Sample Paper-02

Class 12th NEET (2024)

PHYSICS

ANSWER KEY

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

HINTS AND SOLUTION

1. **(1)**

From the given figure, total capacitance is

$$\frac{1}{1}=\frac{1}{C}+\frac{1}{(1+2.5)}\Rightarrow 1=\frac{1}{C}+\frac{1}{3.5}\Rightarrow C=\frac{3.5}{2.5}=1.4\,\mu F$$

2. **(1)**

The electric potential $V(x,y,z)=4x^2 volt$

Now $\vec{E}=-\left(\hat{i}\frac{\partial V}{\partial x}+\hat{j}\frac{\partial V}{\partial y}+\hat{k}\frac{\partial V}{\partial z}\right)$

Now $\frac{\partial V}{\partial x}=8x,\frac{\partial V}{\partial y}=0$ and $\frac{\partial V}{\partial z}=0$

Hence $\vec{E}=-8x\hat{i}$, so at point $(1m,0,2m)$

$E=-8\hat{i}\ volt/metre$ or 8 along negative X-axis

3. **(3)**

$$W=U_f-U_i=9\times10^9\times Q_1Q_2\left[\frac{1}{r_2}-\frac{1}{r_1}\right]$$

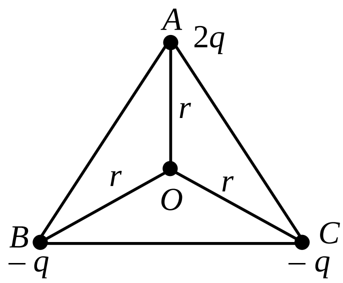
$$\Rightarrow W=9\times10^9\times12\times10^{-6}\times8\times10^{-6}\left[\frac{1}{4\times10^{-2}}-\frac{1}{10\times10^{-2}}\right]$$

= 12.96 J = 13 J

4. **(3)**

In an equilateral triangle distance of centroid from all the vertices is same (say).

$$\therefore V=V_1+V_2+V_3=\frac{1}{4\pi\varepsilon_0}\left[\frac{2q}{r}-\frac{q}{r}-\frac{q}{r}\right]=0$$



But $\vec{E}_A=\frac{1}{4\pi\varepsilon_0}.\frac{2q}{r^2}$ along $AO,\vec{E}_B=\frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$ along OB and

$\vec{E}_c=\frac{1}{4\pi\varepsilon_0}.\frac{q}{r^2}$ along OC.obviously $\vec{E}_B+\vec{E}_C$

Will also be in the direction of AO extended and hence $\vec{E}_A$ *and* $\left(\vec{E}_B+\vec{E}_C\right)$ being in same direction will not give zero resultant.

5. **(2)**

Potential inside the sphere will be same as that on its surface.

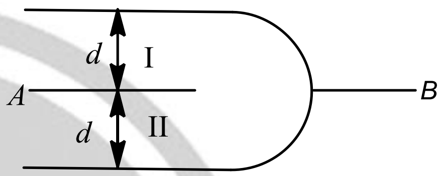
$$ie,\ V=V_{surface}=\frac{q}{10}\text{stat}-\text{volt}$$

$$V_{out}=\frac{q}{15}\text{stat}-\text{volt}$$

$$\therefore\frac{V_{out}}{V}=\frac{2}{3}\Rightarrow V_{out}=\frac{2}{3}V$$

6. **(4)**

Here, we have two capacitors I and II connected in parallel order.



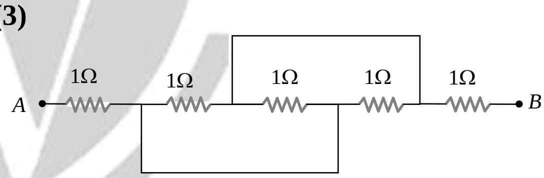
So, $C=C_1+C_2$

$$=\frac{\varepsilon_0A}{d}+\frac{\varepsilon_0A}{d}=\frac{2\varepsilon_0A}{d}$$

7. **(2)**

According to Kirchhoff's law $i_{CD}=i_2+i_3$

8. **(3)**



$$R_{AB}=2+\frac{1}{3}=2\frac{1}{3}\Omega$$

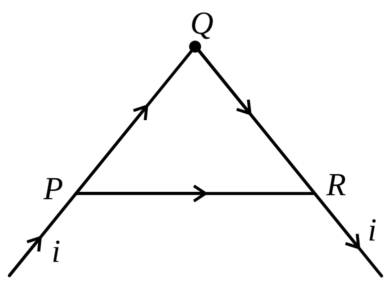
9. **(3)**

$$R=\frac{V}{i_g}-G=\frac{6}{6\times10^{-3}}-25=975\Omega\ \text{[In series]}$$

10. **(4)**

Magnetic field at O due to PR

$$B_1=\frac{\mu_0}{4\pi}\frac{2i/3}{r}[\sin60°+\sin60°]$$



It is directed outside the paper. Magnetic field at O, due to PQR,

$$B_2 = 2\times\frac{\mu_0}{4\pi}\frac{(i/3)}{r}[\sin 60° + \sin 60°]$$

It is directed inside the paper.

$\therefore$ Resultant magnetic field at O,

$B = B_1 - B_2 = 0$

$\therefore$ $B_1 = B_2$

11. **(3)**

Magnetic field at the centre of a current carrying loop is given by

$$B = \frac{\mu_0 ni}{2r}$$

Here, n = no. of turns in loop

i = current, r_1 = radius of loop, $r_1 = r$

For n = 1 turn

$$B = \frac{\mu_0 i}{2r_1} \quad \ldots(i)$$

When n = 2 turns and radius $r_2 = \frac{r}{2}, i_2 = i$

$$B_2 = \frac{\mu_0 \times 2\times i}{2\left(\frac{r}{2}\right)}$$

or $$B_2 = \frac{2\mu_0 i\times 2}{2r} \quad \ldots(ii)$$

Now, from Eqs. (i) and (ii)

$$\frac{B_2}{B} = 4$$

Hence, $B_2 = 4B$

12. **(1)**

As magnetic moments are directed along SN, angle between $\vec{M}$ and $\vec{M}$ is $\theta = 120°$

$\therefore$ Resultant magnetic moment

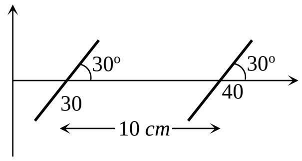
$$= \sqrt{M^2 + M^2 + 2M\,M\cos 120°}$$

$$= \sqrt{M^2 + M^2 + 2M^2(-1/2)} = M$$

13. **(1)**

Susceptibility of a paramagnetic substance is independent of magnetising field and for paramagnetic substance it is positive.

14. **(2)**



$$|B| = \frac{\Delta V}{\Delta x} = \frac{0.1\times 10^{-4}}{0.1\sin 30°} = 2\times 10^{-4}T$$

15. **(1)**

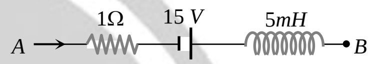
Both points A and B lie on axial position

$$B \propto \frac{1}{d^3} \Rightarrow \frac{B_A}{B_B} = \left(\frac{d_B}{d_A}\right)^3 = \left(\frac{48}{24}\right)^3 = \frac{8}{1}$$

16. **(3)**

By using Kirchhoff's voltage law

$$V_A - iR + E - L\frac{di}{dt} = V_B \Rightarrow V_B - V_A = 15\,volt$$



17. **(1)**

ϕ = BA

$\Rightarrow$ Change in flux $d\phi = BdA$

$= 0.05(101–100)\ 10^{-4}$

$= 5\times 10^{-6}$ Wb

Now, charge $dQ = \frac{d\phi}{R} = \frac{5\times 10^{-6}}{2} = 2.5\times 10^{-6}C$

18. **(1)**

$$M_{21} = \frac{\mu_0 N_1 N_2 A_2}{l_2}$$

$$\therefore\ M_{21} = \frac{\left(4\times 3.14\times 10^{-7}\right)\times 1500\times 100\times\left\{3.14\left(2\times 10^{-2}\right)^2\right\}}{80\times 10^{-2}}$$

$M_{21} = 2.96\times 10^{-4}$ H

$\Rightarrow$ $M_{12} = M_{21} = 2.96\times 10^{-4}$ H

19. **(2)**

We know that Q - factor of series resonant circuit is given as

$$Q = \frac{\omega_r L}{R}$$

Here, L = 8.1 mH, C = 12.5 μF, R = 10Ω,

f = 500 Hz

$$\therefore\quad Q = \frac{\omega_r L}{R} = \frac{2\pi fL}{R}$$

$$= \frac{2\times\pi\times 500\times 8.1\times 10^{-3}}{10} = \frac{8.1\pi}{10} = 2.5434$$

20. **(2)**

Capacitive reactance X_C is inversely proportional to frequency f

$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi fC} \quad i.e., X_C \propto \frac{1}{f}$$

21. **(1)**

R = 6 + 4 = 10Ω

$X_L = \omega L = 2000 \times 5 \times 10^{-3} = 10\Omega$

$$X_C = \frac{1}{\omega C} = \frac{1}{2000 \times 50 \times 10^{-6}} = 10\Omega$$

$$\therefore Z = \sqrt{R^2 + (X_L - X_C)^2} = 10\Omega$$

Amplitude of current $= i_0 = \frac{V_0}{Z} = \frac{20}{10} = 2A$

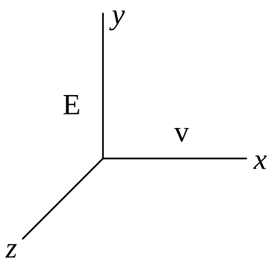
22. **(1)**

The frequency of Electromagnetic Wave along *y*-direction

v =30 MHz

The electric field component of the wave along y-direction.

E = 6 Vm^{-1}



In Electromagnetic, the ratio of the amplitudes of electric and magnetic field is always constant and it is equal to velocity of the Electromagnetic Waves.

i.e., $\frac{E}{B} = c$

or $B = \frac{E}{c} = \frac{6}{3 \times 10^8}$

or B = 2×10^{-8} T

23. **(4)**

Intensity of electromagnetic wave is

$$I = \frac{P_{av}}{4\pi \times r^2} = \frac{E_0^2}{2\mu_0 c}$$

or $E_0 = \sqrt{\frac{\mu_0 c P_{av}}{2\pi r^2}}$

$$= \sqrt{\frac{(4\pi \times 10^{-7}) \times (3 \times 10^8) \times 800}{2\pi \times (4)^2}}$$

$= 54.77\ Vm^{-1}$

24. **(1)**

Time taken to cross the sheet

$$t = \frac{\mu x}{c} = \frac{3 \times 4 \times 10^{-3}}{3 \times 10^8} = 4 \times 10^{-11} s$$

25. **(1)**

Power of lens, *P* (in dioptre)

$$= \frac{100}{\text{focal length } f \text{ (in cm)}}$$

$$\therefore f = \frac{100}{10} = 10\,cm$$

According to lens maker's formula

$$\frac{1}{f} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

For biconvex lens R_1 = + R, R_2 = – R

$$\therefore \frac{1}{f} = (\mu - 1)\left(\frac{1}{R} + \frac{1}{R}\right)$$

$$\Rightarrow \frac{1}{f} = (\mu - 1)\left(\frac{2}{R}\right)$$

$$\frac{1}{10} = (\mu - 1)\left(\frac{2}{10}\right)$$

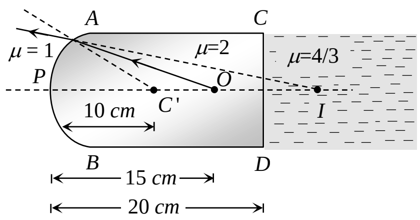
$$\Rightarrow (\mu - 1) = \frac{1}{2} \quad \mu = \frac{1}{2} + 1 = \frac{3}{2}$$

26. **(2)**

In case of refraction from a curved surface, we have

$$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R} \Rightarrow \frac{1}{v} - \frac{2}{(-15)} = \frac{(1-2)}{-10}$$

$\Rightarrow \quad v = -30$ cm



i.e., the curved surface will form virtual image I at distance of 30 cm from P. Since the image is virtual there will be no refraction at the plane surface CD (as the rays are not actually passing through the boundary), the distance of final image I from P will remain 30 cm

27. **(2)**

If I_0 is intensity of unpolarized light, then intensity of polarized light from 1st Polaroid = $I_0/2$.

On rotating through 45°, intensity of light from 2nd Polaroid,

$$I=\left(\frac{I_0}{2}\right)(\cos 45°)^2=\frac{I_0}{2}\left(\frac{1}{\sqrt{2}}\right)^2=\frac{I_0}{4}$$

= 25% I_0

28. **(1)**

Phenomenon of interference of light takes place

29. **(2)**

Position of 3^{rd} bright fringe $x_3=\frac{3D\lambda}{d}$

$$\Rightarrow \lambda=\frac{x_3 d}{3D}=\frac{(0.9\times10^{-2})\times(0.28\times10^{-3})}{3\times1.4}=6000\mathring{A}$$

30. **(3)**

Ratio of there wavelengths:

$$W_0\propto\frac{1}{\lambda}\Rightarrow\frac{\lambda_1}{\lambda_2}=\frac{(W_2)}{(W_1)}=\frac{4.5}{2.3}=\frac{2}{1}$$

31. **(3)**

We know that,

$qE = mg$

$\frac{qQ}{\varepsilon_0 A}=mg$ or $q=\frac{\varepsilon_0 Amg}{Q}$

$$=\frac{8.85\times10^{-12}\times2\times10^{-2}\times2.5\times10^{-7}\times10}{5\times10^{-7}}C$$

= 8.85×10^{-13} C

32. **(4)**

$$\because V_0=\left(\frac{h}{e}\right)v-\left(\frac{W_0}{e}\right).$$

From the graph $V_2 > V_1$

$$\Rightarrow\frac{hv_2}{e}-\frac{W_0}{e}>\frac{hv_1}{e}-\frac{W_0}{e}\Rightarrow v_2>v_1$$

$$\Rightarrow\lambda_1>\lambda_2\left(\text{as }\lambda\propto\frac{1}{v}\right)$$

33. **(3)**

$KE_{max} = hv - \phi$

Where hv = energy of incident photon,

ϕ = work function

$KE_{max} = 6.6 \times 10^{-34} \times 6 \times 10^{14} - 2 \times 1.6 \times 10^{-19}$

$= 3.96 \times 10^{-19} - 3.2 \times 10^{-19}$

$$=\frac{0.76\times10^{-19}}{1.6\times10^{-19}}\text{ eV}=0.475\text{ eV}$$

34. **(1)**

Here, $u = 0$, $a = qE/m$; $s = l$ and v = ?

As $v^2=u^2+2as$; so $v^2=0+2\frac{qEl}{m}$

or $v=\sqrt{\frac{2qEl}{m}}$

35. **(1)**

For nth Bohr orbit,

$$r=\frac{\varepsilon_0 n^2h^2}{\pi mZe^2}$$

de-Broglie wavelength

$$\lambda=\frac{h}{mv}$$

Ratio of both r and λ, we have

$$\frac{r}{\lambda}=\frac{\varepsilon_0 n^2h^2}{\pi mZe^2}\times\frac{mv}{h}$$

$$=\frac{\varepsilon_0 n^2hv}{\pi Ze^2}$$

But $v=\frac{Ze^2}{2h\varepsilon_0 n}$ for n^{th} orbit

Hence, $\frac{r}{\lambda}=\frac{n}{2\pi}$

36. **(1)**

$$E=E_2-E_1=-\frac{13.6}{2^2}-\left(-\frac{13.6}{1^2}\right)=10.2\,\text{eV}$$

37. **(2)**

The electron in a hydrogen atom, moves with constant acceleration, called centripetal acceleration, round the nucleus. Acceleration of electron $a=\frac{v^2}{r}$

Given, $v = 2.18 \times 10^6$ m/s

r = 0.528 Å = 0.528×10^{-10} m

$$\therefore a=\frac{(2.18\times10^6)^2}{0.528\times10^{-10}}=9\times10^{22}\,m/s^2$$

38. **(1)**

By formula $N = N_0\left(\frac{1}{2}\right)^{t/T}$

or $10^4 = 8\times10^4\left(\frac{1}{2}\right)^{t/3}$

or $\left(\frac{1}{8}\right) = \left(\frac{1}{2}\right)^{t/3}$ or $\left(\frac{1}{2}\right)^3 = \left(\frac{1}{2}\right)^{t/3} \Rightarrow 3 = \frac{t}{3}$

Hence t = 9 years

39. **(3)**

Energy of electron in H atom $E_n = \frac{-13.6}{n^2}eV$

$\Rightarrow -1.5 = \frac{-13.6}{n^2} \Rightarrow n^2 = \frac{13.6}{1.5} = 9$ or $n = 3$

Now angular momentum

$L = n\frac{h}{2\pi} = \frac{3\times6.6\times10^{-34}}{2\times3.14} = 3.15\times10^{-34}\,J\times s$

40. **(2)**

Balmer series lies in the visible region.

41. **(1)**

The rms value of voltage across the source,

$V_{rms} = \frac{100\sqrt{2}}{\sqrt{2}} = 100\,\text{V}$

$\therefore$ ω = 1000 rad/s

$\therefore$ $i_{rms} = \frac{V_{rms}}{|Z|} = \frac{V}{\sqrt{R^2 + (X_L - X_C)^2}}$

$= \frac{V_{rms}}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}}$

$= \frac{100}{\sqrt{(1000)^2 + \left(1000\times2 - \frac{1}{1000\times1\times10^{-6}}\right)^2}}$

= 0.0707 A

The current will be same everywhere in the circuit,

therefore,

PD across inductor, $V_L = i_{rms}\,X_L$

= 0.0707 × 1000 × 2 = 141.4 V

PD across capacitor, $V_C = i_{rms}\,X_C$

$= 0.0707\times\frac{1}{1\times1000\times10^{-6}} = 70.7\,\text{V}$

42. **(1)**

A → II; B → III; C → I; D → IV

	Wavelength (m)	Frequency
Radio	$> 1\times10^{-1}$	$< 3\times10^{9}$
Microwave	$1\times10^{-3} - 1\times10^{-1}$	$3\times10^{9} - 3\times10^{11}$
Optical	$4\times10^{-7} - 7\times10^{-7}$	$4\times10^{14} - 7.5\times10^{14}$
X-ray	$1\times10^{-11} - 1\times10^{-8}$	$3\times10^{16} - 3\times10^{19}$

43. **(3)**

Statement I is incorrect, but Statement II is correct.

The electric and magnetic field components of a linearly polarized electromagnetic wave oscillate in such a way that they peak at the same time and they become zero at the same time but they point to different directions in space, separated by an angle of 90∘.

Since there is no time difference between the peaks of the electric and magnetic oscillations the phase difference between the electric and magnetic field vectors of a linearly polarized electromagnetic wave is zero.

44. **(1)**

Resistivity of conductors increases with increase in temperature because rate of collisions between free electrons and ions increases with increase of temperature. However, the resistivity of semiconductors decreases with increase in temperature, because more and more covalent bonds are broken at higher temperatures and free electrons increase with increase in temperature.

45. **(3)**

Magnetic moment of circular loop,

$M = NIA$

where, $A = \pi r^2$

when $r' = 2r$

$M' = NIA' = NI\pi r'^2 = 4NI\pi r^2$

$M' = 4M$

46. **(1)**

These gates are called digital building blocks because using these gates (either NAND or NOR) we can compile all other gates also (like OR, AND, NOT, XOR).

47. **(3)**

Half-life, $t_{1/2} = \frac{0.693}{\lambda}$

$\Rightarrow$ $t_{1/2} \propto 1/\lambda$

As, $\lambda_2 < \lambda_1 \Rightarrow (t_{1/2})_1 < (t_{1/2})_2$

48. **(3)**

$$i = \frac{dq}{dt}$$

$$\therefore \quad \int_0^q dq = \int_0^3 i dt$$

$$\therefore \quad q = \int_0^3 (3 + 2t^2) dt$$

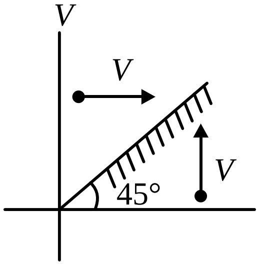
$$q = \left[3t + \frac{2t^3}{3}\right]_0^3$$

q = 9 + 18 = 27 C

49. **(3)**

The image moves along y-axis with speed V.

$$\overrightarrow{V_{I/O}} = \overrightarrow{V_{I/G}} - \overrightarrow{V_{O/G}} = v\hat{j} - v\hat{i}$$



50. **(1)**

M = ml

After cutting each piece

$m' = \frac{m}{2}$ and length $= \frac{l}{2}$ for each piece

$$M' = \frac{m'l}{2} = \frac{ml}{4} = \frac{M}{4}$$