Sample Paper- 04

Class 12th NEET (2024)

PHYSICS

ANSWER KEY

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

HINTS AND SOLUTION

1. **(2)**

In YDSE, the condition of maxima

$d \sin\theta = n\lambda$

$d \sin\left(\frac{\pi}{2}\right) = n\lambda \qquad \left(\therefore \theta = \frac{\pi}{2}\right)$

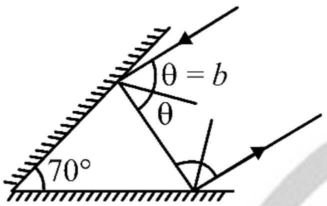
$n = \frac{d}{\lambda} = 2 \qquad (d = 2\lambda)$

$\sin\theta$ varies as $-1 < \sin\theta < 1$.

Hence, n can take 5 values (i.e. –2, –1, 0, 1, 2).

$\therefore$ no. of possible interference maxima = 5.

2. **(1)**



Angle of incidence = b = angle of reflection

Angle of incidence on the 2nd mirror

$90 - [180 - 70 - (90 - b)] = 70 - b$

Angle between the reflected ray & the mirror (2nd)

$= b + 20$

As it parallel to the 1st mirror

$b + 20 = 70$

$b = 70 - 20$

$b = 50$

3. **(4)**

Resultant amplitude

$A = \sqrt{A_1^2 + A_2^2 + 2A_1A_2 \cos\phi}$

Hence, $A_1 = A_2 = 1cm$ and $\phi = 3\pi$ rad (given.)

$\therefore A = \sqrt{I^2 + I^2 + 2\times1\times1\times\cos3\pi} = \sqrt{2\times2(-1)} = 0$

4. **(3)**

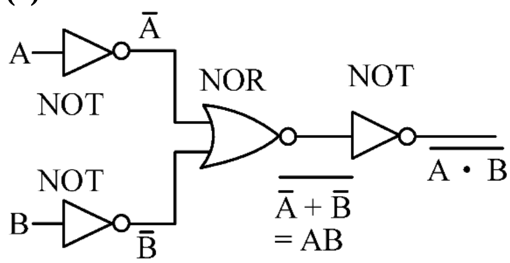
In YDSE, for half angular width

$\lambda = 589$ nm $= 589 \times 10^{-1}$m & d = 0.589nm

$\sin\theta = \frac{\lambda}{d} = \frac{589\times10^{-9}}{0.58\times10^{-3}} = 10^{-3}$

$\theta = \sin^{-1}(0.001)$

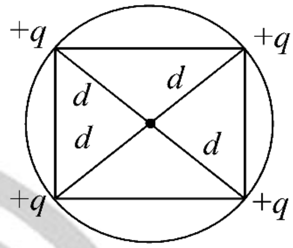
5. **(4)**



Hence option (4) is correct.

6. **(2)**

Potential at centre due to all charges are



$= \frac{1}{4\pi\varepsilon_0}\left[\frac{q}{d} + \frac{q}{d} + \frac{q}{d} + \frac{q}{d}\right]$

$= \frac{1}{4\pi\varepsilon_0}\frac{4q}{d}$ in S.I. unit

$= \frac{4q}{d}$ in C.G.S. unit

7. **(1)**

$v_d = \frac{e}{m}\times\frac{V}{l}\tau \qquad$ or $v_d = \frac{e}{m} = \frac{El}{l}\tau\left(v = El\right)$

$\therefore \quad v_d \propto E$

8. **(3)**

Given, $P = Cr^2$

we know hat,

Total charge on sphere $Q = \int_o^r 4\pi r^2 dr p$

$= \int_o^r 4\pi Cr^4 dr = \frac{4}{5}\pi Cr^5$

$E_{r=R/2} = \frac{kQ}{(R/2)^2} = \frac{k(4/5)\pi C(R/2)^5}{(R/2)^2}$ … (1)

and

$E_{r=2R} = \frac{kQ}{(R/2)^2} = \frac{k(4/5)\pi CR^5}{4R^2}$ … (2)

Now (2) by (1)

$\frac{E_{r=2R}}{E_{r=R/2}} = 2.$

9. **(4)**

Given $V = -x^2y - xz^3 + 4$

$\vec{E} = -\frac{dV}{dr}$,

$E_x = -\frac{dV}{dx} = -\left[-2xy - z^3\right]$

$E_y = -\frac{dV}{dy} = -\left[x^2\right]$

$E_z = -\frac{dV}{dz} = -\left[-3z^2x\right]$

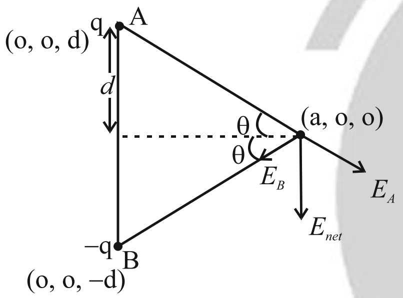
$\vec{E} = Ex\hat{i} + Ey\hat{j} + Ez\hat{k} = \hat{i}\left(2xy + z^3\right) + \hat{j}\left(x^2\right) + \hat{k}\left(3xz^2\right)$

10. **(3)**

$E_A = \frac{kq}{r^2}$

$E_B = \frac{kq}{r^2}$

$r = \sqrt{a^2 + d^2}$



E_{net} at $(a, 0, 0) = 2E_A \cos(90-\theta)$ (from figure)

$E_{net} = 2E_A \sin\theta = \frac{2kqd}{r^2(r)}(\hat{z}) = \frac{-2kqd\hat{z}}{r^3}$

$= \frac{-2kqd}{\left(a^2 + d^2\right)^{3/2}}\hat{z}$

$= \frac{-2qd}{4\pi\varepsilon_0\left(a^2 + d^2\right)^{3/2}}\hat{z}$

11. **(1)**

For the arrangement shown in fig.

$\vec{E_1}$ (due to wire) $= \frac{2k\lambda_1}{R}$ at(R, 0)

$\vec{E_2}$ (arc) $= = \frac{2k\lambda_2}{R}\left(\sin\frac{\pi}{2}\right) = \frac{2k\lambda_2}{R}$

$\vec{E_1} + \vec{E_2} = 0$ (given $\vec{E}_{net} = 0$)

$\frac{2k\lambda_1}{R} - \frac{2k\lambda_2}{R} = 0 \Rightarrow \frac{2k\lambda_1}{R} = \frac{2k\lambda_2}{R}$

$\Rightarrow \frac{\lambda_1}{\lambda_2} = 1.$

12. **(1)**

Apparent depth of the pond appears to be less than the real depth only because of refraction of light.

13. **(1)**

For helium nucleus

No. of protons = 2

No. of neutrons = 2

So, B.E = $\Delta m \times 931$ MeV

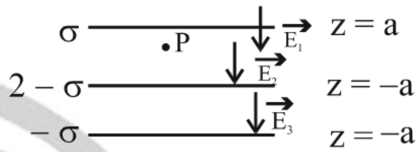
$\Rightarrow$ E = $(2(m_n + m_p) - M) \times 931$ MeV

$= (2 \times (1.0073 + 1.0087) - 4.0015) \times 931$ MeV

= 28.4 MeV

14. **(3)**

We know that $\vec{E} = \frac{\sigma}{2\varepsilon_0}\hat{k}$



For the given case:

$\vec{E}_{net} = \frac{\sigma}{2\varepsilon_0}$

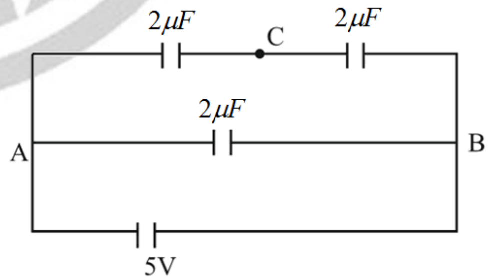
$\vec{E}_{net} = \vec{E_1} + \vec{E_2} + E_3 = \frac{\sigma}{2\varepsilon_0}\left(-\hat{k}\right) + \frac{2\sigma}{2\varepsilon_0}\left(-\hat{k}\right) + \frac{\sigma}{2\varepsilon_0}\left(-\hat{k}\right)$

$= \frac{-2\sigma}{\varepsilon_0}\hat{k}.$

15. **(2)**

16. **(1)**

The equivalent circuit for the given circuit is



$Ceq = \frac{2 \times 3}{2 + 3} + 2 = \frac{16}{5}\mu F$

Total charge Q = $\frac{16}{5} \times 5 = 16\mu C$

$Q_1 = 2\mu F \times 5 = 10\mu C$

$\therefore Q_2 = Q - Q_1$

$= 16 - 10 = 6\ \mu C$

Hence, voltage between B and C.

$V_{BC} = \frac{Q_2}{3\mu F} = \frac{3\mu C}{3\mu F} = 2V$

17. **(1)**

The phenomenon of total internal reflection takes place during reflection at P.

$\sin\theta = \dfrac{1}{{}_w\mu_g}$ --------(1)

Now

${}_w\mu_g = \dfrac{{}_a\mu_g}{{}_a\mu_w} == \dfrac{1.5}{4/3} = 1.125$

$\therefore$ from (1)

$\sin\theta = \dfrac{1}{1.125} = \dfrac{8}{9}$

$\therefore$ $\sin\theta$ should be greater than or equal to $\dfrac{8}{9}$.

18. **(1)**

For Lyman series

$\dfrac{1}{\lambda} = R\left[\dfrac{1}{1^2} - \dfrac{1}{n^2}\right]$

For shortest wavelength, $n = \infty$,

$\therefore \dfrac{1}{\lambda_2} = R \Rightarrow \lambda_1 = \dfrac{1}{R}$

For Balmer series

$\dfrac{1}{\lambda_2} = R\left[\dfrac{1}{2^2} - \dfrac{1}{n^2}\right]$

For shortest wavelength, $n = \infty$,

$\therefore \dfrac{1}{\lambda_2} = \dfrac{R}{4} \Rightarrow \lambda_2 = \dfrac{4}{R}$

The ratio $\dfrac{\lambda_2}{\lambda_1} = \dfrac{4}{1}$

19. **(4)**

According to Gauss' Law

$E.ds = \dfrac{Q_{\text{enclosed by closed surface}}}{\varepsilon_0} = \text{flux}$

So, total flux = Q/ε_0

Since cube has six face, so flux coming out through one wall or one face is $Q/6\varepsilon_0$.

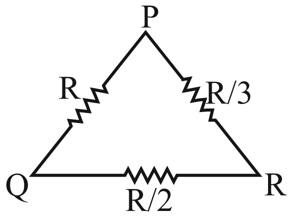
20. **(2)**

The combination of resistances and their equivalent will be.

Along PQ

$$R_{PQ} = \frac{R\left(\frac{R}{3} + \frac{R}{2}\right)}{R + \frac{R}{2} + \frac{R}{3}} = \frac{5R^2}{6} \times \frac{6}{11R} = \frac{5R}{11}$$

Along QR, $R_{QR} = \dfrac{\frac{R}{2}\left(\frac{R+R}{3}\right)}{11R/6} = \dfrac{4R}{11}$

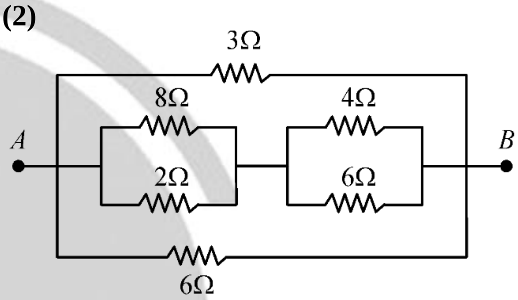


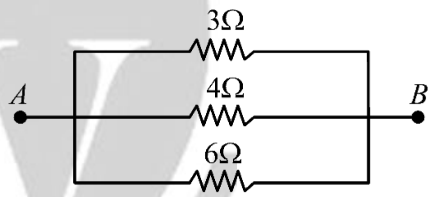
Along PR, $R_{PR} = \dfrac{\frac{R}{3}\left(\frac{R+R}{2}\right)}{\frac{11R}{6}} = \dfrac{3R}{11}$

Hence, $R_{PQ} > R_{QR} > R_{PR}$

$\therefore$ Maximum value is between P and Q.

21. **(2)**





$\dfrac{1}{R} = \dfrac{1}{3} + \dfrac{1}{4} + \dfrac{1}{6} = \dfrac{4+3+2}{12}$

$\Rightarrow R = \dfrac{12}{9} = \dfrac{4}{3}\Omega$

22. **(3)**

Current in each bulb = $\dfrac{\text{Power}}{\text{Voltage}}$

$= \dfrac{100}{220} = 0.45A$

Current through ammeter = 0.45 × 3 = 1.35 A

23. **(2)**

Energy density = $\dfrac{1}{2}\dfrac{B^2}{\mu_0}$

$\Rightarrow B = \sqrt{2 \times \mu_0 \times \text{Energy density}}$

$\mu_0 = \dfrac{1}{C^2\varepsilon_0} = 4\pi \times 10^{-7}$

$\therefore B = \sqrt{2 \times 4\pi \times 10^{-7} \times 1.02 \times 10^{-8}}$

= $160 \times 10^{-9} = 160\ nT$

24. **(2)**

For electromagnetic wave,

$F_E = F_M \Rightarrow eE = Bec \Rightarrow E = Bc$

$= 2 \times 10^{-7} \times 3 \times 10^{8} = 60\ V/m$

25. **(1)**

$$\frac{1}{f_w} = \left({}_w\mu_g - 1\right)\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$

f_w is focal length of lens in water

$$\frac{1}{f} = \left({}_a\mu_g - 1\right)\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$

$$\Rightarrow \frac{f_w}{f} = \frac{\left({}_a\mu_g - 1\right)}{\left({}_w\mu_g - 1\right)} = \frac{\left({}_a\mu_g - 1\right)}{\left(\frac{{}_a\mu_g}{{}_a\mu_w} - 1\right)}$$

$$\Rightarrow \frac{f_w}{f} = \frac{\left(\frac{3}{2} - 1\right)}{\left(\frac{9}{8} - 1\right)} = \frac{\frac{1}{2}}{\frac{1}{8}} = \frac{8}{2} = 4$$

$\Rightarrow f_w = 4 \times f = 4 \times 10 = 40$ cm

26. **(4)**

Energy sequence of radiations is

$E_{\gamma\text{-Rays}} > E_{\text{X-Rays}} > E_{\text{microwave}} > E_{\text{AM Radiowaves}}$

$\therefore \lambda_{\gamma\text{-Rays}} < \lambda_{\text{X-Rays}} < \lambda_{\text{microwave}} < \lambda_{\text{AMRadiowaves}}$

From the above sequence, we have

(A) Microwave → $10^{-3}\ m$ (IV)

(B) Gamma Rays → $10^{-15} m$ (II)

(C) AM Radio wave → 100 m (I)

(D) X-Rays → $10^{-10} m$ (III)

27. **(2)**

A galvanometer can be changed into an ammeter by the use of low resistance in parallel. So that ammeter does not draw much current which may change the magnitude of main current.

28. **(1)**

$$\mu = \frac{1}{\sin C} = \frac{1}{\sin 30^\circ} = \frac{1}{1/2} = 2$$

Velocity of light in the medium

$$= \frac{3 \times 10^8}{2} = 1.5 \times 10^8 \text{ m/sec}$$

29. **(3)**

$F_n = q\ (v \times B)$

$= qvB\sin\theta = 0$ (because θ - 0°)

30. **(1)**

Here, $F_{AB} + F_{BCDA} = 0$

$\Rightarrow \quad F_{BCDA} = -F_{AB} = -F$

$(F_{AB} = F)$

31. **(4)**

Since $\phi_{\text{total}} = \phi_A + \phi_B + \phi_C = \dfrac{q}{\varepsilon_0}$,

where$q$ is the total charge.

As shown in the figure, flux associated with the curved surface B is $\phi = \phi_B$

Let us assume flux linked with the plane surfaces A and C be

$\phi_A = \phi_C = \phi'$

Therefore,

$$\frac{q}{\varepsilon_0} = 2\phi' + \phi_B = 2\phi' + \phi \Rightarrow \phi' = \frac{1}{2}\left(\frac{q}{\varepsilon_0 - \phi}\right)$$

32. **(3)**

For n^{th} orbit, energy, $E_n = \dfrac{2\pi^2 em^4 z^2}{n^2 h^2}$

For hydrogen (z = 1), $E_n = \dfrac{2\pi^2 em^4}{n^2 h^2}$

For helium (z = 2),

So, $E = \dfrac{2\pi^2 em^4 \times 4}{n^2 h^2}$

$$\frac{E}{E_n} = \frac{4}{1} \Rightarrow E = 4E_n$$

33. **(1)**

$$e = \frac{LdI}{dt} = \frac{40 \times 10^{-3}(11 - 1)}{4 \times 10^{-3}} = 100V$$

34. **(3)**

$$P = V_{r.m.s} \times I_{r.m.s} \times \cos\phi = \frac{1}{2} V_0 I_0 \cos\phi$$

$$= \frac{1}{2} \times 100 \times \left(100 \times 10^{-3}\right)\cos\pi/3 = 2.5W$$

35. **(2)**

Study of junction diode characteristics shows that the junction diode offers a low resistance path, when forward biased and high resistance path when reverse biased. This feature of the junction diode enables it to be used as a rectifier.

36. **(2)**

37. **(1)**

We know that.

Self-inductance $L = \frac{N\phi}{i}$

$= \frac{500 \times 4 \times 10^{-3}}{2} = 1.0$ henery

38. **(3)**

Electric field $E = -\frac{d\phi}{dr} = -2ar$ ...(i)

By Gauss theorem

$E = -\frac{1}{4\pi\varepsilon_0} \cdot \frac{q}{r^2}$ ...(ii)

$\oint \vec{E} \cdot \vec{ds} = \frac{q_{inside}}{\varepsilon_0}$

$q_{inside} = -8\varepsilon_0 a\pi r^3$

Charge density inside the ball is

$\rho_{inside} = \frac{q_{inside}}{\frac{4}{3}\pi r^3} = \frac{-8\varepsilon_0 a \pi r^3}{\frac{4}{3}\pi r^3}$

$\rho_{inside} = -6a\varepsilon_0$

39. **(4)**

Since $P = nhv$

$\Rightarrow \quad n = \frac{P}{hv} = \frac{2 \times 10^{-3}}{6.6 \times 10^{-34} \times 6 \times 10^{14}}$

$= 5 \times 10^{15}$

40. **(2)**

A according to Einstein's photoelectric equation

$\frac{1}{2} m v_{\max}^2 = hv - \phi_0$

$\frac{1}{2} m v_{\max 1}^2 = 2eV - 1eV = 1eV$

$\frac{1}{2} m v_{\max 2}^2 = 5eV - 1eV = 4eV$

$\therefore \frac{v_{\max_1}}{v_{\max_2}} = \frac{1}{2}$

41. **(1)**

Bohr's atomic model is valid only for single electron species because it does not consider forces due to inter-electronic attractions.

42. **(2)**

According to question

$E_y \propto J_x B_z$

$\therefore$ Constant of proportionality

$K = \frac{E_y}{B_z J_x} = \frac{C}{J_x} = \frac{m^3}{As}$

[As $\frac{E}{B} = C$ (speed of light) and $J = \frac{I}{\text{Area}}$]

43. **(2)**

The flux for both the charges exactly cancels the effect of each other.

44. **(1)**

45. **(1)**

The final Boolean expression is,

$X = \overline{\left(\overline{A}.\overline{B}\right)} = \overline{\overline{A}} + \overline{\overline{B}} = A + B \Rightarrow$ OR gate

46. **(3)**

$\Delta x = \frac{\lambda}{(2\alpha)}$

47. **(3)**

$r = E/I = 1.5/3 = 0.5$ ohm.

48. **(4)**

49. **(4)**

The current that will given full scale deflection in the absence of the shunt is nearly equal to the current through the galvanometer when shunt is connected i.e. I_g

As $I_g = \frac{IS}{G+S}$

$= \frac{5.5 \times 1}{120 + 1} = 0.045$ ampere

50. **(4)**

de Broglie wavelength

$$\lambda = \frac{h}{mv} \Rightarrow m = \frac{h}{\lambda v}$$

Clearly, $m \propto \frac{1}{\lambda v}$

If λ and v be the wavelength and velocity of electron and λ' and v' be the wavelength and velocity of the particle then

$$\Rightarrow \frac{m'}{m} = \frac{v\lambda}{v'\lambda'} = \frac{1}{5} \times \frac{9.1 \times 10^{-31}}{1.878} \times 10^{-4}$$

$\Rightarrow \quad m' = 9.7 \times 10^{-28}$ kg