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NEET PHYSICS PAPER SOLUTION

17 JULY 2022

Each Question Properly Explained With Theory

&

Formulae

Hand Written

1. Two hollow conducting spheres of radii R_1 and R_2 ($R_1 >> R_2$) have equal charges. The potential would be :

(1) more on smaller sphere ✓

(2) equal on both the spheres

(3) dependent on the material property of the sphere

(4) more on bigger sphere

$$V = \frac{1}{4\pi\epsilon_0}\frac{q}{r}$$

$$V_1 = \frac{1}{4\pi\epsilon_0}\frac{q}{R_1}$$

$$V_2 = \frac{1}{4\pi\epsilon_0}\frac{q}{R_2}$$

Since $R_1 >> R_2$

$V_1 < V_2$

potential is more for smaller sphere

2. The angular speed on a fly wheel moving with uniform angular acceleration changes from 1200 rpm to 3120 rpm in 16 seconds. The angular acceleration in rad/s² is :

(1) 4π ✓

(2) 12π

(3) 104π

(4) 2π

$$\omega = \omega_0 + \alpha t$$

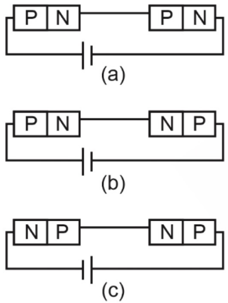
$$\alpha = \frac{\omega - \omega_0}{t}$$

$$= \frac{2\pi f_f - 2\pi f_i}{t}$$

$$= \frac{2\pi \left(\frac{3120}{60} - \frac{1200}{60}\right)}{16}$$

$$= \frac{2\pi}{16\times 60}(3120 - 1200)$$

$$= \frac{2\pi}{16\times 60} \times 1920 = 4\pi \text{ rad/sec}^2$$

3. 

In the given circuits (a), (b) and (c), the potential drop across the two *p-n* junctions are equal in

(1) Circuit (b) only

(2) Circuit (c) only

(3) Both circuits (a) and (c)

(4) Circuit (a) only

circut (a) & (c)

both the circuits are similarly biased and offer equal resistance (and also in series)

hence equal potential drop across the junction

4. Two objects of mass 10 kg and 20 kg respectively are connected to the two ends of a rigid rod of length 10 m with negligible mass. The distance of the center of mass of the system from the 10 kg mass is

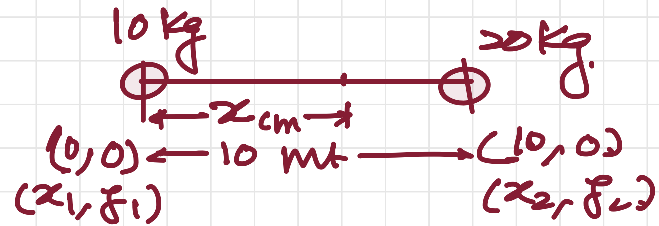
(1) $\frac{20}{3}$ m ✓

(2) 10 m

(3) 5 m

(4) $\frac{10}{3}$ m

(4)



$$x_{cm} = \frac{m_1x_1 + m_2x_2}{m_1+m_2}$$

$$= \frac{10(0) + 20(10)}{10+20} = \frac{200}{30}$$

$$= 20/3 \text{ mt}$$

5. A biconvex lens has radii of curvature, 20 cm each. If the refractive index of the material of the lens is 1.5, the power of the lens is

(1) +20 D

(2) +5 D ✓

(3) Infinity

(4) +2 D

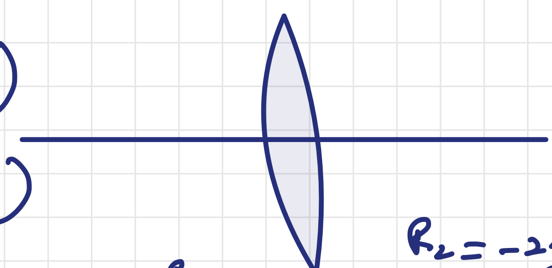
(5)

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

$$= \left(\frac{3}{2}-1\right)\left(\frac{1}{0.2} - \frac{1}{-0.2}\right)$$

$$= (0.5)\left(\frac{2}{0.2}\right)$$

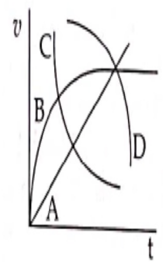
$$= +5 D$$



$R_1 = 20$ cm $= 0.2$ mt

$R_2 = -20$ cm $= -0.2$ mt

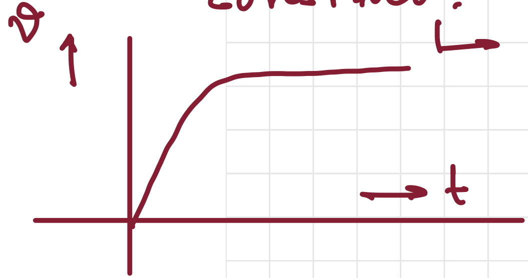
6. A spherical ball is dropped in a long column of a highly viscous liquid. The curve in the graph shown, which represents the speed of the ball (v) as a function of time (t) is



(1) B ✓ (2) C

(3) D (4) A

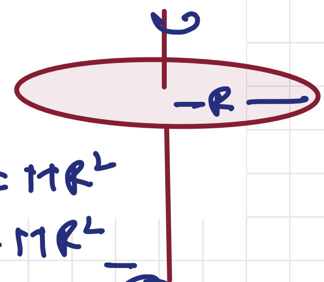
Initial speed = 0 then increases after some time and becomes constant. ⟹ It attains terminal velocity.

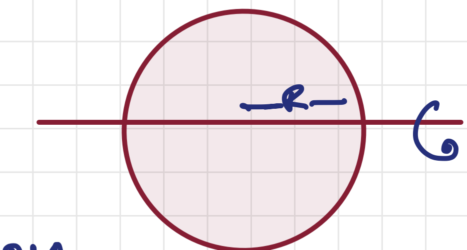


7. The ratio of the radius of gyration of a thin uniform disc about an axis passing through its centre and normal to its plane to the radius of gyration of the disc about its diameter is

(1) $\sqrt{2}:1$ ✓ (2) $4:1$

(3) $1:\sqrt{2}$ (4) $2:1$





$I_C = MR^2$

$MK_1^2 = MR^2$ — (1)

$I_{DIA} = \frac{MR^2}{2} \Rightarrow MK_2^2$ — (2)

eqn (1) / eqn (2)

$\frac{MK_1^2}{MK_2^2} = \frac{MR^2}{MR^2/2} \Rightarrow \frac{K_1}{K_2} = \sqrt{2} : 1$

8. A shell of mass m is at rest initially. It explodes into three fragments having mass in the ratio 2 : 2 : 1. If the fragments having equal mass fly off along mutually perpendicular directions with speed v, the speed of the third (lighter) fragment is

(1) $\sqrt{2}v$ (2) $2\sqrt{2}v$ ✓

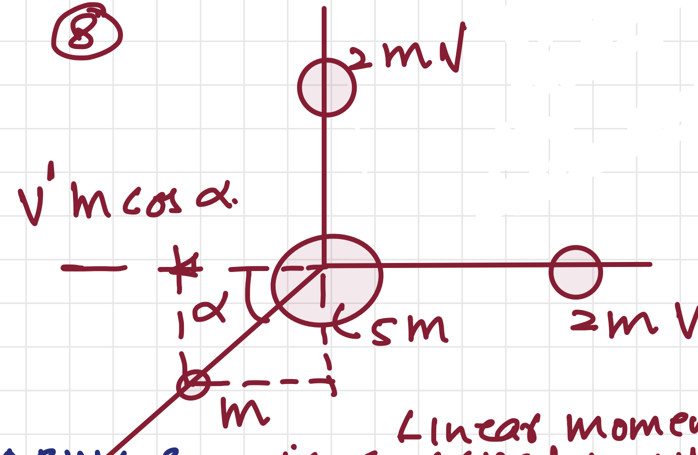
(3) $3\sqrt{2}v$ (4) v

9. A long solenoid of radius 1 mm has 100 turns per mm. If 1 A current flows in the solenoid, the magnetic field strength at the centre of the solenoid is

(1) 12.56×10^{-2} T ✓ (2) 12.56×10^{-4} T

(3) 6.28×10^{-4} T (4) 6.28×10^{-2} T

(8)



Linear momentum is conserved in +ve x direction and +ve y direction

$\Sigma p_x = 0$, $\Sigma p_y = 0$

$2mV - mV'\cos\alpha = 0$

$2V = V'\cos\alpha$ — (1)

$\Sigma p_y = 0$

$2mV - mV'\sin\alpha = 0$

$2V = V'\sin\alpha$ — (2)

SQUARING & ADDING EQUATION (1) & (2)

$(V'\cos\alpha)^2 + (V'\sin\alpha)^2 = (2V)^2 + (2V)^2$

$V'^2(\cos^2\alpha + \sin^2\alpha) = 8V^2$

$V' = 2\sqrt{2}\,V$

(9) $B = \mu_0 n I$

$= \mu_0 \frac{N}{l} I$

$= 4\pi \times 10^{-7} \times 100 \times 10^{3} \times 1$

$= 4\pi \times 10^{-2}$ Tesla

$= 12.56 \times 10^{-2}$ T.

10. Let T_1 and T_2 be the energy of an electron in the first and second excited states of hydrogen atoms, respectively. According to the Bohr s model of an atom, the ratio $T_1 : T_2$ is

(1) 4 : 1 (2) 4 : 9

(3) 9 : 4 (4) 1 : 4

ANS - 10

$E_n = \frac{E_0}{n^2}$

First excited state $n_1 = 2$

Second excited state $n_2 = 3$

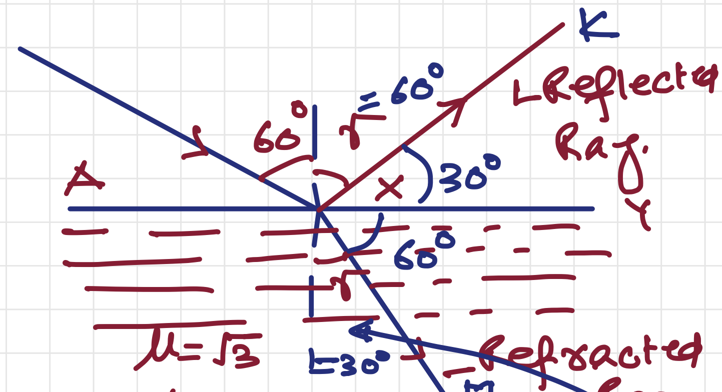
$\frac{T_1}{T_2} = \frac{n_2^2}{n_1^2} = \frac{9}{4}$

11. A light ray falls on a glass surface of refractive index $\sqrt{3}$, at an angle 60°. The angle between the refracted and reflected rays would be

(1) 60° (2) 90°

(3) 120° (4) 30°

11 - ANS



Apply Snell's law at surface AXY

$1 \sin 60° = \sqrt{3} \sin r$

$\frac{\sqrt{3}}{2} = \sqrt{3} \sin r \Rightarrow r = 30°$

$\angle KXM = 90°$

12. If a soap bubble expands, the pressure inside the bubble

(1) Increases (2) Remains the same

(3) Is equal to the atmospheric pressure (4) Decreases

ANS - 12 → $\Delta P = \frac{2S}{R}$

Soap bubble expands $R \uparrow$ then $\Delta P = \frac{2S}{R} \downarrow$ decreases

13. Plane angle and solid angle have

(1) Dimensions but no units

(2) No units and no dimensions

(3) Both units and dimensions

(4) Units but no dimensions

ANS- 13

$$\text{Angle} = \frac{\text{ARC}}{\text{RADIUS}} = \frac{\text{mt}}{\text{mt}}$$

Dimensionless but unit radian

$$\text{Solid angle} = \frac{\text{AREA}}{(\text{RADIUS})^2} = \frac{\text{mt}^2}{\text{mt}^2} = 1$$

Dimensionless but unit - steradian

14. When light propagates through a material medium of relative permittivity ε_r and relative permeability μ_r, the velocity of light, v is given by (c-velocity of light in vacuum)

(1) $v = \sqrt{\frac{\mu_r}{\varepsilon_r}}$

(2) $v = \sqrt{\frac{\varepsilon_r}{\mu_r}}$

(3) $v = \frac{c}{\sqrt{\varepsilon_r \mu_r}}$

(4) $v = c$

ANS- 14

$$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$$

$$v = \frac{1}{\sqrt{\mu_0 \mu_r \varepsilon_0 \varepsilon_r}}$$

$$v = \frac{1}{\sqrt{\mu_r \varepsilon_r}} \times \frac{1}{\sqrt{\mu_0 \varepsilon_0}} = \frac{c}{\sqrt{\mu_r \varepsilon_r}}$$

15. Two resistors of resistance, 100 Ω and 200 Ω are connected in parallel in an electrical circuit. The ratio of the thermal energy developed in 100 Ω to that in 200 Ω in a given time is

(1) 2 : 1

(2) 1 : 4

(3) 4 : 1

(4) 1 : 2

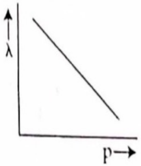
ANS-15

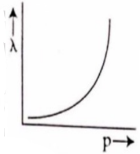
$$P = \frac{V^2}{R}$$

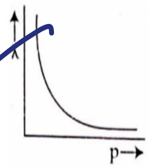
Since parallel potential = constant

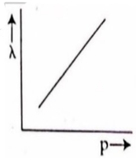
$$\frac{P_1}{P_2} = \frac{R_2}{R_1} = \frac{200}{100} = 2$$

16. The graph which shows the variation of the de Broglie wavelength (λ) of a particle and its associated momentum (p) is

(1) 

(2) 

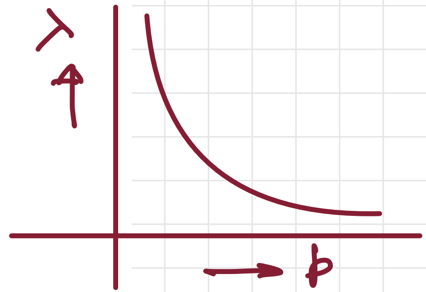
(3) 

(4) 

Answer (3)

ANS-16 $p = \frac{h}{\lambda}$, hence $p \propto \frac{1}{\lambda}$

h = constant (Rectangular hyperbola)



17. A square loop of side 1 m and resistance 1 Ω is placed in a magnetic field of 0.5 T. If the plane of loop is perpendicular to the direction of magnetic field, the magnetic flux through the loop is

(1) 0.5 weber (2) 1 weber

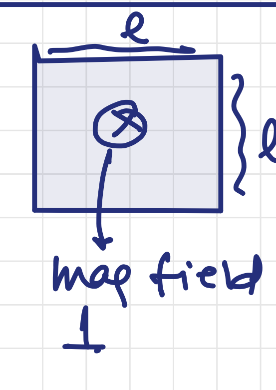
(3) Zero weber (4) 2 weber

Answer (1)

ANS-17 → $\phi = BA\cos\theta$

$= 0.5\,l^2$

$= 0.5$ weber



18. The dimensions $[MLT^{-2}A^{-2}]$ belong to the

(1) Self inductance (2) Magnetic permeability

(3) Electric permittivity (4) Magnetic flux

ANS-18 $B = \mu_0 n I$

$F = qvB\sin\theta \Rightarrow B = \frac{F}{qv\sin\theta}$

$= \frac{MLT^{-2}}{AT\,LT^{-1}}$

$= MA^{-1}T^{-2}$

$\mu_0 = \frac{MA^{-1}T^{-2}}{L^{-1}A}$

$= MA^{-2}LT^{-2}$

19. When two monochromatic lights of frequency, ν and $\frac{\nu}{2}$ are incident on a photoelectric metal, their stopping potential becomes $\frac{V_s}{2}$ and V_s respectively. The threshold frequency for this metal is

(1) 3ν (2) $\frac{2}{3}\nu$

(3) $\frac{3}{2}\nu$ ✓ (4) 2ν

ANS-19

$$h\nu = h\nu_0 + e\frac{V_s}{2} \quad — (1)$$

$$\frac{h\nu}{2} = h\nu_0 + eV_s \quad — (2)$$

$$eV_s = \frac{h\nu}{2} - h\nu_0 \rightarrow \text{put in eq}^n \ (1)$$

$$h\nu = h\nu_0 + \frac{1}{2}\left(\frac{h\nu}{2} - h\nu_0\right)$$

$$h\nu = h\nu_0 + \frac{h\nu}{4} - \frac{h\nu_0}{2}$$

$$h\nu - \frac{h\nu}{4} = h\nu_0\left(1 - \frac{1}{2}\right) = \frac{h\nu_0}{2}$$

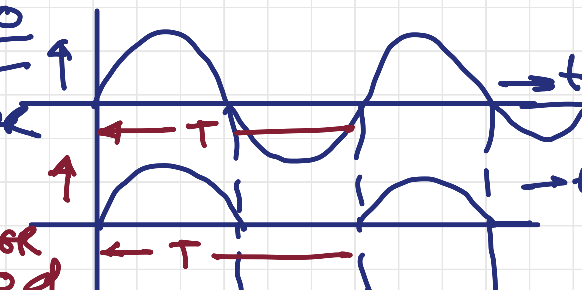
$$\frac{3h\nu}{4} = \frac{h\nu_0}{2} \Rightarrow \nu_0 = \frac{3\nu}{2}$$

20. In half wave rectification, if the input frequency is 60 Hz, then the output frequency would be

(1) 30 Hz (2) 60 Hz ✓

(3) 120 Hz (4) Zero

ANS-20

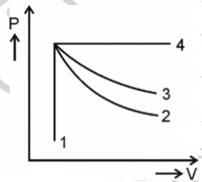


INPUT of ½ WAVE RECTIFIER

OUTPUT of ½ WAVE RECTIFIER

Time period for input and output is same hence frequency is same

21. An ideal gas undergoes four different processes from the same initial state as shown in the figure below. Those processes are adiabatic, isothermal, isobaric and isochoric. The curve which represents the adiabatic process among 1, 2, 3 and 4 is



(1) 2 ✓ (2) 3

(3) 4 (4) 1

ANS-21

$$\left.\frac{dP}{dV}\right|_{\text{ADIABATIC}} = -\gamma P$$

$$\left.\frac{dP}{dV}\right|_{\text{ISOTHERMAL}} = -P$$

$$\left|\frac{dP}{dV}\right|_{\text{ADIABATIC}} > \left|\frac{dP}{dV}\right|_{\text{ISOTHERMAL}}$$

22. Match List-I with List-II

	List-I (Electromagnetic waves)		List-II (Wavelength)
(a)	AM radio waves	(i)	10^{-10} m
(b)	Microwaves	(ii)	10^{2} m
(c)	Infrared radiations	(iii)	10^{-2} m
(d)	X-rays	(iv)	10^{-4} m

Choose the correct answer from the options given below

(1) (a) - (iii), (b) - (ii), (c) - (i), (d) - (iv)

(2) (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)

✓ (3) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

(4) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

ANS - 22 (LEARN TABLE OF EMW FROM NCERT)

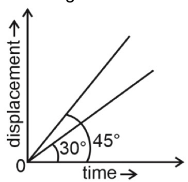
AM RADIO WAVE → 10^{2} mt

MICROWAVE → 10^{-2} mt

INFRARED RADIATION → 10^{-4} mt

X RAY → 10^{-2} mt

23. The displacement-time graphs of two moving particles make angles of 30° and 45° with the *x*-axis as shown in the figure. The ratio of their respective velocity is



(1) 1 : 1 (2) 1 : 2

(3) 1: $\sqrt{3}$ (4) $\sqrt{3}$: 1

ANS - 23 → slope of velocity time graph is velocity

$\frac{v_{30°}}{v_{45°}} = \frac{\tan 30°}{\tan 45°} = \frac{1/\sqrt{3}}{1} = \frac{1}{\sqrt{3}}$

24. In a Young's double slit experiment, a student observes 8 fringes in a certain segment of screen when a monochromatic light of 600 nm wavelength is used. If the wavelength of light is changed to 400 nm, then the number of fringes he would observe in the same region of the screen is

(1) 8 (2) 9

✓ (3) 12 (4) 6

ANS - 24 →

No of fringes = Length of the screen / FRINGE WIDTH

for ① $8 = \frac{x}{\lambda_1 D/d}$, for ② $n = \frac{x}{\lambda_2 D/d}$

$\frac{8}{n} = \frac{\lambda_2}{\lambda_1}$

$\frac{8}{n} = \frac{4}{6} \Rightarrow n = \frac{8 \times 6}{4} = 12$

25. The peak voltage of the ac source is equal to

(1) The rms value of the ac source
(2) $\sqrt{2}$ times the rms value of the ac source
(3) $1/\sqrt{2}$ times the rms value of the ac source
(4) The value of voltage supplied to the circuit

ANS - 25

$V_{rms} = V_0/\sqrt{2}$

for $V = V_0 \sin\omega t$

$V_0 = \sqrt{2}\, V_{rms}$

26. If the initial tension on a stretched string is doubled, then the ratio of the initial and final speeds of a transverse wave along the string is

(1) $\sqrt{2}:1$
(2) $1:\sqrt{2}$
(3) $1:2$
(4) 1

ANS - 26 — $v = \sqrt{\frac{T}{m}}$

$\frac{v_1}{v_2} = \sqrt{\frac{T}{2T}} = \frac{1}{\sqrt{2}}$

27. Given below are two statements

Statement I : Biot-Savart's law gives us the expression for the magnetic field strength of an infinitesimal current element (Idl) of a current carrying conductor only.

Statement II : Biot-Savart's law is analogous to Coulomb's inverse square law of charge *q*, with the former being related to the field produced by a scalar source, Idl while the latter being produced by a vector source, *q*.

In light of above statements choose the most appropriate answer from the options given below

(1) Both Statement I and Statement II are incorrect
(2) Statement I is correct and Statement II is incorrect
(3) Statement I is incorrect and Statement II is correct
(4) Both Statement I and Statement II are correct

ANS - 27 → $dB = \frac{\mu_0}{4\pi} \frac{I(\vec{dl} \times \vec{r})}{r^3}$ (VALID FOR INFINITESIMAL ELEMENT)

$I\vec{dl}$ – Vector source

electric field is produced by charge q

ANALOGOUS TO COULOMB'S LAW

I – CORRECT

II – INCORRECT

28. As the temperature increases, the electrical resistance

(1) Decreases for both conductors and semiconductors
(2) Increases for conductors but decreases for semiconductors
(3) Decreases for conductors but increases for semiconductors
(4) Increases for both conductors and semiconductors

ANS - 28 – $R_t = R_0(1 + \alpha t)$

α +ve for conductor

α –ve for semiconductor

hence increases in conductor & decreases in semi conductor

29. The energy that will be ideally radiated by a 100 kW transmitter in 1 hour is

(1) 36×10^4 J (2) 36×10^5 J

(3) 1×10^5 J (4) 36×10^7 J

ANS – 29 → $P = W/t$

$W = P(t) = 100 \times 10^3 \times 3600$

$= 36 \times 10^7$ Joules

30. A body of mass 60 g experiences a gravitational force of 3.0 N, when placed at a particular point. The magnitude of the gravitational field intensity at that point is

(1) 50 N/kg (2) 20 N/kg

(3) 180 N/kg (4) 0.05 N/kg

ANS – 30 $F = mE$

$3 = \frac{60}{1000}(E) \Rightarrow E = 50\,N/kg.$

31. In the given nuclear reaction, the element X is

$^{22}_{11}Na \rightarrow X + e^+ + \nu$

(1) $^{23}_{10}Ne$ (2) $^{22}_{10}Ne$

(3) $^{22}_{12}Mg$ (4) $^{23}_{11}Na$

ANS – 31 $^{22}_{11}Na \rightarrow X + e^+ + \nu$

$e^+ \rightarrow {}_{1}e^0$

$^{22}_{11}Na \rightarrow {}^{22}_{10}Ne + {}_{1}e^0 + \nu$

32. The angle between the electric lines of force and the equipotential surface is

(1) 45° (2) 90°

(3) 180° (4) 0°

ANS – 32 $dV = -\bar{E}\cdot d\bar{r}$

$(V_f - V_i) = -\bar{E}\cdot d\bar{r}$

for equipotential surface $V_f = V_i = V$

$V - V = -E\,dr\cos\theta$

$0 = -E\,dr\cos\theta$

$E \neq 0,\ dr \neq 0,\ \cos\theta = 0,$ $\theta = 90^0$

33. A copper wire of length 10 m and radius $\left(\frac{10^{-2}}{\sqrt{\pi}}\right)$ m has electrical resistance of 10 Ω. The current density in the wire for an electric field strength of 10 (V/m) is

(1) 10^6 A/m²
(2) 10^{-5} A/m²
(3) 10^5 A/m² ✓
(4) 10^4 A/m²

ANS-33

$l = 10$ mt, $r = \frac{10^{-2}}{\sqrt{\pi}}$ mt

$R = 10$ ohm

current density $J = I/A$

$J = \frac{V}{RA} = \frac{El}{RA} = \frac{10 \times 10}{10 \times \pi r^2}$

$= \frac{10}{\pi \frac{10^{-4}}{\pi}} = 10^5$ A/mt²

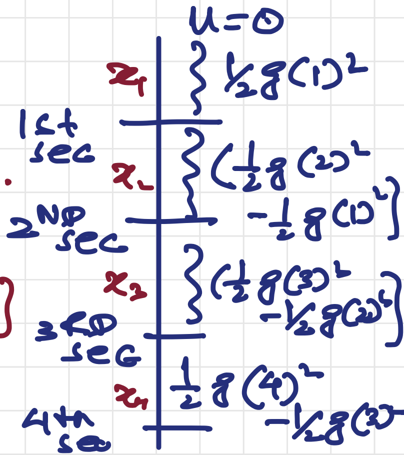
34. The ratio of the distances travelled by a freely falling body in the 1st, 2nd, 3rd and 4th second

(1) 1 : 4 : 9 : 16
(2) 1 : 3 : 5 : 7 ✓
(3) 1 : 1 : 1 : 1
(4) 1 : 2 : 3 : 4

35. An electric lift with a maximum load of 2000 kg (lift + passengers) is moving up with a constant speed of 1.5 ms^{-1}. The frictional force opposing the motion is 3000 N. The minimum power delivered by the motor to the lift in watts is : (g = 10 m s^{-2})

(1) 20000
(2) 34500 ✓
(3) 23500
(4) 23000

ANS-34



$x_1 : x_2 : x_3 : x_4 ::$

$\left[\frac{1}{2}g(1)^2\right] : \left[\frac{1}{2}g(2)^2 - \frac{1}{2}g(1)^2\right] : \left[\frac{1}{2}g(3)^2 - \frac{1}{2}g(2)^2\right] : \left[\frac{1}{2}g(4)^2 - \frac{1}{2}g(3)^2\right]$

$= 1 : (4-1) : (9-4) : (16-9)$

$= 1 : 3 : 5 : 7$

ANS-35

$P = F \cdot v$

$= (2000 \times 10 + 3000)(1.5)$

$= \{20000 + 3000\}(1.5)$

$= 34500$ watt

SECTION-B

36. The volume occupied by the molecules contained in 4.5 kg water at STP, if the intermolecular forces vanish away is

(1) 5.6×10^{3} m^3 (2) 5.6×10^{-3} m^3

(3) 5.6 m^3 (4) 5.6×10^{6} m^3

ANS-36

$PV = nRT$, $V = \frac{nRT}{P}$

$n = \frac{\text{mass of water}}{\text{molecular weight}} = \frac{4.5 \times 10^3}{18}$

$T = 273$ K, $P = 10^5$ N/m^2 at STP

$V = \frac{4.5 \times 10^3}{18} \times \frac{8.3 \times 273}{10^5}$

$= 5.66$ mt^2

37. The area of a rectangular field (in m^2) of length 55.3 m and breadth 25 m after rounding off the value for correct significant digits is

(1) 1382 (2) 1382.5

(3) 14×10^2 (4) 138×10^1

ANS-37

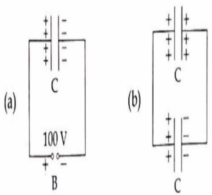
AREA $= l \times b$

$= 55.3 \times 25$

$= 1382.5$ mt^2

$= 14 \times 10^2$ mt^2

38. A capacitor of capacitance C = 900 pF is charged fully by 100 V battery B as shown in figure (a). Then it is disconnected from the battery and connected to another uncharged capacitor of capacitance C = 900 pF as shown in figure (b). The electrostatic energy stored by the system (b) is



(1) 3.25×10^{-6} J (2) 2.25×10^{-6} J

(3) 1.5×10^{-6} J (4) 4.5×10^{-6} J

ANS-38

$q_1 = 900 \times 10^{-12} \times 100$

$= 9 \times 10^{-8}$ C

$V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2} = \frac{9 \times 10^{-8}}{1800 \times 10^{-12}} = 50$ Volt

$U = \frac{1}{2}(C_1 + C_2)V^2$

$= \frac{1}{2} \times 1800 \times 10^{-12} \times 50 \times 50$

$= 2.25 \times 10^{-6}$ J

39. Match **List - I** with **List - II** :

	List - I		**List - II**
(a)	Gravitational constant (G)	(i)	$[L^2T^{-2}]$
(b)	Gravitational potential energy	(ii)	$[M^{-1}L^3T^{-2}]$
(c)	Gravitational potential	(iii)	$[LT^{-2}]$
(d)	Gravitational intensity	(iv)	$[ML^2T^{-2}]$

Choose the **correct answer** from the options given below :

(1) (a)–(ii), (b)–(iv), (c)–(i), (d)– (iii) ✓

(2) (a)–(ii), (b)–(iv), (c)–(iii), (d)– (i)

(3) (a)–(iv), (b)–(ii), (c)–(i), (d)– (iii)

(4) (a)–(ii), (b)–(i), (c)–(iv), (d)– (iii)

ANS-39 $F = \frac{G m_1 m_2}{r^2} \Rightarrow G = \frac{F r^2}{m_1 m_2} = \frac{MLT^{-2}L^2}{M^2} = M^{-1}L^3T^{-2}$

$PE = mgh = MLT^{-2}L = ML^2T^{-2}$

GRAVITATIONAL POTENTIAL $= \frac{W}{m} = \frac{ML^2T^{-2}}{M} = L^2T^{-2}$

GRAVITATIONAL INTENSITY $= \frac{F}{m} = \frac{MLT^{-2}}{M} = LT^{-2}$

40. Two pendulums of length 121 cm and 100 cm start vibrating in phase. At some instant, the two are at their mean position in the same phase. The minimum number of vibrations of the shorter pendulum after which the two are again in phase at the mean position is:

(1) 9
(2) 10
(3) 8
(4) 11 ✓

ANS-40

$n_1 T_1 = n_2 T_2$

$n_1 2\pi\sqrt{\frac{l_1}{g}} = n_2 2\pi\sqrt{\frac{l_2}{g}}$

$n_1\sqrt{121} = n_2\sqrt{100}$

$11 n_1 = 10 n_2$

$\frac{n_2}{n_1} = \frac{11}{10}$

After completion of 11th oscillation of shorter pendulum

41. Given below are two statements : One is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A): The stretching of a spring is determined by the shear modulus of the material of the spring.

Reason (R): A coil spring of copper has more tensile strength than a steel spring of same dimensions.

In the light of the above statements, choose the **most appropriate** answer from the options given below

(1) Both **(A)** and **(R)** are true and **(R)** is not the correct explanation of **(A)**

(2) **(A)** is true but **(R)** is false

(3) **(A)** is false but **(R)** is true

(4) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**

ANS-41

STRETCHING OF SPRING CAN BE DETERMINED BY SHEAR MODULUS AS THERE IS NO CHANGE IN SHAPE.

TENSILE STRENGTH OF STEEL MORE THAN COPPER.

Hence Assertion is true but reason is false

42. A ball is projected with a velocity, 10 ms^{-1}, at an angle of 60° with the vertical direction. Its speed at the highest point of its trajectory will be

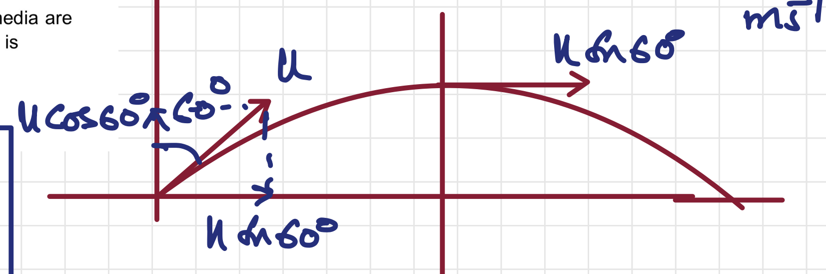
(1) $5\sqrt{3}$ ms^{-1} ✓ (2) 5 ms^{-1}

(3) 10 ms^{-1} (4) Zero

ANS-42

Horizontal component at max height

Hence $= u \sin 60 = 10 \times \frac{\sqrt{3}}{2} = 5\sqrt{3}$ ms^{-1}



43. Two transparent media *A* and *B* are separated by a plane boundary. The speed of light in those media are 1.5×10^8 m/s and 2.0×10^8 m/s, respectively. The critical angle for a ray of light for these two media is

(1) $\sin^{-1}(0.750)$ ✓ (2) $\tan^{-1}(0.500)$

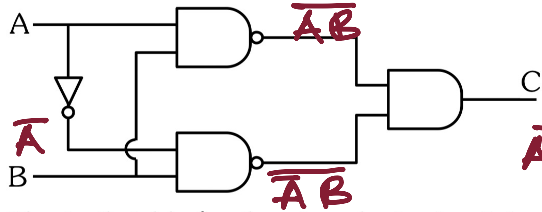
(3) $\tan^{-1}(0.750)$ (4) $\sin^{-1}(0.500)$

ANS-43

$\mu = \frac{v_a}{v_m} = \frac{2 \times 10^8}{1.5 \times 10^8} = \frac{20}{15} = \frac{4}{3}$

$\mu = 4/3$

$\sin C = \frac{1}{\mu} = \frac{1 \times 3}{4} \Rightarrow C = \sin^{-1}(0.75)$

44. 

The truth table for the given logic circuit is :

(1)

A	B	C
0	0	1
0	1	0
1	0	0
1	1	1

(2) ✓

A	B	C
0	0	1
0	1	0
1	0	1
1	1	0

(3)

A	B	C
0	0	0
0	1	1
1	0	0
1	1	1

(4)

A	B	C
0	0	0
0	1	1
1	0	1
1	1	0

Remember Demorgane rule

$\overline{AB} = \bar{A} + \bar{B}$

ANS-44

$\overline{AB}\;\overline{\bar{A}B} = (\bar{A}+\bar{B})(\bar{\bar{A}}+\bar{B})$

$= (\bar{A}+\bar{B})(A+\bar{B})$

$= A\bar{A} + \bar{A}\bar{B} + \bar{B}A + \bar{B}\bar{B}$

$= 0 + \bar{A}\bar{B} + \bar{B}A + \bar{B}$

$= \bar{B}(\bar{A}+1) + \bar{B}A = \bar{B} + \bar{B}A$

$= \bar{B}(1+A) = \bar{B}$

A	B	$\bar{B}$
0	0	1
0	1	0
1	0	1
1	1	0

45. A series LCR circuit with inductance 10 H, capacitance 10 μF resistance 50 Ω is connected to an ac source of voltage, $V = 200\sin(100t)$ volt. If the resonant frequency of the LCR circuit is ν_0 and the frequency of the ac source is ν, then

(1) $\nu_0 = \nu = \frac{50}{\pi}$ Hz (2) $\nu_0 = \frac{50}{\pi}$ Hz, $\nu = 50$ Hz

(3) $\nu = 100$ Hz; $\nu_0 = \frac{100}{\pi}$ Hz (4) $\nu_0 = \nu = 50$ Hz

ANS-45

For resonance $X_L = X_C$

$\omega L = 1/\omega C \Rightarrow \omega = \frac{1}{\sqrt{LC}}$

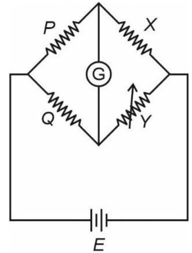
$= \frac{1}{\sqrt{10 \times 10 \times 10^{-6}}} = 100$

$\omega = 2\pi f \Rightarrow f = \frac{\omega}{2\pi} = \frac{100}{2\pi} = \frac{50}{\pi}$

$\nu_0 = f_0 = \frac{50}{\pi}$

$\nu = f = 50/\pi$

46. A wheatstone bridge is used to determine the value of unknown resistance X by adjusting the variable resistance Y as shown in the figure. For the most precise measurement of X, the resistances P and Q



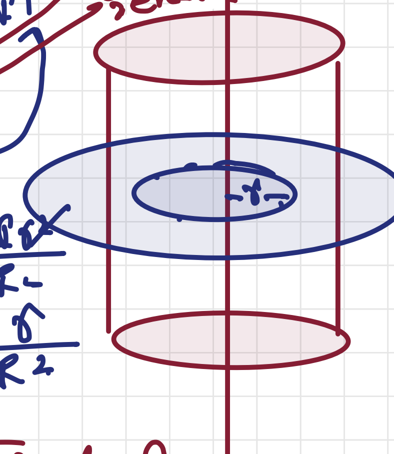
(1) Should be approximately equal and are small
(2) Should be very large and unequal
(3) Do not play any significant role
(4) Should be approximately equal to 2X

ANS- 46 → more precise / more accurate can be done by making ratio arm equal.

47. From Ampere's circuital law for a long straight wire of circular cross-section carrying a steady current, the variation of magnetic field in the inside and outside region of the wire is

(1) A linearly increasing function of distance upto the boundary of the wire and then linearly decreasing for the outside region.
(2) A linearly increasing function of distance r upto the boundary of the wire and then decreasing one with $\frac{1}{r}$ dependence for the outside region.
(3) A linearly decreasing function of distance upto the boundary of the wire and then a linearly increasing one for the outside region.
(4) Uniform and remains constant for both the regions.

ANS - 47
Inside
$\oint B \cdot dl = \mu_0 I'$
$B \cdot 2\pi r = \mu_0 I'$
$\frac{I}{\pi R^2} = \frac{I'}{\pi r^2}$ — current density constant
$I' = \frac{I r^2}{R^2}$ — net current enclosed $= I'$
$B \cdot 2\pi r = \mu_0 \frac{I r^2}{R^2}$
$B = \frac{\mu_0}{2\pi} \frac{I r}{R^2}$
$B \propto r$



outside $\oint B \cdot dl = \mu_0 I$
$B \cdot 2\pi r = \mu_0 I$
$B = \frac{\mu_0}{2\pi} \frac{I}{r}$
$B \propto 1/r$

48. A big circular coil of 1000 turns and average radius 10 m is rotating about its horizontal diameter at 2 rad s^{-1}. If the vertical component of earth's magnetic field at that place is 2×10^{-5} T and electrical resistance of the coil is 12.56 Ω, then the maximum induced current in the coil will be :

(1) 1.5 A (2) 1 A

(3) 2 A (4) 0.25 A

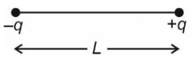
ANS-48

$I_{max} = \frac{e_{max}}{R} = \frac{NBA\omega}{R}$

$= \frac{1000 \times 2 \times 10^{-6} \times \pi (10)^2 \times 2}{12.56}$

$= 1$ Amp

49. Two point charges –q and +q are placed at a distance of L, as shown in the figure.



The magnitude of electric field intensity at a distance R(R >>L) varies as:

(1) $\frac{1}{R^3}$ (2) $\frac{1}{R^4}$

(3) $\frac{1}{R^6}$ (4) $\frac{1}{R^2}$

Que-49 → for $R >> L$ for electric dipole

$E = \frac{1}{4\pi\epsilon_0} \frac{2p}{R^3}$ $p = q(L)$

$E \propto 1/R^3$

50. A nucleus of mass number 189 splits into two nuclei having mass number 125 and 64. The ratio of radius of two daughter nuclei respectively is

(1) 4 : 5

(2) 5 : 4

(3) 25 : 16

(4) 1 : 1

ANS-50

$R = R_0 A^{1/3}$

$\frac{R_1}{R_2} = \left(\frac{A_1}{A_2}\right)^{1/3} = \left(\frac{125}{64}\right)^{1/3}$

$= 5/4$