
$M(_8O^{16}) = M(_7N^{15}) + 1m_p$
binding energy of last proton
$= M(N^{15}) + m_p - M(_1O^{16})$
= 15.00011 + 1.00783 - 15399492
= 0.01302 amu = 12.13 MeV

Q.20 **(2)**
In order to compare the stability of the nuclei of different atoms we determine the binding energy per nucleon. Higher the binding energy per nucleon. More stable is the nucleus. A graph between energy per nucleon and the mass number of nuclei is called the binding energy curve. It gives the following information that of two or more very light nuclei (nucleus of heavy hydrogen $_1H^2$ fuse into a relatively heavier nucleus ($_2He^4$), then binding energy will increase showing that helium is stable.



Q.21 **(4)**
Average BE/nucleon increase first, and then decreases, as is clear from BE curve.

Q.22 **(4)**



For middle values of mass number, nuclei is more stable than lighter and heavier nuclei.

Q.23 **(4)**
$\Delta m = 0.3$ g
$= 0.3 \times 10^{-3}$ kg $= 3 \times 10^{-4}$ kg

Energy liberated, $E = \Delta mc^2$

$= 3 \times 10^{-4} \times (3 \times 10^8)^2$

$= 3 \times 10^{-4} \times 9 \times 10^{16}$

$= 27 \times 10^{12}\ J = \dfrac{27 \times 10^{12}}{3.6 \times 10^6}$ kWh

$= 7.5 \times 10^6$ kWh

Q.24 **(3)**
$_2He^4$ Binding energy
= 4 × 7 = 28 MeV.
Energy = 28 – 2 × 2.2
= 28 – 4.4 MeV = 23.6 MeV.

Q.25 (2)
$2\ _1H^2 \rightarrow {}_2He^4 + Q$
Q = 28 – 2 × 2 .2

Q = 23.6 Mev

Q.26 **(4)** $M(N, Z) = N\,Mn + ZMp - B/C^2$

Mass defect $\Delta m = \dfrac{M}{C^2}$

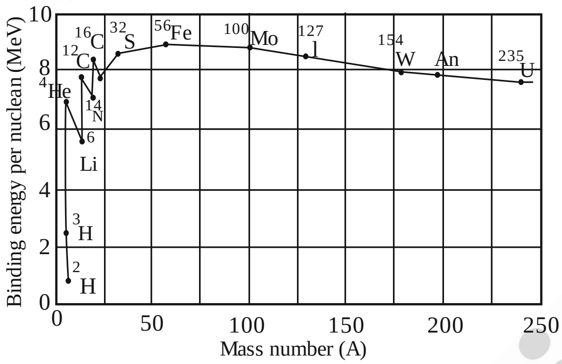
Also,
Mass defect = Total Mass of protons + Total Mass of neutrons - Mass of the nucleus
⇒ Mass of the nucleus = Total Mass of protons + Total mass of neutrons - Mass defect.

$\Rightarrow M(N, Z) = NMn + Zm_p - \frac{B}{C^2}$

Q.27 (3)
Energy is released
$\therefore (B.E.)_{product} > (B.E.)_{Reactant}$

Q.28 (2)
Released energy = $2 \times 4 \times 7 - 2 \times 1 - 7 \times 5.4$
= 16 MeV

Q.29 (3)



From the above graph we notice the following main features of the plot:
The binding energy per nucleon (Ebn) is practically constant, i.e. practically independent of the atomic number for nuclei of middle mass number (30 <A < 170)
The curve has a maximum of about 8.75 MeV for A = 56 and has a value of 7.6 MeV for A = 238.
Ebn is lower for both light nuclei (A < 30) and heavy nuclei (A > 170).
Also from this, we can see that Fe or iron has the highest binding energy per nucleon, hence it is the most stable nucleus among all.

Q.30 (2)
Binding energy per nucleon is almost constant in the mass number range 30-170. This is because nuclear force is a short range force.

Q.31 (1)
Q.32 (2)
Q.33 **(2)**

Q.34 (4)
Q.35 (2)
To start chain reaction mass should be greater than or equal to critical mass.

Q.36 **(3)**

Q.37 (2) Heavy water is used as moderators in nuclear reactions to slow down the neutrons

Q.38 (3) The energy released per unit mass is more in fusion and that per atom is more in fission.

Q.39 **(4)**

Q.40 (2)
In fission of uranium, there are three neutrons in each fission. Hence, this reaction becomes a chain reaction.

Q.41 **(1)**
Q.42 (4)
Conserving charge and nucleons gives
Atomic number of x = 13 – 11 = 2
Atomic mass of x = 27 + 1 – 24 = 4
$\Rightarrow$ x is Alpha-particle

Q.43 **(1)**
Q.44 **(4)**
Q.45 (2)
Q.46 **(4)**
nucli with law Bianding energy per nucleon support nuclear fusion process.
Q.47 (2)
Mass defect $\Delta m = (Mass)_H + (Mass)_{He}$
$\Delta m = [1 - 0.993] = 0.007 \text{ gm} = 7 \times 10^{-6}$ kg
$E = \Delta m \times c^2$
$= 7 \times 10^{-6} \times 9 \times 10^{16}$
$= 7 \times 9 \times 10^{10}$
$= 63 \times 10^{10}$J
Q.48 (3)
Statement-1 states that energy is released when heavy nuclei undergo fission and light nuclei undergo fusion is correct. Statement-2 is wrong.
The binding energy per nucleon, B/A, starts at a small value, rises to a maximum at ^{62}Ni, then decreases to 7.5 MeV for the heavy nuclei. The answer is (3).

Q.49 (3)
Deutron is $_1H^2$ and alpha particle is $_2He^4$.
Nuclear reaction is

$$_1H^2 + {_8O^{16}} \longrightarrow {_2He^4} + {_7X^{14}}$$

X is nitrogen

Q.50 (4)
Mass of uranium changed into energy

$$= \frac{0.1}{100} \times 1 = 10^{-3} \text{kg}$$

The energy released = mC^2
$= 10^{-3} \times (3 \times 10^8)^2$ 7$= 9 \times 10^{13}$ J.

TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Semiconductor Electronics- Materials, Devices and Simple Circuits**

ANSWER KEY

Q.1 (2)	**Q.2** (4)	**Q.3** (2)	**Q.4** (1)	**Q.5** (1)	**Q.6** (1)	**Q.7** (1)	**Q.8** (1)	**Q.9** (2)	**Q.10** (1)
Q.11 (2)	**Q.12** (1)	**Q.13** (3)	**Q.14** (1)	**Q.15** (2)	**Q.16** (3)	**Q.17** (2)	**Q.18** (4)	**Q.19** (4)	**Q.20** (2)
Q.21 (4)	**Q.22** (4)	**Q.23** (4)	**Q.24** (2)	**Q.25** (2)	**Q. 26** (2)	**Q.27** (3)	**Q.28** (2)	**Q.29** (4)	**Q. 30** (1)
Q.31 (4)	**Q.32** (3)	**Q.33** (1)	**Q.34** (1)	**Q.35** (2)	**Q.36** (3)	**Q.37** (4)	**Q.38** (3)	**Q.39** (4)	**Q.40** (3)
Q.41 (1)	**Q.42** (1)	**Q.43** (1)	**Q.44** (4)	**Q.45** (2)	**Q.46** (3)	**Q.47** (4)	**Q.48** (1)	**Q.49** (1)	**Q.50** (1)

Hints and Solutions

Q.1 (2)

Q.2 **(4)**

Q.3 **(2)**A positive hole in a semiconductor is created when an electron leaves its side breaking the covalent bond thus creating a positive charge equal to that of electron.

Q.4 **(1)** In forward biasing, resistance of PN Junction diode is zero, so whole voltage appears across the resistance.

Q.5 (1) Mobility of e^- is greater, then mobility of holes
$\Rightarrow \mu_e > \mu_h$
Option (1)

Q.6 (1)

Q.7 (1)
When the connection of battery is reversed, then a semiconduction device is reverse biased. We know that in forward biasing of p-n junction the current is of the order of milliampere while in reverse biassing the current is of the order of microampere (negigible). Thus, device is a p -n junction.

Q.8 (1)
Silicon is a intrinsic semi-conductor
N-type semiconductor prepared by adding impurity like phosphorus.
P-type semiconductor prepared by adding impurity like indium.
Depletion layer have immobile ion.

Q.9 (2)
Due to difference of concentration of holes and electrons across the Junction holes move to the n-side & electrons move to the p-side. This leads to creation of depletion layer. It is called as diffusion.

Q.10 (1)
In reverse biasing, drift current increases due to large velocity of the minority charge carriers.

Q.11 (2)
F.B. $\rightarrow$ Diffusion
R.B $\rightarrow$ Drift

Q.12 (1)

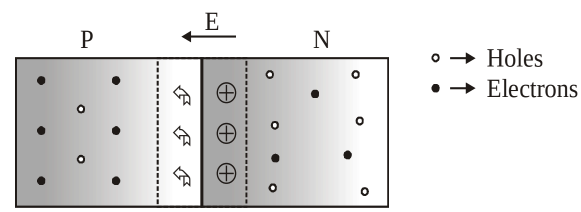
$$E = \frac{dV}{dr} = \frac{0.5}{5\times10^{-7}} = 10^6\ V/m$$

Q.13 (3)
A bond is broken on the n-side and the electron freed from the bond jumps to a broken bond on the p-side to complete it.
A hole diffuses from the p side to the n side in a p - n junction; that is, an electron moves from the n side to the p side. This implies that a bond is broken on the n side. As the electron travels towards the p side, which is rich in holes, it combines with a hole. A hole is created because of the deficiency of one electron. So, when an electron combines with a hole, it completes that bond.

Q.14 (1)
Pentavalnet activities have excess free e^-
So e^- density increases but overall semiconductor is neutral.
Option (1)

Q.15 **(2)**

Q.16 (3)
At junction a potential barrier/depletion alyer is formed, with N-side at higher potential and P-side at lowr potential. Therefore there is an electric field at the jucntion directed from the N-side to P-side.



Q.17 (2)
Reverse bias increases the potential barrier.

Q.18 **(4)**

Q.19 **(4)**
Q.20 **(2)**
Q.21 **(4)**

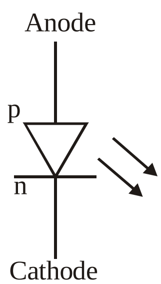
Q.22 (4)

Q.23 (4)

$$E = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{12400}{E(ev)} = \frac{12400}{2.5} = 4960\text{Å}$$

Q.24 (2)

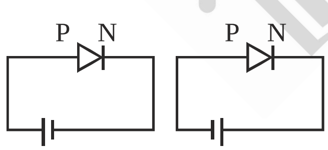
Q.25 (2)
Let diode



Optin (2)

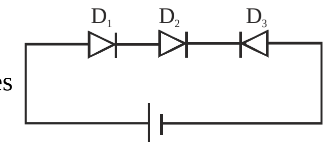
Q. 26 (2)
Statement I : Photocell/solar cell convert light energy into electric energy/current.
Statement II : We use zener diode in reverse biased condition, when reverse biased voltage more than break down voltage than it act as stablizer.

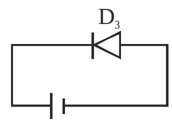
Q.27 **(3)**



If p side is connected to +ve terminal of battery and N side is connected to -ve terminal of battery,
Then diode is forward biased.
If p side is connected to -ve terminal of battery and N side is connected to +ve terminal of battery then diode is reverse baised.

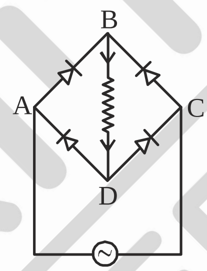
⇒ For ideal diodes





D_3 is reverse biased.

Q.28(2)

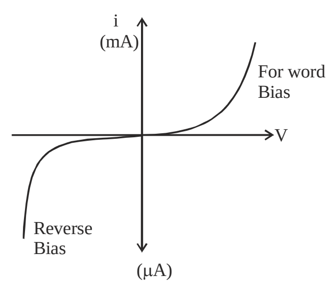


For both +ve and –ve input of voltage current flows from B to D across load resistance.

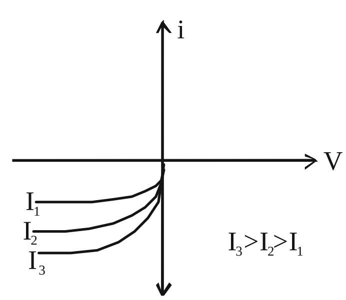
Q.29 (4)
Both the statements are true. To convert the pulsating voltage into steady D.C. both the methods can be implemented.

Q. 30 (1)

Q.31 (4)



For Photodiode , it is always operated in reverse bias .



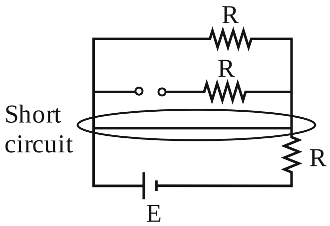
Q.32 **(3)**

If the item has two terminals, it may be diode , a LED, a resistor or a capacitor . But diode, LED conducts only in forward biased while capacitor and resistor conduct in both direction

Q.33 **(1)**

Q.34 (1)

For forward biased, ideal diode provides zero resistance. For reverse biased, ideal diode provides infinite resistance. So, equivalent circuit diagram is



$$i = \frac{\varepsilon}{R}$$

Q.35 **(2)**

$$i_1 = \frac{2}{5}\text{amp} = 0.4 \text{ Amp}$$

When D_2 is in forward bias

$$i_2 = \frac{2}{10} = 0.2 \text{ Amp}$$

Q.36 (3)

Q.37 **(4)**

(a) $\overline{A} + \overline{B} = \overline{A.B}$ $(\because \overline{A.B} = \overline{A} + \overline{B})$

(b) $\overline{A}.\overline{B} = \overline{A+B}$ $(\because \overline{A+B} = \overline{A}.\overline{B})$

Q.38 **(3)**

(A) NOT Gate
(B) OR
(C) AND
(D) NAND

Q.39 **(4)**

Q.40 **(3)**

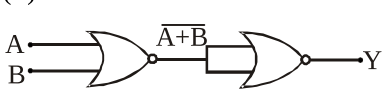
Q.41 **(1)**

Q.42 **(1)**

Q.43 **(1)**

Q.44 (4)

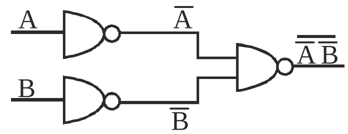
Q.45 (2)



$Y = \overline{\overline{A+B}} = A + B$

The given circuit performs OR gate operation

Q.46 (3)



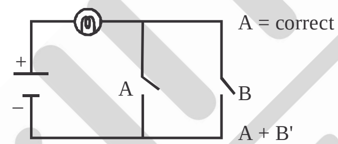
Output = $\overline{\overline{A}\,\overline{B}} = \overline{\overline{A}} + \overline{\overline{B}} = A + B$

= OR Gate

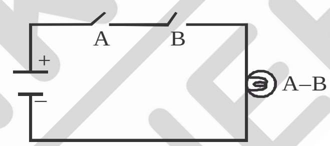
$\Rightarrow$ 3 NAND GATESsw

Q.47 **(4)**

OR Gate



And Gate



Q.48 (1)

Putting (0,0)

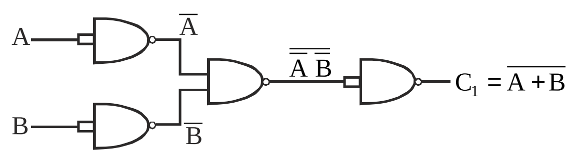
A + B = 0,

$\overline{A+B} = 1$,

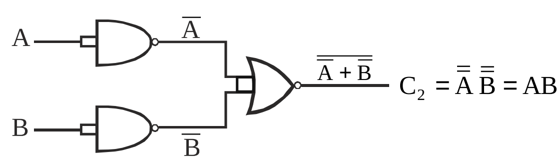
A . B = 0, $\overline{A+B} = 1$

For any other value $\overline{A+B} = 0$

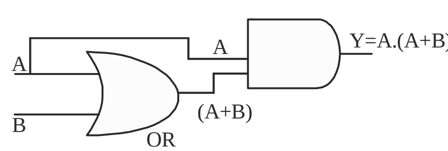
Q.49 (1)



$\overline{\overline{A}\,\overline{B}} = \overline{\overline{A}} + \overline{\overline{B}} = A + B$



Q.50 (1)



TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Magnetism and Matter**

ANSWER KEY

Q.1 (1)	**Q.2** (1)	**Q.3** (2)	**Q.4** (4)	**Q.5** (2)	**Q.6** (2)	**Q.7** (2)	**Q.8** (1)	**Q.9** (2)	**Q.10** (1)
Q.11 (4)	**Q.12** (4)	**Q.13** (2)	**Q.14** (4)	**Q.15** (1)	**Q.16** (1)	**Q.17** (1)	**Q.18** (2)	**Q.19** (2)	**Q.20** (3)
Q.21 (3)	**Q.22** (3)	**Q.23** (2)	**Q.24** (1)	**Q.25** (2)	**Q.26** (2)	**Q.27** (3)	**Q.28** (1)	**Q.29** (3)	**Q.30** (3)
Q.31 (3)	**Q.32** (1)	**Q.33** (3)	**Q.34** (1)	**Q.35** (3)	**Q.36** (3)	**Q.37** (2)	**Q.38** (1)	**Q.39** (4)	**Q.40** (4)
Q.41 (2)	**Q.42** (3)	**Q.43** (2)	**Q.44** (4)	**Q.45** (4)	**Q.46** (4)	**Q.47** (1)	**Q.48** (3)	**Q.49** (1)	**Q.50** (1)

Hits and Solutions

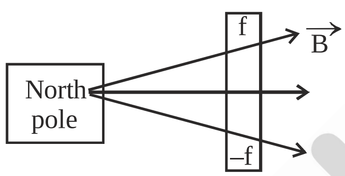
Q.1 (1)

n equal parts perpendicular to the length $T' = \frac{T}{n}$

Q.2 (1)

Force = mB – m (B + dB)

$= -\,mdB = -\,(ml)\frac{dB}{r} = -M\frac{dB}{dr} \neq 0$



torque on magnet ≠ 0

Q.3 (2)

When magnets are placed perpendicular to each other then,

Resultant magnetic moment

$M' = \sqrt{M_1^2 + M_2^2}$

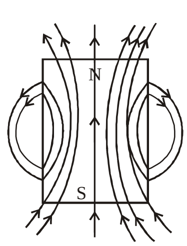
Here, $M_1 = M_2 = M$

So, $M' = M\sqrt{2} = (\sqrt{2})m\ell$

Q.4 **(4)** $W = MB(\cos\theta_1 - \cos\theta_2)$

$= (2\times 10^4)(6\times 10^{-4})\,[1-0.5] = 6$ J

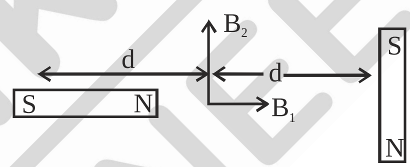
Q.5 (2)



The direction of magnetic line of force of a bar magnet from south to north pole inside the magnet and from north to south outside the magnet.

Q.6 (2)

$B_{net} = \sqrt{B_1^2 + B_2^2}$



$B_1 = \left(\frac{\mu_o}{4\pi}\right)\frac{2M}{d^3}$, $B_2 = B_2 = \left(\frac{\mu_o}{4\pi}\right)\frac{M}{d^3}$

$B_{net} = \sqrt{B_1^2 + B_2^2} = \left(\frac{\mu_o}{4\pi}\right)\frac{M}{d^3}\sqrt{4+1} = \left(\frac{\mu_o}{4\pi}\right)\frac{M\sqrt{5}}{d^3}$

Q.7 **(2)**

From $T = 2\pi\sqrt{\frac{I}{MB}}, 4 = 2\pi\sqrt{\frac{I}{MB}}$

When it is cut into two equal parts in length, mass of each part becomes $\frac{1}{2}$, I = mass $\frac{(\text{length})^2}{12}$ becomes $\frac{1}{8}$th and M becomes $\frac{1}{2}$

$$T' = 2\pi\sqrt{\frac{\frac{I}{8}}{\left(\frac{M}{2}\right)B}}$$

$\therefore T' = \frac{1}{2}\left(2\pi\sqrt{\frac{I}{MB}}\right)$

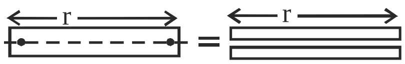
$T' = \frac{1}{2}T = 2s$

Q.8 (1)

Initially pole strength = m

magnetic moment = M

After cut along axis



Pole strength becomes $\frac{m}{2}$

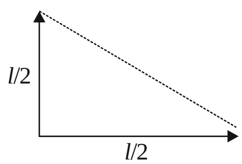
and magnetic moment = pole strength × separation

$$\frac{m}{2} \times l = \frac{M}{2}$$

Q.9 (2)

Magnetic moment of each part is = M/2

So, the net magnetic moment is



$$= \sqrt{\left(\frac{M}{2}\right)^2 + \left(\frac{M}{2}\right)^2} = \frac{M}{\sqrt{2}}$$

Q.10 **(1)**

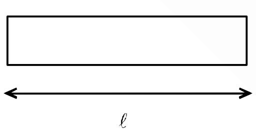
Monopole is not exist. it exist in pair

Q.11 (4)

Time Period, $T = 2\pi\sqrt{\frac{I}{MB}} = 2\pi\sqrt{\frac{I}{MH}}$

$\Rightarrow T \propto \sqrt{I}$ and $T \propto \sqrt{\frac{I}{H}}$, $T \propto \sqrt{\frac{I}{M}}$

Q.12 (4)



$M = m\ell$

$M_1 = m.\frac{3\ell}{\pi}$

$M_1 = \frac{3M}{\pi}$

Q.13 (2)

Diamagnetic materials are repelled in an external magneitc field.

Q.14 (4)

Statement-I Magnetic fied in closed loop.

Statement-II $\phi_{\text{inclose}} = 0$

Q.15 (1)

Work done = change in potential energy

$\Rightarrow \Delta E = -M\,B[\cos 60° - \cos 0°]$

$= -10^4 \times 4 \times 10^{-5}\left[\frac{1}{2} - 1\right]$

= 0.2 J

Q.16 (1)

Two magnetic line of force never intersect

Q.17 (1)

Work done in changing the orientation of a dipole of moment M in a magnetic field B from position θ_1 to θ_2 is given by

$W = MB\,(\cos\theta_1 - \cos\theta_2)$

Here, $\theta_1 = 0°$ and $\theta_2 = 180°$

So, W = 2MB = 2 × 2.5 × 0.5 = 1J

Q.18 (2)

Since long magnet ⇒ one end of magnet is on take and other end of magnet is at infinity.

$\Rightarrow \vec{B}$ due to single pole $= \left(\frac{\mu_0}{4\pi}\right)\frac{m}{r^2} = |\vec{B}_H|$

(∵ neutral point)

because at neutral point, $\overrightarrow{B_{Net}} = 0$

$$\Rightarrow \left(\frac{\mu_0}{4\pi}\right)\frac{m}{r^2} = 5 \times 10^{-5} \Rightarrow (10^{-7})\frac{m}{(0.2)^2} = 5 \times 10^{-5}$$

$$\Rightarrow \frac{m}{(0.04)} = 500 \Rightarrow m = (500)\left(\frac{4}{100}\right) = 20 \text{ A-m}$$

Q.19 (2) $\therefore U = -\vec{M}.\vec{B} = -MB\cos\theta$

For stable equilibrium, θ = 0°

$\therefore$ U = –MB = –(0.4 J T^{-1}) (0.16 T) = –0.064J

Q.20 (3)

$$\frac{KM}{X^3} = B_H \Rightarrow M = \frac{B_H x^3}{K}$$

Q.21 (3)
$U = U_f - U_i$
$W = MB - (-MB)$
$= 2MB$
$= 2 \times 4 \times 0.2 = 1.6J$

Q.22 (3)
$\tau = MB \sin\theta$
$0.018 = M \times 0.06 \times 0.5$
$\Rightarrow M = 0.6\ Am^2$
$W = U_f - U_i$
$= MB (\cos\theta_i - \cos\theta_f) = MB (\cos0° - \cos180°)$
$= 0.6 \times 0.06 (1 - (-1))$
$= 7.2 \times 10^{-2}$ J

Q.23 (2)
$M = NIA$
$= 1000 \times 2 \times 8 \times 10^{-3} = 16\ Am^2$
$\tau = M \times B \sin\theta$
$= 5 \times 10^{-2} \times 16 \times \frac{1}{2} = 0.4$ Nm

Q.24 (1)
Case-I
When diamagnetic material is placed in magnetic field, dipole moment lies in opposite diection.
So, on increasing magnetising field (H), magnetization (M) will decrease in opposite direction.
Therefore, correct representation of H vs M is shown by (a).
Case-II
Magnetic susceptilibity for diamagnetic material is independent of tempertaure.
Therefore, correct graph will be (c).

Q.25 (2)
Formula based

Q.26 (2)
Volume of rod $= 10 \times 0.5 \times 0.2 \times 10^{-6} = 10^{-6}\ m^3$
$H = 0.5 \times 10^4\ Am^{-1}$, $M = 5\ Am^2$ B = ?
Intensity of magnetisation i.e.

$$I = \frac{M}{V} = \frac{5}{10^{-6}} = 5 \times 10^6\ Am$$

From $B = \mu_0(I + H)$
Magnetic induction
i.e. $B = 4\pi \times 10^{-7}[5 \times 10^6 + 0.5 \times 10^4]$
$= 4\pi \times 10^{-7} \times 5 \times 10^6 = 20 \times 3.14 \times 10^{-1}$
$= 6.28$ T

Q.27 (3)
$\vec{B}_{net} = \mu_0 \left(\vec{H} + \vec{I}\right) = \mu_0 (1 + \chi) H$
$B_{net} = \mu_0 H(1 + \chi) = 4\pi \times 10^{-6} (1 + 1999)$
$= 8\pi \times 10^{-3}$ T

Q.28 (1)

Q.29 (3)

Q.30 **(3)**

Susceptibility $(X) \frac{\text{intensity of magnetisation(I)}}{\text{magnetic field (B)}}$

Or $I = \chi B$
$\therefore I = 3 \times 10^{-4} \times 4 \times 10^{-4}$
Or $I = 12 \times 10^{-8}\ Am^{-1}$

Q.31 (3)

$\phi = \vec{B}.\vec{A} = \mu_m \vec{H}.\vec{A} = \mu_o \mu_r HA$

$\Rightarrow \mu_r (\mu_o HA) = 0{\cdot}91 \Rightarrow \mu_r = \frac{0{\cdot}91}{0{\cdot}65} = 1{\cdot}4$

Q.32 **(1)**

Q.33 (3)
$p_m \times l = M$

$p_m l = n i A$

Q.34 **(1)**
In SI units, we have $B = \mu_0(H + I)$

Q.35 (3)
Magnetization in a ferromagnetic material depends on both magnetic intensity, and history of the specimen.

Q.36 (3)
$I \propto H$

Q.37 (2)

Q.38 (1)

Q.39 **(4)**
factual

Q.40 (4)
For paramagnetic

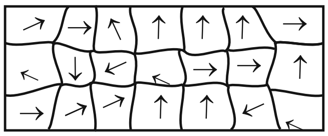
Magnetic suscaptibility, $\chi \propto \frac{1}{T}$

$\Rightarrow$ inversely proportional to absolute temperature

Q.41 (2)
When a magnetic needle is placed in a uniform magnetic field, equal and opposite forces act on the poles of the needle which give rise to a torque, but not net force.

Q.42 **(3)**

Q.43 **(2)**
In ferromagnetic substance, domains are randomly arranged.



Q.44 **(4)**
As $\mu_r < 1$ for substance X, it must be diamagnetic. And $\mu_r > 1$ for substance Y, is must be paramagnetic.

Q.45 (4)

Q.46 (4)

Q.47 **(1)**
On applying magnetic field, domains of ferromagnetic substance align themselves in the direction of magnetic field.

Q.48 (3)

Q.49 (1)

Q.50 (1)

TOPIC WISE TEST (NEET)

Subject : Physics **Topic : Electromagnetic Waves**

ANSWER KEY

Q.1 (1)	**Q.2** (1)	**Q.3** (3)	**Q.4** (2)	**Q.5** (3)	**Q.6** (4)	**Q.7** (3)	**Q.8** (2)	**Q.9** (1)	**Q.10** (3)
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Hints and Solutions

Q.1 (1)

$$\frac{k}{\omega} = \frac{\frac{2\pi}{\lambda}}{2\pi\upsilon} = \frac{1}{c}$$

Where c is the speed of electromagnetic wave in vacuum. It is constant whose value is 3×10^8 m s^{-1}

Q.2 **(1)**

Q.3 (3)

Q.4 (2)

Q.5 (3)
equally in both electric and magnetic field

Q.6 **(4)**

Q.7 (3)

Q.8 (2)

Q.9 (1)

Q.10 **(3)**

Q.11 (4)
$P = 3.9 \times 10^{26}$ W, $r = 6.96 \times 10^8$ m

$$I = \frac{P}{4\pi r^2}$$

$$= \frac{3.9 \times 10^{26}}{4\pi \times (6.96)^2 \times 10^{16}}$$

$I = 6.4 \times 10^7$ W/m^2

Q.12 (4)
Maxwell's equations are the fundamental laws of electromagnetism.

Q.13 (4)

$$B_0 = \frac{E_0}{c} = \frac{6.0 \times 10^{-4}}{3 \times 10^8} = 2.0 \times 10^{-12}\,T$$

Q.14 (1)

Displacement current, $I_d = \varepsilon_0 A \frac{dE}{dt}$

$I_d = 8.85 \times 10^{-12} \times 2 \times 10^{-4} \times 6 \times 10^6$
$= 1.06 \times 10^{-8}$ A

Q.15 **(3)**
Nature of Emw is transverse

Q.16 (1)
$V_e = V_B$

Q.17 **(1)**
E and B in y and Z direction only

Q.18 **(4)**

$$\frac{E_0}{B_0} = c \Rightarrow B_0 = \frac{10^{18}}{3 \times 10^8} = 0.33 \times 10^{10}$$

Q.19 **(1)**

A = 100 V/m, V=$10^8 \Rightarrow \omega = 2\pi n = \frac{2\pi C}{\lambda}$

$$\lambda = \frac{2\pi \times 3 \times 10^8}{10^8} = 6\pi$$

$= 6\pi = 18.84$m

and $k = \frac{2\pi}{\lambda} = \frac{2\pi}{6\pi} = \frac{1}{3} = 0.33$ rad/m

Q.20 (1) $I = \frac{P}{4\pi r^2}$

$$I = \frac{1}{2 \times 4} \frac{314}{\times 3.14 \times (0.1)^2} = 1.25 \times 10^3\ \text{W m}^{-2}$$

Q.21 **(3)**
Factual.

Q.22 (1)
$V_m = 2 \times 10^8$m/s $\quad \mu_r = 1 \quad \varepsilon = ?$

$v_m = \frac{c}{\sqrt{\mu_r \varepsilon_r}} \Rightarrow 2\times10^8 = \frac{3\times10^8}{\sqrt{1.\varepsilon_r}}$

$\sqrt{\varepsilon_r} = \frac{3}{2} \Rightarrow \varepsilon_r = \frac{9}{4}$

$\boxed{\varepsilon_r = 2.25}$

Q.23 **(4)**

Direction of e.m wave propagation is along $\vec{E}\times\vec{B}$

Q.24 (4)

Electric & magnetic field vectors are perpendicular to each other so option (4) is false.

Q.25 (2)

Q.26 (1)

$\sqrt{\mu_r \varepsilon_r} = 2$

$v = \frac{c}{n} = \frac{3\times10^8}{2} = 15\times10^7$ m/s

$x = 15$

Q.27 (3)

Velocity of wave (v)

$v = \frac{\omega}{k} = \frac{10\times10^{10}}{500} = 2\times10^8 \quad \Rightarrow \quad v = \frac{2c}{3}$

Q.28 (3) $f = \frac{c}{\lambda}; \lambda = \frac{c}{f} = \frac{3\times10^8}{40\times10^6} = 7.5\text{m}$

Q.29 (4)

Displacement current = conductional current

$\Rightarrow i_d = i_c = \frac{dq}{dt} = \frac{d(CV)}{dt}$

$\Rightarrow i_d = C\frac{dV}{dt} = (1\times10^{-6})\times5$

$\Rightarrow i_d = 5\times10^{-6}$ A

$\Rightarrow \boxed{i_d = 5\mu A}$

Q.30 (3)

$V = \frac{1}{\sqrt{9\mu_0\varepsilon_0}}$

$V = \frac{C}{3}$

$\lambda' = VT$

$\lambda' = \frac{\lambda}{3}$

Q.31 (1)

(a) Infrared rays are used to treat muscular strain.
(b) Radiowaves are used for broadcasting purposes.
(c) X-rays are used to detect fracture of bones.
(d) Ultraviolet rays are absorbed by ozone.

Q.32 (4)

Microwave, X-rays, γ-rays are part of electromagnetic spectrum. β-rays are beam of electrons emitted from nucleus during nuclear reaction when a neutron breaks into a proton and an electron

$n \rightarrow p + e$

And β-rays can travel at any speed.

Q.33 (1)

Infra Red waves	Visible light	UV rays

$\xrightarrow[\text{decreasing wavelength}]{\lambda}$

visible light varies from 400 nm to 700 nm,
And UV rays can penetrate Ozone layer
$\Rightarrow$ EM waves less than 400 nm = 4×10^{-7} m can be blocked by ozone layer

Q.34 (4)

The electromagnetic waves in the order of decreasing frequencies is given by

$\upsilon_{X\text{-rays}} > \upsilon_{ultraviolet} > \upsilon_{visible} > \upsilon_{infrared} > \upsilon_{micro}$

As energy, $E = h\upsilon$

$\therefore$ The electromagnetic waves in the order of decreasing energies is given by

$E_{X\text{-rays}} > E_{ultraviolet} > E_{visible} > E_{infrared} > E_{micro}$

From above it is clear that the energy of infrared waves is greater than that of microwaves.

Q.35 (1) As, we know energy liberated, $E = \frac{hc}{\lambda}$

i.e. $E \propto \frac{1}{\lambda}$

So, lesser the wavelength, greater will be energy liberated by electromagnetic radiations per quantum.
As order of wavelengths is given by

X-ray,	VIBGYOR,	Radio Waves
(3)	(1) (2)	(4)

$\therefore$ Order of electromagnetic radiations per quantum.

$\Rightarrow \quad D > B > A > C$

Q.36 **(1)**
Microwaves have large wavelengths and low frequencies. Due to which they travel along a straight line without bending.

Q.37 **(3)**
The orderly arrangement of different parts of EM wave in decreasing order of wavelength is as follows :

$\lambda_{\text{radio waves}} > \lambda_{\text{micro waves}} > \lambda_{\text{visible}} > \lambda_{X-\text{rays}}$

Q.38 (2)
Electromagnetic radiations in the order of increasing frequencies is given by

$\upsilon_{\text{radio}} < \upsilon_{\text{micro}} < \upsilon_{\text{infrared}} < \upsilon_{\text{visible}} < \upsilon_{\text{ultraviolet}} < \upsilon_{\text{X-rays}} < \upsilon_{\gamma\text{-rays}}$
Therefore, γ-rays have the highest frequency.

Q.39 (4)
Microwaves are used to cook food. Microwave oven is a domestic application of these waves.

Q.40 (3)
X-rays, radiowaves and ultraviolet rays are electromagnetic waves and do not require a medium to travel whereas infrasonic are mechanical waves and they require a medium to travel. Hence, infrasonic waves do not travel in vacuum.

Q.41 (3)
Wavelength order of given rays are listed below :

Rays	**Wavelengths [Å]**
Visible light	4000–7900
X-rays	1–100
Microwaves	10^7–10^9

Obviously, $\lambda_x < \lambda_v > \lambda_x$ $\lambda_m < \lambda_v > \lambda_x$
Note : Visible light, X-rays and microwaves are all electromagnetic waves.

Q.42 (3)

Q.43 (4)
Given, E = 13.2 keV

$$\lambda\,(\text{in Å}) = \frac{hc}{E(eV)} = \frac{12400}{13.2\times10^3} = 0.939\text{Å} \approx 1\text{Å}$$

X-rays covers wavelengths ranging from about 10^{-9} m (1 nm) to 10^{-12} m (10^{-3} nm).
An electromagnetic radiation of energy 13.2 keV belongs to X-ray region of electromagnetic spectrum.

Q.44 (2) The direction of propagation of EM wave is along $\vec{E}\times\vec{B}$ ·

Q.45 (2) As $\lambda = \dfrac{hc}{E}$
where the symbols have their usual meanings.
Here, E = 15 keV = 15 × 10^3 V
and hc = 1240 eV nm

$$\therefore\ \lambda = \frac{1240\,\text{eV nm}}{15\times10^3\,\text{eV}} = 0.083\text{ mm}$$

As the wavelength range of X-rays is from 1 nm to 10^{-3} nm, so this wavelength belongs to X-rays.

Q.46 (4)

Q.47 (3)
Every body at all time, at all temperatures emits rediation except at T=0
The radiation emitted by the human body lies in the Infra-red region.

Q.48 (2)
Theory based

Q.49 (4)

Q.50 (4)
Factual