Sample Paper-02

Dropper NEET (2024)

PHYSICS

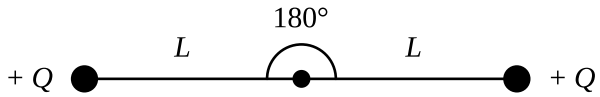
ANSWER KEY

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

HINTS AND SOLUTION

1. **(1)**

The position of the balls in the satellite will become as shown below.



Thus, angle θ = 180° and Force $= \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q^2}{(2L)^2}$

2. **(2)**

The value of high resistance (R) that should be connected in series with the galvanometer of resistance G for converting it into a voltmeter of range 0 to V is given by $R = \frac{V}{I_g} - G$ and $I_g = \frac{V}{G}$

For increasing its range to nV, R should be changed to $R' = \frac{nV}{\left(\frac{V}{G}\right)} - G$

$\therefore \quad R' = nG - G = G(n-1).$

3. **(2)**

Since, $X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}$

$\Rightarrow \quad X_C \propto \frac{1}{f}$

$\Rightarrow \quad X_C f$ = Constant

which is the equation of rectangular hyperbola xy = Constant.

4. **(4)**

From the formula of potentiometer, we have

$\frac{E_1}{E_2} = \frac{l_1}{l_2}$

where, E_1 and E_2 are the emf's of two given cells and l_1 and l_2 are the corresponding balancing lengths on potentiometer wire.

Given, $E_1 = E$ volt, l_2 = 30 cm, l_1 = 100 cm

$\therefore \quad E_2 = E_1 \cdot \frac{l_2}{l_1} = E \cdot \frac{30}{100}$

5. **(2)**

Magnetic moment of coil $= NIA\hat{j}$

$= NI(\pi r^2)\hat{j}$

Torque on loop (coil) = $\vec{M} \times \vec{B}$

$= NI(\pi r^2) B \sin 90°(-\hat{k})$

$= NI\pi r^2 B(-\hat{k}).$

6. **(1)**

Both electric and magnetic fields have sinusoidal nature in a plane electromagnetic wave. As we know, the average value of a sinusoidal wave is zero, so both magnetic and electric fields have average values of zero.

7. **(1)**

Path difference due to plate is

$\Delta x = (\mu - 1)t$

For constructive interference $\Delta x = n\lambda$

$n\lambda = (\mu - 1)t$

For $t_{\min} = \frac{\lambda}{(\mu - 1)} = 2\lambda$

8. **(3)**

Trajectory C is not possible because alpha particle will be repeled by nucleus, so trajectory C is showing attraction, so it is not possible.

9. **(3)**

We know that, $I = neAv_d$

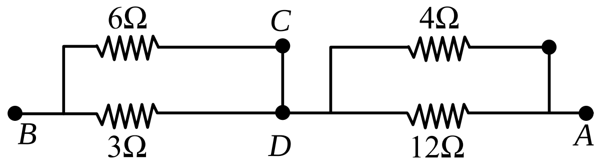
$\frac{I_e}{I_h} = \frac{n_e \times e \times (v_d)_e \times A}{n_h \times e \times (v_d)_h \times A}$

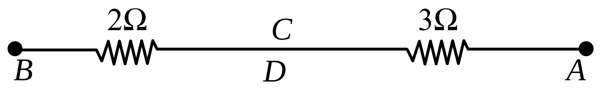
Given that $\frac{n_e}{n_h} = \frac{7}{5}$ and $\frac{I_e}{I_h} = \frac{7}{4}$

$\frac{7}{4} = \frac{7}{5} \times \frac{(v_d)_e}{(v_d)_h}$

$\Rightarrow \quad \frac{(v_d)_e}{(v_d)_h} = \frac{5}{4}$

10. (4)





In the above circuit, the resistance 6Ω and 3Ω are connected in parallel, So, the equivalent resistance is calculated as,

$$\frac{1}{R'_P} = \frac{1}{3} + \frac{1}{6}$$

$$\Rightarrow \quad R'_P = 2\Omega$$

The resistance 4Ω and 12Ω are connected in parallel, So, the equivalent is calculated as,

$$\frac{1}{R''_P} = \frac{1}{4} + \frac{1}{12}$$

$$\Rightarrow \quad R''_P = 3\Omega$$

Now, R'_P and R''_P are in series, so the equivalent resistance between the points, A and B is,

$$R_{eq} = R'_P + R''_P$$

$$R_{eq} = 2 + 3 = 5\Omega$$

11. (2)

Speed and wavelength decrease when light travels from rare to denser medium. Hence, when light enters from air to water, then its frequency is the same but the wavelength is smaller in water than in air.

12. (2)

Volume, $V = \frac{4}{3}\pi r^3 = \frac{4}{3}\pi(1.2\times10^{-15} A^{1/3})^3$

Mass, $m = A \times 1.67 \times 10^{-27}$ kg

Density

$$= \frac{\text{mass}}{\text{volume}} = \frac{1.67\times10^{-27} A}{\frac{4}{3}\pi\times1.2^3\times10^{-45}\times A} = 2.3\times10^{17}\ \text{kgm}^{-3}$$

13. (2)

B is zero only in case of C.

In C two, wires are producing $(\odot)$ magnetic field and two wires are producing $(\otimes)$ magnetic field.

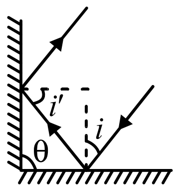
14. (3)

$$\lambda_{\min} \propto \frac{1}{V} \propto V^{-1}$$

% change in $\lambda_{\min}$ = (–1) (% change in V) for small % changes

For 2% change in V there will be 2% decrease in wavelength.

15. (1)



$$\delta = \delta_1 + \delta_2 = (180 - 2i) + (180 - 2i') = 360 - 2(i + i')$$

$$\delta = 360° - 2\theta$$

$$\delta = 360° - 2(90°) = 180°.$$

16. (4)

Incident angle > Critical angle,

$i > i_c$

$\therefore \quad \sin i > \sin i_c$

$$\sin i_c = \frac{1}{n}$$

$$\sin 45° > \frac{1}{n}$$

$$\frac{1}{\sqrt{2}} > \frac{1}{n} \Rightarrow n > \sqrt{2}$$

17. (3)

$$\phi_E = \vec{E}.\vec{A} = \left(5\hat{i} + 8\hat{j} + 9\hat{k}\right).10\hat{i} = 50\,\text{units}$$

18. (2)

Photon moves with speed of light ie,

$v = c$ and rest mass of a particle is

$$m_0 = m\sqrt{1 - v^2/c^2}$$

hence m_0 (photon) = 0

$\therefore \quad$ photon has zero rest mass.

Momentum of photon $= \frac{h}{\lambda}$

19. (4)

Phase difference corresponding to the path difference, $\Delta x = \frac{\lambda}{3}$ is

$$\phi = \left(\frac{2\pi}{\lambda}\right)\left(\frac{\lambda}{3}\right) = \frac{2\pi}{3} \text{ or } \frac{\phi}{2} = \frac{\pi}{3}$$

$$I = I_0 \cos^2\left(\frac{\pi}{3}\right) = \frac{I_0}{4}$$

20. **(1)**

$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$

$= \frac{1}{100}\sqrt{\frac{80 \times 10^{-3}}{2 \times 10^{-6}}}$

= 2

21. **(4)**

The resultant magnetic field is given by,

$B = B_1 + B_2$

$B = \frac{\mu_0}{4\pi}\frac{2\pi n i_1}{r_1} - \frac{\mu_0 2\pi n i_2}{4\pi\, r_2}$

$B = \frac{\mu_0}{2}\left[\frac{n i_1}{r_1} - \frac{n i_2}{r_2}\right]$

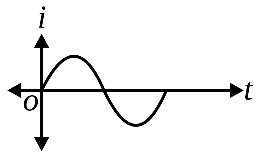
$B = \frac{\mu_0}{2}\left[\frac{10 \times 0.2}{0.20} - \frac{10 \times 0.4}{0.40}\right]$

$B = 0$

22. **(3)**

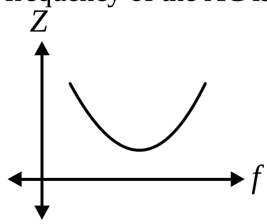
We know that, in a pure inductive circuit, current lags behind the applied voltage by a phase difference of $\frac{\pi}{2}$.

As applied voltage is a cos function, therefore, current function should be a sin function.



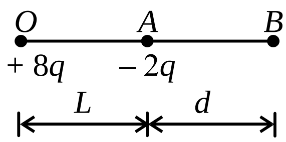
23. **(4)**

The curve between impedance of the circuit and frequency of the AC is shown in the diagram.



$\Rightarrow$ Impedance first decreases, then increases.

24. **(3)**



$\frac{1}{4\pi\varepsilon_0}\frac{8q}{(L+d)^2} - \frac{1}{4\pi\varepsilon_0}\frac{2q}{d^2} = 0$

or $(L + d)^2 = 4d^2$

or $d = L$

$\therefore$ Distance from origin = $2L$.

25. **(4)**

Since, net electric field should be perpendicular to a equipotential surface.

Equation that represents electric field line will have slope $m_2 = -\frac{1}{2} (\because m_1 m_2 = -1)$

But slope, $m_2 = \tan\theta = \frac{y}{x}$

From the given options, $\frac{y}{x}$ value becomes $-\frac{1}{2}$ only for option (4).

26. **(1)**

Acceleration,

$a = \frac{v-u}{t} = \frac{6j - (6\hat{i} - 2\hat{j})}{10} = \frac{-3\hat{i} + 4\hat{j}}{5}\,\text{m/s}^2$

Force, $F = ma = 5 \times \frac{(-3\hat{i} + 4\hat{j})}{5} = (-3\hat{i} + 4\hat{j})N$

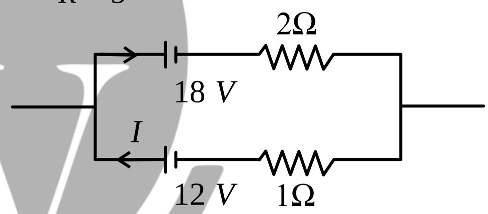
27. **(3)**

From Kirchhoff's law,

I × 2 + I × 1 = 18 – 12

Current in the circuit,

$I = \frac{V}{R} = \frac{6}{3} = 2A$



Voltage drop across 2Ω,

$V_1 = 2 \times 2 = 4\ V$

Voltmeter reading = 18 – 4 = 14 V.

28. **(3)**

$X_C = \frac{1}{\omega C} = \frac{1}{100 \times 10^{-6}} = 10^4\,\Omega$

$I_{rms} = \frac{V_{rms}}{X_C} = \frac{(200\sqrt{2})/\sqrt{2}}{10^4}$

= 0.02 A = 20 mA

29. **(2)**

$a \propto t^n$

$\Rightarrow \frac{dv}{dt} \propto t^n$

On integrating, we get

$\Rightarrow v \propto t^{n+1}$

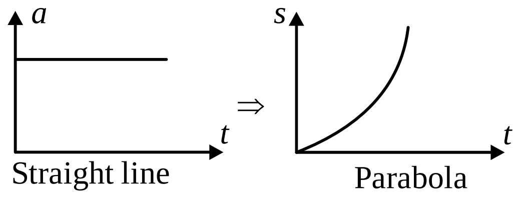
Further $v = \frac{ds}{dt}$

$\Rightarrow \frac{ds}{dt} \propto t^{n+1}$

On integrating, we get

$s \propto t^{n+2}$

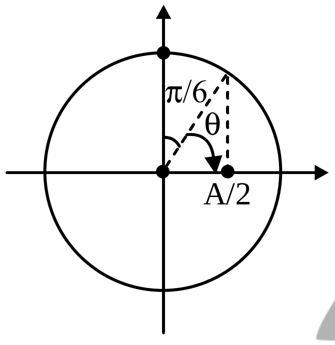
Further



30. **(4)**

$V(t) = 220\sin(100\pi t)$ volt

$I(t) = \frac{220}{50}\sin(100\pi t)$ Amp



Comparing with $I = I_0 \sin(\theta)$,

$I = \frac{I_0}{2}$ when $\theta = 30°$

$I = I_0$ when $\theta = 90°$

$\therefore$ phase to be covered $\theta = 60° = \frac{\pi}{3}$

Time taken,

$t = \frac{\theta}{\omega} = \frac{\frac{\pi}{3}}{100\pi} = \frac{1}{300}$ sec

= 3.3 ms.

31. **(2)**

Formula used:

$\upsilon = \frac{v}{4L}$ (for closed organ pipe) and $\upsilon = \frac{3v}{2L}$

(second overtone open organ pipe)

Since both frequencies are equal, thus;

$\frac{3v}{2L_0} = \frac{v}{4L_c}$

$\Rightarrow$ $L_0 = 6L_c$

$\Rightarrow$ $L_0 = 6 \times 20 = 120$ cm

32. **(2)**

Given $y = t^2$. The velocity of the lift varies with *t* as

$v = \frac{dy}{dt} = 2t$

Acceleration $a = \frac{dv}{dt} = 2\,\text{ms}^{-2}$, directed upwards,

Hence,

$T' = 2\pi\sqrt{\frac{l}{g+a}}$

and $T = 2\pi\sqrt{\frac{l}{g}}$

$\therefore \quad \frac{T'}{T} = \sqrt{\frac{g}{g+a}} = \sqrt{\frac{10}{(10+2)}} = \sqrt{\frac{5}{6}}$

33. **(4)**

Intensity of light, $I = \frac{P}{4\pi r^2} = u_{av} \times c$

where $u_{av} = \frac{1}{2}\epsilon_0 E_0^2$

$\therefore \quad \frac{P}{4\pi r^2} = \frac{1}{2}\epsilon_0 E_0^2 \times c$

or $\quad E_0 = \sqrt{\frac{2P}{4\pi r^2 \epsilon_0 c}} = \sqrt{\frac{2 \times 0.1 \times 9 \times 10^9}{1^2 \times 3 \times 10^8}}$

= 2.45 V/m

34. **(2)**

$I_1 = \left(\frac{2}{1+2}\right)i = \frac{2}{3}i$

$I_2 = \left(\frac{1}{1+2}\right)i = \frac{1}{3}i$

Now, $P_1 = I_1^2 R = \left(\frac{2}{3}\right)^2 i^2 \times 1 = \frac{4}{9}i^2$

Again, we can write similarly,

$P_2 = I_2^2 R = \left(\frac{1}{3}\right)^2 i^2 \times 2 = \frac{2}{9}i^2$

Similarly, again, we can write,

$P_3 = I_3^2 R = i^2 \times 3 = 3i^2$

Now, the ratio of the three powers are,

$P_1 : P_2 : P_3 = \frac{4}{9} : \frac{2}{9} : 3 = 4 : 2 : 27$

35. **(2)**

Now as we know the relation between focal length and refractive index is

$\Rightarrow \quad \frac{1}{f} = \left(\frac{\mu_1}{\mu_2} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

$$\Rightarrow \frac{\frac{1}{0.2}}{\frac{1}{-0.5}} = \frac{\left(\frac{1.5}{1}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)}{\left(\frac{1.5}{\mu_L}-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)}$$

Now simplify the above equation we have,

$$\Rightarrow -\frac{5}{2} = \frac{\left(\frac{1.5}{1}-1\right)}{\left(\frac{1.5}{\mu_L}-1\right)}$$

$$\Rightarrow 5\left(\frac{1.5}{\mu_L}-1\right) = -2(0.5) = -1$$

$$\Rightarrow \frac{7.5}{\mu_L} = -1+5 = 4$$

$$\Rightarrow \mu_L = \frac{7.5}{4} = \frac{75}{4\times 10} = \frac{15}{8}$$

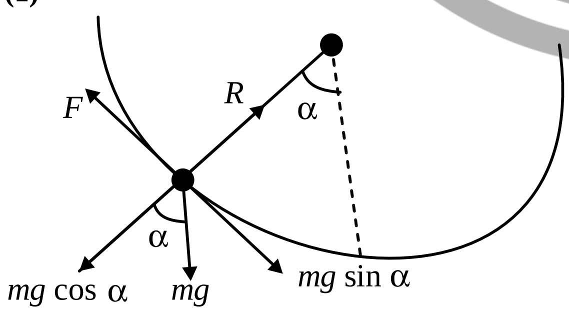
36. **(4)**

The weight of hanging part $\left(\frac{L}{3}\right)$ of chain is $\left(\frac{1}{3}Mg\right)$. This weight acts at centre of gravity of the hanging part, which is at a distance of $\left(\frac{L}{6}\right)$ from the table.

As work done = force × distance

$\therefore \quad W = \frac{Mg}{3}\times\frac{L}{6} = \frac{MgL}{18}$.

37. **(1)**



$F = mg\sin\alpha$

$R = mg\cos\alpha$

$\frac{F}{R} = \tan\alpha$

$\mu = \tan\alpha = \frac{1}{3}$

$\cot\alpha = 3$

38. **(4)**

Assertion is false but Reason is true.

When we start switching on different light buttons, then net resistance of the circuit decreases because all the connections are in parallel. Therefore, main current increases.

39. **(4)**

We know that the value of g at earth's surface is

$g = \frac{GM}{R^2}$ …(i)

While the value of g at a height h above the earth's surface is given by

$g' = \frac{GM}{(R+h)^2}$ …(ii)

Dividing equation (2) by equation (1), we get

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

Here, $g' = \frac{g}{2}$

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

or $\quad \frac{R+h}{R} = \sqrt{2}$

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

$h = \left(\sqrt{2}-1\right)R$

40. **(1)**

Mass of water falling/second = 15 kg/s

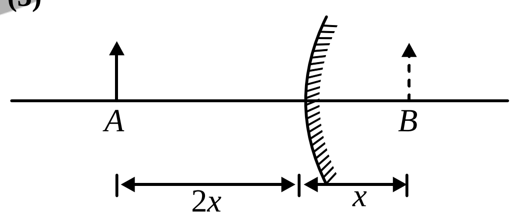
h = 60m, g = 10 m/s^2, loss = 10%

i.e., 90% is used.

Power generated = 15 × 10 × 60 × 0.9

= 8100 W = 8.1 kW.

41. **(3)**



$f = \left(\frac{R}{2}\right) = 30\,\text{cm}$

$\frac{1}{+x} + \frac{1}{-2x} = \left(\frac{1}{+30}\right)$

$\therefore \quad x$ = 15 cm

Hence, $AB = 3x$ = 45 cm.

42. **(4)**

$F = YA\alpha t$

= (2.0 × 10^{11}) (10^{-6}) (1.1 × 10^{-5}) (20)

= 44 newton

43. (2)

A → II; B → I; C → III; D → IV

(A) $\frac{[R]}{[L]}=\frac{[ML^2T^{-3}A^{-2}]}{[ML^2T^{-2}A^{-2}]}=[T]^{-1}$

This is the dimensions of frequency.

(A) → (II)

(B) $[CR]=[M^{-1}L^{-2}T^4A^2]$

This matches with the dimensions of time given in the column.

(B) → (I)

(C) $\frac{[E]}{[B]}=\frac{[MLT^{-3}A^{-1}]}{[MT^{-2}A^{-1}]}=[LT^{-1}]$

This is the dimensions of speed.

(C) → (III)

(D) $[\varepsilon_0\mu_0]^{1/2}$

$=[L^{-2}T^2]^{1/2}=[L^{-1}T]$

(D) → (IV)

44. (4)

In horizontal projectile motion,

Horizontal component of velocity,

$u_x = u = 10\ \text{ms}^{-1}$

Vertical component of velocity,

$u_y = gt = 10 \times 1 = 10\ \text{ms}^{-1}$

Horizontal displacement

$= u \times t = 10 \times (l) = 10\ \text{m}$

Vertical displacement $=\frac{1}{2}gt^2=\frac{1}{2}\times 10\times(1)^2=5\text{m}$

45. (3)

As momentum of a body increases by 50% of its initial momentum, $p_2 = p_1 + 50\%$ of $p_1=\frac{3}{2}p_1$

$\therefore \quad v_2=\frac{3}{2}v_1$

As $K\propto v^2$, so $K_2=\frac{9}{4}K_1$

Increase in

$$KE=\frac{K_2-K_1}{K_1}\times 100=\frac{\frac{9}{4}K_1-K_1}{K_1}\times 100=125\%$$

46. (2)

L about centre $= mvR =$ constant

As, $\tau=\frac{dL}{dt}$ and derivative of any constant is zero.

$\therefore \quad \tau_{\text{centre}}=0$

47. (1)

$$\frac{R_1}{R_2}=\frac{r_2^2}{r_1^2}\text{ or }\frac{5}{R_2}=\frac{(3\times10^{-3})^2}{(9\times10^{-3})^2};\ R_2=45\Omega$$

These six wires are in parallel. Hence, the resistance of the combination would be $R_2=7.5\Omega$.

48. (4)

$$R_{\text{eff}}=\frac{(P+Q)(R+S)}{(P+Q+R+S)}$$

$$=\frac{(R+R)(2R+2R)}{(R+R+2R+2R)}$$

The equivalent resistance of the network between points A and B,

$$R_{\text{eff}}=\frac{4}{3}R$$

In this case, equivalent resistance of the network between points A and B is independent of the value of G, as no current flows through it.

49. (1)

According to the theorem of parallel axes, the moment of inertia of the disc about an axis tangentially and parallel to the surface is given by

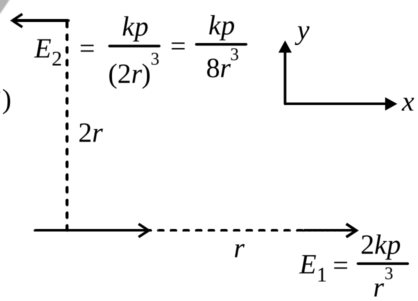
$$I=\frac{MR^2}{4}+MR^2=\frac{5}{4}MR^2 \Rightarrow MR^2=\frac{4I}{5}$$

given by

$$I'=\frac{MR^2}{2}+MR^2=\frac{3}{2}MR^2=\frac{3}{2}\left[\frac{4I}{5}\right]=\frac{6I}{5}$$

50. (2)

$\vec{E}_2=\frac{kp}{8r^3}(-\hat{i})$



$$\frac{\vec{E}_2}{\vec{E}_1}=\frac{-\frac{kp}{8r^3}\hat{i}}{\frac{2kp}{r^3}\hat{i}}=\frac{1}{16} \qquad \vec{E}_1=\frac{2kp}{r^3}\hat{i}$$

$$\vec{E}_2=\frac{\vec{E}_1}{16}\Rightarrow\left[\vec{E}_2=-\frac{\vec{E}_1}{16}\right]$$