Sample Paper-04

Dropper NEET (2024)

PHYSICS

ANSWER KEY

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

HINTS AND SOLUTION

1. **(1)**

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

2. **(2)**

NAND and NOR gates are called universal gates because they can be combined to produce any of the other gates like OR, AND, NOT.

Hence, option (2) is correct.

3. **(2)**

Given $u = -45$ cm

$v = 90$ cm

We know that

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\frac{1}{f} = \frac{1}{90} - \frac{1}{(-45)} \Rightarrow f = 30 \text{ cm.}$$

Also, $m = \frac{v}{u} = \frac{90}{(-45)} = -2$

$$m = \frac{h_i}{h_0}$$

$$\Rightarrow \quad -2 = \frac{h_i}{5} \Rightarrow h_i = 10 \text{ cm.}$$

4. **(2)**

Given mass = 1kg

Gravitational field intensity due to each mass

So, Intensity (I) $= Gm\left(\frac{1}{r_1^2} + \frac{1}{r_2^2} + ...\right)$

Now putting $r_1 = 1$, $r_2 = 2$, $r_3 = 4$

$$I = G\left(\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{4^2} + ...\right)$$

Since this is G.P., we get

$$I = G\left(\frac{1}{1 - \frac{1}{2^2}}\right) \qquad I = \frac{4G}{3}$$

5. **(1)**

Given $m = 2$kg

$k = 2$ N/m

$x = 4$m, $\mu = 0.3$

The spring will compress till the point block stops.

Using work – energy theorem

$$W_{fr} + W_{sp} = -\frac{1}{2}mv^2$$

$$-\mu mgx + \left(-\frac{1}{2}kx^2\right) = \frac{-1}{2}mv^2$$

$$(0.3)(2)(10)(4) + \frac{1}{2} \times (2) \times (4)^2 = \frac{1}{2} \times 2 \times v^2$$

$$24 + 16 = v^2$$

$$\Rightarrow \quad v = \sqrt{40} = 2\sqrt{10} \text{ ms}^{-1}$$

6. **(2)**

We know that,

$$Q = \frac{\text{Energy / Area}}{\text{Time}} = \left(\frac{\text{Watt}}{m^2}\right) = [MT^{-3}]$$

Radiation pressure = $[ML^{-1}T^{-2}]$

Speed of light, $C = [M^0LT^{-1}]$

Given

$[M^0L^0T^0] = [ML^{-1}T^{-2}]^x\ [ML^0T^{-3}]^y[M^0LT^{-1}]^z$

On comparing powers, we get

$x = 1$, $y = -1$, $z = 1$.

7. **(1)**

For helium nucleus

No. of protons = 2

No. of neutrons = 2

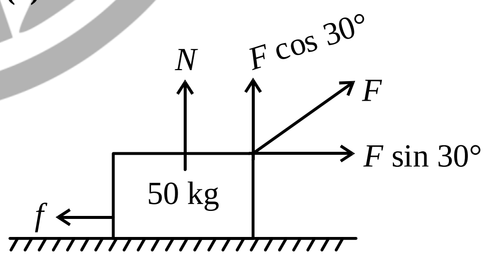
So, B.E = Δm × 931 MeV

$\Rightarrow$ E = (2 (m_n + m_p) – M) × 931 MeV

= (2 × (1.0073 + 1.0087) – 4.0015) × 931 MeV

= 28.4 MeV

8. **(4)**



Given m = 50 kg

$\mu = 0.6$

$\theta = 30°$

From the diagram shown.

N = 50 × g – F cos 30° …..(i)

$f = F$ sin 30° = μN ….(ii)

$$\Rightarrow \quad \frac{F}{2} = 0.6\left(50 \times 10 - F\frac{\sqrt{3}}{2}\right)$$

$$\Rightarrow \quad F = 294.2 \text{ N.}$$

9. **(3)**

Given $v = 3 \times 10^8$ m/s

$\lambda = 150$ m

We know that,

Frequency, $\upsilon = \frac{v}{\lambda} = \frac{3\times10^8}{150} = 2\times10^6$ Hz

$= 2$ MHz

10. **(1)**

$v_d = \frac{e}{m}\times\frac{V}{l}\tau$ or $v_d = \frac{e}{m}\frac{El}{l}\tau (\because V = El)$

$\therefore \quad v_d \propto E$

11. **(3)**

Given $s = 320$ m

$t = 4$s

$u = 0$

Using equation of motion

$S = ut + \frac{1}{2}\text{at}^2$

$320 = 0 + \frac{1}{2}\times a\times 4^2 = 40\,\text{m/s}^2$

Also, $v = u + \text{at}$

$v = 0 + 40 \times 10 = 400$ m/s

12. **(1)**

Given $E_p = 220$ V $\quad E_s = 22$V

$R_s = 220\Omega \quad I_p = ?$

$I_s = \frac{E_s}{R_s} = \frac{22}{220} = 0.1$

Also, $\frac{E_s}{E_p} = \frac{I_p}{I_s}$

$\Rightarrow \frac{22}{220} = \frac{I_p}{0.1} \Rightarrow I_p = 0.01$ A

13. **(1)**

We know that,

$W_0(eV) = \frac{12375}{\lambda_0}\text{Å} \quad \Rightarrow \lambda_0 = \frac{12375}{4.5} \approx 2750\,\text{Å}$

14. **(1)**

We know that height to which liquid will rise is given by

$h = \frac{2T}{r\rho g}$

So, $\frac{h_1}{h_2} = \frac{r_2\rho_2}{r_1\rho_1} = \frac{3\times4}{2\times5} = \frac{6}{5}$

15. **(2)**

At highest point $v = v\cos 45° = \frac{v}{\sqrt{2}}$

$\therefore$ Momentum $p = \frac{mv}{\sqrt{2}}$

Also, Angular momentum $L = \frac{mv}{\sqrt{2}(h)}$

Here, $h = \frac{v^2\sin^2 45°}{2g} = \frac{v^2}{4g}$

$\therefore \quad L = \frac{mv}{\sqrt{2}}\frac{v^2}{4g} = \frac{mv^3}{4\sqrt{2}g}$

16. **(1)**

As work done = 0

$\Delta U = mc\Delta T = 100 \times 10^{-3} \times 4184 \times (50 - 30)$

$= 84$ kJ

17. **(3)**

Given $l = 2.4\ m$, $r = 4.6$ mm $= 4.6 \times 10^{-3}$ m

$q = -4.2 \times 10^{-7}$ C

Linear charge density $\lambda = \frac{q}{l} = \frac{-4.2\times10^{-7}}{2.4}$

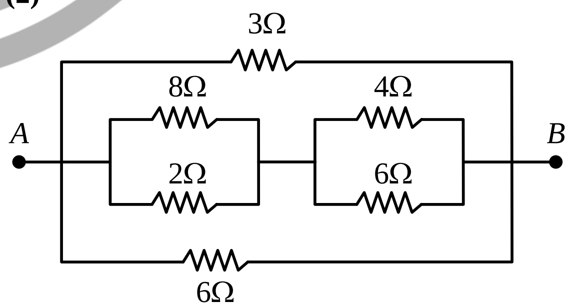
$= -1.75 \times 10^{-7}$ Cm^{-1}

Electric field $E = \frac{\lambda}{2\pi\varepsilon_0 r}$

$= \frac{-1.75\times10^{-7}}{2\times3.14\times8.85\times10^{-12}\times4.6\times10^{-3}}$

$= -6.7 \times 10^5$ NC^{-1}

18. **(2)**



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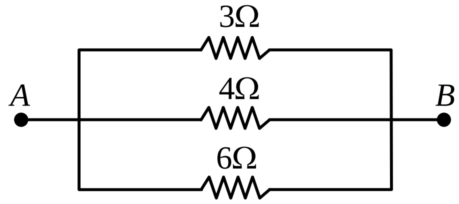


$\frac{1}{R} = \frac{1}{3} + \frac{1}{4} + \frac{1}{6} = \frac{4+3+2}{12}$

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

19. **(3)**

Let 'm' grams = mass of steam.

Heat lost by steam = $m \times L + m \times 1 \times (100 - 0)$

$= m \times 540 + 100\text{ m} = 640\, m$

Heat gained by ice = $m_i \times s \times \Delta T + m_i L$

$= 3200 \times 0.5 \times [0 - (-10)] + 3200 \times 80$

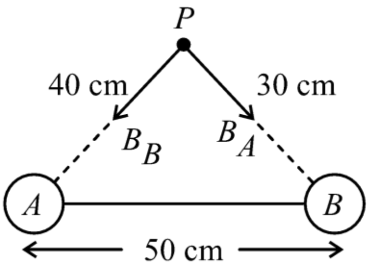
$= 272000$ cal.

According to principle of calorimetry

640 m = 27200

$\Rightarrow \quad m = 425$ g

20. **(2)**



$$B_B = \frac{\mu_0 I}{2\pi d} = \frac{4\pi \times 10^{-7} \times 20}{2\pi \times 40 \times 10^{-2}} = 10^{-5} T$$

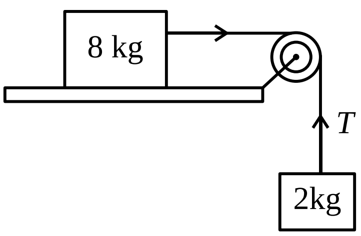
$$B_A = \frac{\mu_0 I}{2\pi d} = \frac{4\pi \times 10^{-7} \times 15}{2\pi \times 30 \times 10^{-2}} = 10^{-5} T$$

The resultant magnetic field

$$B = \sqrt{B_A^2 + B_B^2} = 10^{-5}\sqrt{2}$$

$$= \sqrt{2} \times 10^{-5} T$$

21. **(2)**



Let tension = T, a = acceleration

From the diagram

For block of mass 8 kg, $T = 8a$ ….(i)

For block of mass 2 kg,

$2g - T = 2a \Rightarrow 2g = 2a + T$

$20 = 2a + 8a$ (From (i))

$\Rightarrow \quad 20 = 10\, a$

$\Rightarrow \quad a = 2\text{ m/s}^2$

$T = 8a = 16N$

22. **(1)**

The flux linked with the coil initially.

$\phi_1 = NBA \cos 0° = NBA$

The flux when rotated through 180°

$\phi_2 = NBA \cos 180° = -NBA$

$\therefore$ Change in flux, $\Delta\phi = \phi_2 - \phi_1 = -2NBA$

The magnitude of induced emf is,

$$E = \left|\frac{\Delta\phi}{\Delta t}\right| = \frac{2NBA}{\Delta t} = \frac{2 \times 200 \times 0.4 \times 10^{-4} \times 400 \times 10^{-4}}{0.5}$$

$E = 0.0128$ V

23. **(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.

24. **(1)**

Fact based.

25. **(3)**

Total capacitance equivalent

$$= \frac{2 \times 4}{(2+4)} = \frac{8}{6} = \frac{4}{3}$$

$$Q = CV$$

$$Q = 1200 \times \frac{4}{3}$$

$$Q = 1600 V = \frac{q}{V}$$

$$V = \frac{1600}{2}$$

$$V = 800$$

26. **(4)**

$$\eta = \frac{P(r^2 + x^2)}{4vl}$$

$= [ML^{-1}T^{-2}]\,[L^2]\,[LT^{-1}]^{-1}\,[L^{-1}]$

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

27. **(1)**

Given, $x = 60 + 75t - t^3$ …. (i)

At $t = 0$

$x = 60$ m

Also, $v = \dfrac{dx}{dt} = -3t^2 + 75$

$v = 0$

$\Rightarrow \quad 3t^2 = 75 \Rightarrow t = 5$s

Putting value of t in (i)

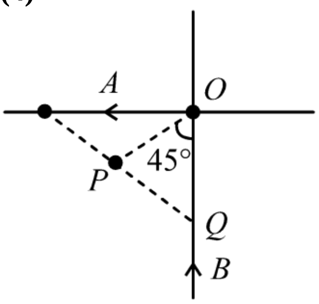
$x = 60 + 75\,(5) - (5)^3 = 310$ m

Particle started his journey when it is at 60 m and come to rest at 310 m

Hence particle travelled a distance of

$= 310\text{ m} - 60\text{ m} = 250$ m

28. **(4)**



$\overrightarrow{V_{AB}} = \overrightarrow{V_A} - (-\overrightarrow{V_B}) = \overrightarrow{V_A} + \overrightarrow{V_B}$

Then,

$|V_{AB}| = \sqrt{V_A^2 + V_B^2}$

$= \sqrt{10^2 + 10^2} = 10\sqrt{2}$

$(\therefore V_A = V_B = 10 \text{ km/h})$

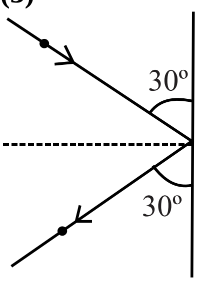
From the diagram, the shortest distance between ships A and B is PQ.

$\sin 45° = \dfrac{PQ}{OQ}$ and $OQ = 100$ km.

Then, $PQ = OQ \times \sin 45° = 100 \times \dfrac{1}{\sqrt{2}} = 50\sqrt{2}$ m

time taken $= \dfrac{\text{distance}}{\text{velocity}} = \dfrac{50\sqrt{2}}{10\sqrt{2}} = 5$ h.

29. **(3)**



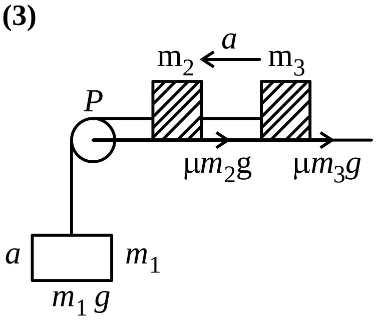
Change in momentum = 2mv sin30°

F = $\dfrac{\text{Change in momentum}}{\text{Time}}$

F = $\dfrac{1 \times 36}{0.15}$

F = 240 N

30. **(3)**



Frictional force on $m_2 = \mu m_2 g$

Frictional force on $m_3 = \mu m_3 g$

Let acceleration = a

$\therefore \quad a = \dfrac{m_1 g - \mu m_2 g - \mu m_3 g}{m_1 + m_2 + m_3}$

$a = g\dfrac{(1-2\mu)}{3}$ $(\because m_1 = m_2 = m_3 = m)$

Hence downward acceleration of m_1 is $g\dfrac{(1-2\mu)}{3}$

31. **(2)**

Maximum compression when cylinder comes to rest

v = 0 & ω = 0

$\omega_{\text{Frictional}} = 0$ ($\because$ Pure rolling)

Loss in K.E. = Gain in P.E.

$\Rightarrow \quad \dfrac{1}{2}mv^2 + \dfrac{1}{2}I\omega^2 = \dfrac{1}{2}kx_m^2$

For pure rolling v = Rω

$\Rightarrow \quad \dfrac{1}{2}m(R\omega)^2 + \dfrac{1}{2}\left(\dfrac{MR^2}{2}\right)\left(\dfrac{V^2}{R^2}\right) = \dfrac{1}{2}Kx_m^2$

$\Rightarrow \quad \dfrac{3mv^2}{4} = \dfrac{1}{2}Kx_m^2$

$\Rightarrow \quad \dfrac{3 \times 5 \times (3)^2}{4} = \dfrac{1}{2} \times 100 \times x_m^2$

$= \dfrac{2 \times 3 \times 5 \times 3^2}{4 \times 200} = x_m = 0.82$ m

32. **(2)**

K.E. of ball = K.

v at highest point = v cosθ

$= v \cos 45° = \dfrac{v}{\sqrt{2}}$

$\therefore \quad K.E. = \dfrac{1}{2} \times m \times \left(\dfrac{v}{\sqrt{2}}\right)^2 = \dfrac{1}{4}mv^2 = \dfrac{K}{2}$

33. **(3)**

Translational $K.E = \dfrac{1}{2}mv^2$

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

Let mass = m & velocity = v

$M.O.I = mK^2$

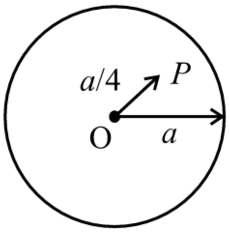
$V = R\omega$

Total $K.E. = \dfrac{1}{2}mv^2 + \dfrac{1}{2}I\omega^2 = \dfrac{1}{2}mv^2 + \dfrac{mK^2v^2}{2R^2}$

Fraction of rotational kinetic energy associated with total energy.

$$\dfrac{\dfrac{mK^2v^2}{2R^2}}{\dfrac{1}{2}mv^2 + \dfrac{mK^2v^2}{2R^2}} = \dfrac{K^2}{K^2 + R^2}.$$

34. **(3)**



Mass = M

Radius = a

Gravitational potential at point P due to particle at 0, $V_1 = -\frac{GM}{a/4}$

Gravitational potential at point P due to spherical shell $V_2 = -\frac{GM}{a}$

Hence, Total gravitational potential P.

$V = V_1 + V_2$

$$= \frac{-GM}{a/4} + \left(\frac{-GM}{a}\right)$$

$$= \frac{-GM}{a}\left(\frac{4}{1}+1\right) = -\frac{5GM}{a}$$

35. **(1)**

We know that rate of heat flow $H = \frac{KA\Delta T}{\Delta x}$

$\because$ ΔT & Δx same for both rods

So, $\frac{H}{KA} = \text{constant}$

i.e., $\frac{H_1}{K_1A_1} = \frac{H_2}{K_2A_2}$

$\Rightarrow$ $\frac{H_1}{H_2} = \frac{K_1A_1}{K_2A_2} = 6$

$\Rightarrow$ $K_1A_1 = 6K_2A_2$

36. **(4)**

Using equation of continuity

$A_1V_1 = A_2V_2$

$\pi R^2 V = n(\pi r^2 V)$

$\Rightarrow$ $V = \frac{VR^2}{nr^2}$

37. **(3)**

For isothermal expansion

PV = P′ (2V) $\Rightarrow$ $P' = \frac{P}{2}$

For adiabatic expansion

$$P'(2V)^{\gamma} = P_f(16V)^{\gamma} \quad (\because PV^{\gamma} = C)$$

Putting value of P′

$$P_f = \frac{P}{2}\left(\frac{2V}{16V}\right)^{5/3} = \frac{P}{64}$$

38. **(2)**

We know that,

$T = 2\pi\sqrt{\frac{m}{k}}$ $\quad\therefore\quad k = \frac{4\pi^2 m}{T^2}$

In the given situation

$k = k_1 + k_2$

$$\therefore \quad \frac{4\pi^2 m}{t_0^2} = \frac{4\pi^2 m}{t_1^2} + \frac{4\pi^2 m}{t_2^2}$$

$$\therefore \quad t_0^{-2} = t_1^{-2} + t_2^{-2}$$

39. **(1)**

The number of beats will be the difference of frequencies of two strings.

Frequency of first string $f_1 = \frac{1}{2l_1}\sqrt{\frac{T}{m}}$

$$= \frac{1}{2\times 5.16\times 10^{-2}}\sqrt{\frac{20}{10^{-3}}} = 137$$

Similarly for 2nd string

$$= \frac{1}{2\times 49.1\times 10^{-2}}\sqrt{\frac{20}{10^{-3}}} = 144$$

No. of beats = $f_2 - f_1$ = 144 – 137 = 7 beats

40. **(2)**

Initial energy stored in $2\mu F$

$U = \frac{1}{2}\times 2\times V^2 = V^2 \quad (\because V = \frac{1}{2}CV^2)$

Final voltage after S_2 is on

$$V_f = \frac{C_1V_1}{C_1+C_2} = \frac{2V}{10} = 0.2V$$

Final energy in both capacitors

$$U_f = \frac{1}{2}(C_1+C_2)V_f^2 = \frac{1}{2}\times 10\times\left(\frac{2V}{10}\right)^2 = 0.2V^2$$

$\therefore$ Energy dissipated $= \frac{V^2 - 0.2V^2}{V^2}\times 100 = 80\%$

41. **(4)**

Given $V = -x^2y - xz^3 + 4 \quad E = E_x\hat{i} + E_y\hat{j} + E_z\hat{k}$

$$E = \frac{dv}{dx} = \frac{d}{dx}(-x^2y - xz^3 + 4)$$

$$= (2xy + z^3)\hat{i} + x^2\hat{j} + 3xz^2\hat{k}.$$

42. **(4)**

Apply Kirchoff’s current Law.

43. (4)

Reversing the direction of the current reverses the direction of the magnetic field.

However, it has no effect on the magnetic-field energy density, which is proportional to the square of the magnitude of the magnetic field.

44. (1)

$F_1 > F_2$, hence net attraction force will be towards conductor.

45. (2)

We know that,

$U = -MB\cos\theta$

For stable equilibrium $\theta = 0°$

$U = -MB$

$= -(0.4)(0.16) = -0.064$ J

46. (1)

We know that.

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

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

47. (4)

48. (2)

According to Einstein's photoelectric equation

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

$$\frac{1}{2}mv_{max1}^2 = 2eV - 1eV = 1eV$$

$$\frac{1}{2}mv_{max2}^2 = 5eV - 1eV = 4eV$$

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

49. (1)

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

50. (4)