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Test Booklet Code
48

NEET (UG) 2025

Questions, Answer Key (AK) & Text Solutions (TS)

Date: 04 May, 2025 | TIME: 02:00 PM to 05:00 PM
Duration: 200 minutes (03 Hrs.) | Max. Marks: 720

Important Instructions:

1. The Answer Sheet is inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars on ORIGINAL Copy carefully with **blue/black** ball point pen only.
2. The test is of **3 hours** duration and Test Booklet contains **180** multiple-choice questions (four options with a single correct answer) from **Physics, Chemistry and Biology (Botany and Zoology).**
3. Wherever the symbols/constants are not mentioned, they are to be considered as per their standard meaning/value.
4. Each question carries **4 marks**. For each correct response, the candidate will get **4** marks. For each incorrect response, **one mark** will be deducted from the total scores. **The maximum marks are 720.**
5. Use **Blue/Black Ball Point Pen only** for writing particulars on this page/marking responses on Answer Sheet.
6. Rough work is to be done on the space provided for this purpose in the Test Booklet only.
7. On completion of the test, the candidate **must hand over the Answer Sheet (ORIGINAL and OFFICE Copy) to the Invigilator** before leaving the Room/Hall. The candidates are allowed to take away this Test Booklet with them.
8. **The CODE for this Booklet is "48". Make sure to enter this code in OMR answer sheet.**
9. The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere else except in the specified space in the Test Booklet/Answer Sheet.
10. Use of white fluid for correction is **NOT** permissible on the Answer Sheet.
11. Each candidate must show on-demand his/her Admit Card to the Invigilator.
12. No candidate, without special permission of the centre Superintendent or Invigilator, would leave his/her seat.
13. The candidates should not leave the Examination Hall without handing over their Answer Sheet to the Invigilator on duty and sign (with time) the Attendance Sheet twice. **Cases, where a candidate has not signed the Attendance Sheet second time, will be deemed not to have handed over the Answer Sheet and dealt with as an Unfair Means case.**
14. Use of Electronic/ Manual Calculator is prohibited.
15. The candidates are governed by all Rules and Regulations of the examination with regard to their conduct in the Examination Room/Hall. All cases of unfair means will be dealt with as per the Rules and Regulations of this examination along with public Examinations (Prevention of unfair means act 2024).
16. **No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.**
17. The candidates will write the Correct Test Booklet Code as given in the Test Booklet/Answer Sheet in the Attendance Sheet.
18. If a candidate marks more than one answers for a question in the OMR Sheet, it will be treated as incorrect and negative marking will be applicable.

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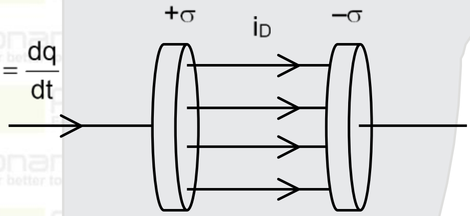
PART : PHYSICS

1. A parallel plate capacitor made of circular plates is being charged such that the surface charge density on its plates is increasing at a constant rate with time. The magnetic field arising due to displacement current is:
(1) non-zero every where with maximum at the imaginary cylindrical surface connecting peripheries of the plates
(2) zero between the plates and non-zero outside
(3) zero at all places
(4) constant between the plates and zero outside the plates

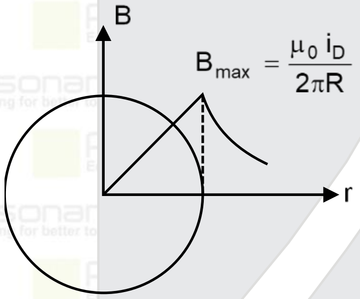
Ans. **(1)**

Sol.



$i_D = i_C = \frac{dq}{dt} = \text{constant}$

The induced magnetic field is maximum at the surface (at r = R)



$B_{max} = \frac{\mu_0 i_D}{2\pi R}$

Ans. will be (1)

2. An electric dipole with dipole moment 5×10^{-6} Cm is aligned with the direction of a uniform electric field of magnitude 4×10^5 N/C. The dipole is then rotated through an angle of 60º with respect to the electric field. The change in the potential energy of the dipole is :
(1) 1.2 J (2) 1.5 J (3) 0.8 J (4) 1.0 J

Ans. **(4)**

Sol. $\Delta U = U_f - U_i = (-pE\cos 60^\circ) - (-pE\cos 0^\circ)$

$\Delta U = \frac{PE}{2} = \frac{(5\times10^{-6})(4\times10^{5})}{2} = 1\ J$

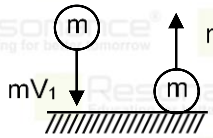
Ans. will be (4)

3. A ball of mass 0.5 kg is dropped from a height of 40 m. The ball hits the ground and rises to a height of 10 m. The impulse imparted to the ball during its collision with the ground is (Take g = 9.8 m/s²)

(1) 0 (2) 84 NS (3) 21 NS (4) 7 NS

Ans. **(3)**

Sol.



$$V_1 = \sqrt{2gh_1} = \sqrt{2 \times 9.8 \times 40} = 28\,m/sec$$

$$V_2 = \sqrt{2gh_2} = \sqrt{2 \times 9.8 \times 10} = 14\,m/sec$$

$$J = \Delta p = \vec{p}_f - \vec{p}_i$$

$J = \Delta p = (+mV_2) - (-mV_1) = m(V_1 + V_2) = (0.5)(28 + 14)$

J = 21 N.sec.

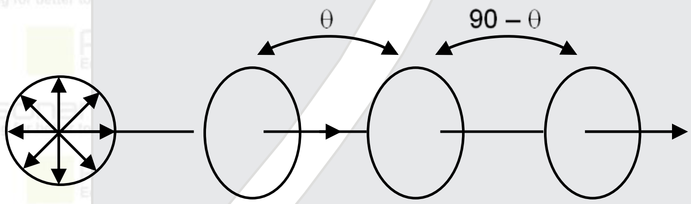
Ans. will be (3)

4. The intensity of transmitted light when a polaroid sheet, placed between two crossed polaroid's at 22.5º from the polarization axis of one of the polaroid, is (I_0 is the intensity of polarised light after passing through the first polaroid):

(1) $\frac{I_0}{8}$ (2) $\frac{I_0}{16}$ (3) $\frac{I_0}{2}$ (4) $\frac{I_0}{4}$

Ans. **(1)**

Sol.



$I_0 \rightarrow I_0 \cos^2\theta \rightarrow I_0 \cos^2\theta \cos^2(90 - \theta)$

$$I_f = I_0 \cos^2\theta \sin^2\theta = I_0 (\sin\theta \cos\theta)^2 = I_0\left(\frac{\sin 2\theta}{2}\right)^2$$

$$I_f = \frac{I_0}{4}\sin^2(2 \times 22.5º) = \frac{I_0}{4}\sin^2 45º = \frac{I_0}{8}$$

Ans. will be (1)

5. The kinetic energies of two similar cars A and B are 100 J and 225 J respectively. On applying breaks, car A stops after 1000 m and car B stops after 1500 m. If F_A and F_B are the forces applied by the breaks on cars A and B, respectively, then the ratio F_A/F_B is

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

Ans. **(4)**

Sol. According to work energy theorem

$W_{all} = KE\uparrow = KE_f - KE_i$

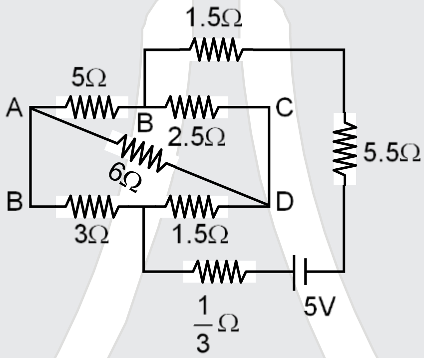
$-(F)(x) = 0 - KE \Rightarrow F = \frac{KE}{x}$

$F_A = \frac{KE_1}{x_1}, \; F_B = \frac{KE_2}{x_2}$

$\frac{F_A}{F_B} = \left(\frac{KE_1}{KE_2}\right)\left(\frac{x_2}{x_1}\right) = \left(\frac{100}{225}\right)\left(\frac{1500}{1000}\right) = \frac{2}{3}$

Ans. will be (4)

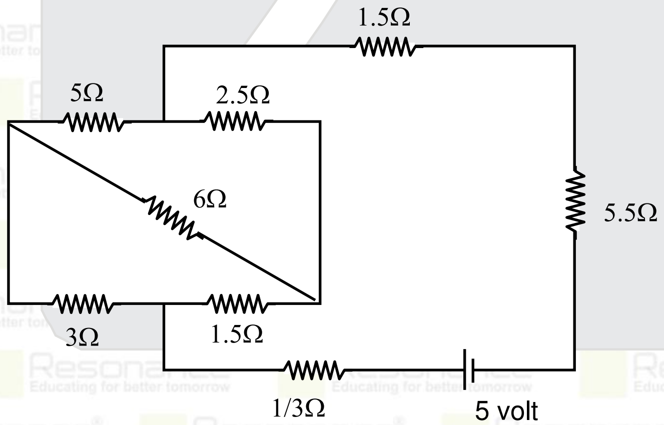
6. The current passing through the battery in the given circuit, is :



(1) 2.5 A (2) 15 A (3) 2.0 A (4) 0.5 A

Ans. (4)

Sol.

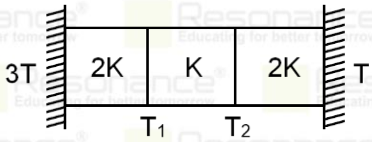


$\frac{1}{R_{eq}} = \frac{1}{8} + \frac{1}{4} \Rightarrow R_{eq} = \frac{8}{3}\Omega$

$R_{net} = \frac{1}{3} + \frac{8}{3} + 1.5 + 5.5 = 10\Omega$

$i = \frac{emf}{R_{net}} = \frac{5}{10} = 0.5$ A, Answer will be (4)

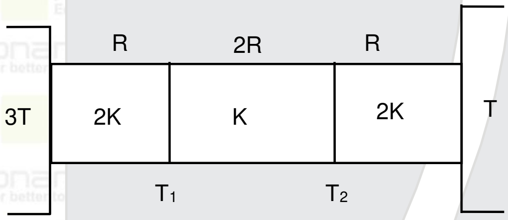
7. Three identical heat conducting rods are connected in series as shown in the figure. The rods on the sides have thermal conductivity 2K while that in the middle has thermal conductivity K. The left end of the combination is maintained at temperature 3T and the right end at T. In steady state, temperature at the left junction is T_1 and that at the right junction is T_2. The ratio T_1/T_2 is



(1) $\frac{5}{3}$ (2) $\frac{5}{4}$ (3) $\frac{3}{2}$ (4) $\frac{4}{3}$

Ans. (4)

Sol.



$R_{th} = \frac{\ell}{KA} \propto \frac{4}{K}$

$i_{in} = i_{out}$

$\frac{3T - T_1}{R} = \frac{T_1 - T}{2R + R}$

$T_1 = 2T$

$i_{in} = i_{out}$

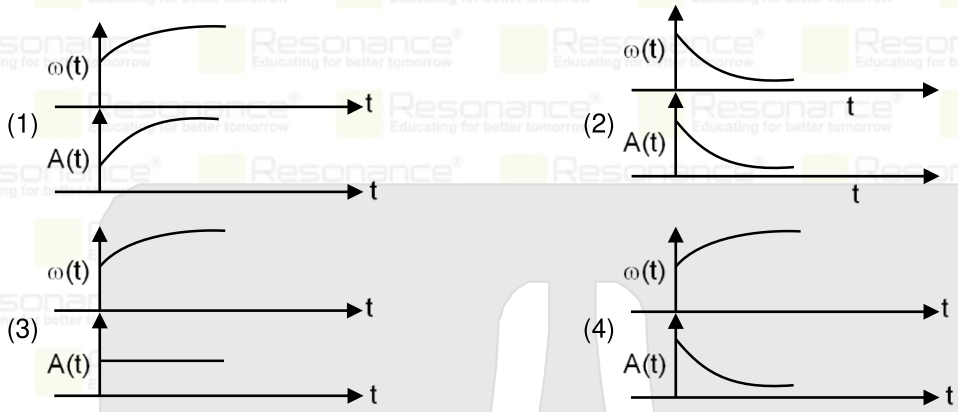
$\frac{3T - T_2}{R + 2R} = \frac{T_2 - T}{R}$

$T_2 = \frac{3}{2}T$

$\frac{T_1}{T_2} = \frac{2T}{3/2T} = \frac{4}{3}$

Answer will be (4)

8. In an oscillating spring mass system, a spring is connected to a box filled with sand. As the box oscillates, sand leaks slowly out of the box vertically so that the average frequency $\omega(t)$ and average amplitude A(t) of the system change with time t. Which one of the following options schematically depicts these changes correctly ?

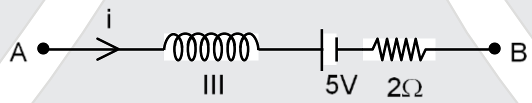


Ans. **(4)**

Sol. $\omega_n = \sqrt{\frac{k}{m}}$, Since m is decreasing, its frequency will increase

Since the sand will take away some energy so the total energy TE = $\frac{1}{2}KA^2$ of the system will decrease, so the amplitude will also decrease. so Answer should be (4)

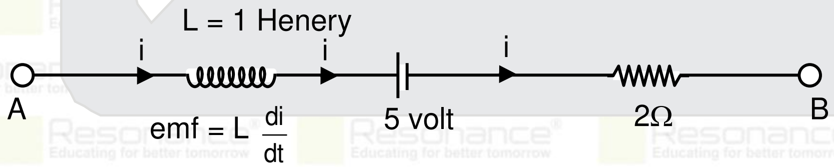
9. AB is a part of an electric circuit (see figure). The potential difference "$V_A - V_B$", at the instant when current I = 2A and is increasing at a rate of 1 amp/second is :



(1) 9 volt (2) 10 volt (3) 5 volt (4) 6 volt

Ans. **(2)**

Sol.



$V_A - V_B = + L\frac{di}{dt} + 5 + iR$

$V_A - V_B = + (1)(+1) + 5 + (2)(2) = 10$ volt,

Answer will be (2)

10. A particle of mass m is moving around the origin with a constant force F pulling it towards the origin. If Bohr model is used to describe its motion, the radius r of the n^{th} orbit and the particle's speed v in the orbit depend on n as

(1) $r \propto n^{2/3}$; $v \propto n^{1/3}$ (2) $r \propto n^{4/3}$; $v \propto n^{-1/3}$ (3) $r \propto n^{1/3}$; $v \propto n^{1/3}$ (4) $r \propto n^{2/3}$; $v \propto n^{2/3}$

Ans. **(1)**

Sol. $\frac{mv^2}{r} = F$ and $mvr = \frac{nh}{2\pi}$

multiplying $V^3 \propto n \Rightarrow V \propto n^{1/3}$

$m(n^{1/3})r \propto h \Rightarrow r \propto n^{2/3}$, Answer will be (1)

11. In some appropriate units, time (t) and position (x) relation of a moving particle is given $t = x^2 + x$. The acceleration of the particle

(1) $+\frac{2}{(x+1)^3}$ (2) $+\frac{2}{2x+1}$ (3) $-\frac{2}{(x+2)^3}$ (4) $-\frac{2}{(2x+1)^3}$

Ans. **(4)**

Sol. $t = x^2 + x$

$\frac{dt}{dx} = (2x+1) \Rightarrow \frac{dx}{dt} = \frac{1}{(2x+1)}$

$a = v\frac{dv}{dx} = -\left(\frac{1}{(2x+1)}\right)\left(\frac{1}{(2x+1)^2}\right) \times 2$

$a = -\frac{2}{(2x+1)^3}$ Answer will be (4)

12. A model for quantized motion of an e in a uniform magnetic field B sates that the flux passing through the orbit of the electron is n(h/e) where n is an integer, h is Planck's constant and e is the magnitude of electron's charge. According to the model, the magnetic moment of an electron in its lowest energy state will be (m is the mass of the electron)

(1) $\frac{heB}{\pi m}$ (2) $\frac{heB}{2\pi m}$ (3) $\frac{he}{\pi m}$ (4) $\frac{he}{2\pi m}$

Ans. **(4)**

Sol. $8(\pi r^2) = \frac{nh}{e} \Rightarrow \left(r^2 = \frac{nh}{eB\pi}\right)$ where $r = \frac{mv}{qB} \Rightarrow v = \frac{qBr}{m}$

$M = Ni_a (i)\left(\frac{q}{T}\right)\pi r^2 = \frac{e}{2\pi r/v} \times \pi r^2 = \frac{evr}{2}$

$M = \frac{(e)\left(\frac{qBr}{m}\right)r}{2} = \frac{e^2B}{2m}r^2 = \left(\frac{e^2B}{2m}\right)\left(\frac{nh}{eB\pi}\right)$

$M = \frac{n(he)}{2\pi m}$, $M_1 = \frac{(1)eh}{2\pi m}$

13. A microscope has an objective of focal length 2 cm, eyepiece of focal length 4 cm and the tube length of 40 cm. If the distance of distinct vision of eye is 25 cm, the magnification in the microscope is

(1) 150 (2) 250 (3) 100 (4) 125

Ans. **(4)**

Sol. $M = -\frac{L}{f_0}\frac{D}{f_e}$

$= \frac{40}{2}\frac{25}{4} = 125$

14. There are two inclined surfaces of equal length (L) and same angle of inclination 45° with the horizontal. One of them is rough and the other is perfectly smooth. A given body takes 2 times as much time to slide down on rough surface than on the smooth surface. The coefficient of kinetic friction (μ_k) between the object and the rough surface is close to

(1) 0.5 (2) 0.75 (3) 0.25 (4) 0.40

Ans. **(2)**

Sol. $2t_{smooth} = t_{Rough}$

$$2\sqrt{\frac{25}{g\sin\theta}} = \sqrt{\frac{25}{g\sin\theta - \mu g\cos\theta}}$$

square both side

$4\sin\theta - 4\mu\cos\theta = \sin\theta$

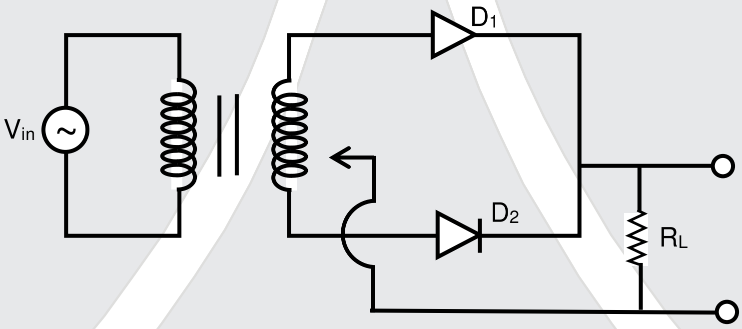
$\sin\theta = \cos\theta = \frac{1}{\sqrt{2}}$ $\theta = 45^\circ$

$4 - 4\mu = 1$

$3 = 4\mu$

$\mu = \frac{3}{4} = 0.75$

15. A full wave rectifier circuit with diodes (D_1) and (D_2) is shown in the figure. If input supply voltage $V_{in} = 220 \sin(100\pi t)$ volt, then at t = 15 m/sec



(1) D_1 and D_2 both are forward biased
(2) D_1 and D_2 both are reverse biased
(3) D_1 is forward biased, D_2 is reverse biased
(4) D_1 is reverse biased, D_2 is forward

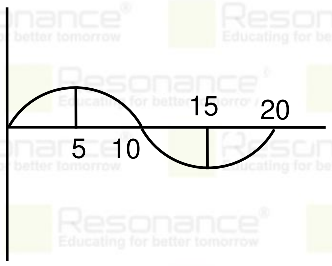
Ans. **(4)**

Sol. $w = 100\pi$

$f = 50$

$T = \frac{1}{50} = \frac{1000}{50}$ ms = 20 ms

t = 15 m/s Ans



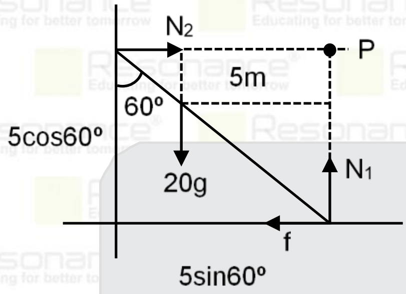
D_1 R_B (reverse biased)
D_2 F_B (forward biased) **Ans. (4)**

16. A uniform rod of mass 20 kg and length 5m leans against a smooth vertical all making an angle of 60° with it. The other end rests on a rough horizontal floor. The friction force that the floor exerts on the rod is (take $g = 10\ m/s^2$)

(1) 200 N (2) $200\sqrt{3}$ N (3) 100 N (4) $100\sqrt{3}$ N

Ans. **(4)**

Sol.



$\tau_P = 0$

$f(5\cos60^\circ) = \dfrac{20g(5\sin60^\circ)}{2}$

$f = 10g\tan60^\circ$

$= 100\sqrt{3}$

17. Two identical charged conducting spheres A and B have their centres separated by a certain distance. Charge on each sphere is q and the force of repulsion between them is F. A third identical uncharged conducting sphere is brought in contact with sphere A first and then with B and finally removed from both. New force of repulsion between spheres A and B (Radii of A and B are negligible compared to the distance of separation so that for calculating force between them they can be considered as point charge s) is best given as:

(1) $\dfrac{F}{2}$ (2) $\dfrac{3F}{8}$ (3) $\dfrac{3F}{5}$ (4) $\dfrac{2F}{3}$

Ans. **(2)**

Sol.

q/2 A 3q/4 B

$F' = \dfrac{K\frac{q}{2}\frac{3q}{4}}{r^2}$

$= \dfrac{3}{8}\dfrac{kq^2}{r^2}$

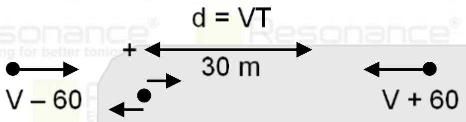
$= \dfrac{3}{8}F$

18. Two cities X and Y are connected by a regular bus services with a bus leaving in either direction every T min. A girl is driving scooty with a speed of 60 km/h in the direction X to Y notices that a bus goes past her every 30 minutes in the direction of her motion, and every 10 minutes in the opposite direction. Choose the correct option for the period T of the bus service and the speed (assumed constant) of the buses.

(1) 10 min, 90 km/h (2) 15 min, 120 km/h
(3) 9 min, 40 km/h (4) 25 min, 100 km/h

Ans. **(2)**

Sol.



$(V - 60)30 = (V + 60)110$

$3V - 180 = V + 60$

$2V = 240$

$V = 120$ km/h

$d = (120 - 60)\ \frac{1}{2}$

$= 30$ km

$$t = \frac{d}{V} = \frac{30\text{km}}{120\text{km/h}} = \frac{1}{4}\text{h} = \frac{60}{4} = 15\ \text{min}$$

19. A container has two chambers of volumes V_1 = 2 litres V_2 = 3 litres separated by a partition made of a thermal insulator. The chambers contains n_1 = 5 and n_2 = 4 moles of ideal gas at pressures P_1 = 1 atm and P_2 = 2 atm. respectively. When the partition is removed, the mixture attains an equilibrium pressure of :

(1) 1.4 atm (2) 1.8 atm (3) 1.3 atm (4) 1.6 atm

Ans. **(4)**

Sol. $$\frac{P_1V_1 + P_2V_2}{V_1 + V_2}$$

$$= \frac{1\times 2 + 2\times 3}{3+2}$$

$$= \frac{8}{5} = 1.6\ \text{atm}$$

20. De-Broglie wavelength of an electron orbiting in the n= 2 state of hydrogen atom is close to (Given Bohr radius = 0.052 nm)

(1) 1.67 nm (2) 2.67 nm (3) 0.067 nm (4) 0.67 nm

Ans. **(4)**

Sol. $2\pi r = g\ \lambda_D$

$\lambda_D = \frac{2\pi r}{n}$

$n = 2$

$= \pi r_2$

$= \pi \left(\frac{h^2}{2}\right) r_0$

$= \pi \left(\frac{4}{1}\right)(.52)$

= 3.14 × 2

= 6.28 A°

= 0.628 nm

Ans 4

21. To an ac power supply of 220 V at 50 Hz, a resistor of 20Ω, a capacitor of reactance 25 Ω and an inductor of reactance 45 Ω are connected in series. The corresponding current in the circuit and the phase angle between the current and the voltage is, respectively

(1) 15.6 A and 30° (2) 15.6 A and 45° (3) 7.8 A and 30° (4) 7.8 A and 45°

Ans. **(4)**

Sol. $X_C = 25$

$X_L = 45$

$R = 20$

$$\tan\phi = \frac{X_L - X_C}{R} = \frac{45-25}{20} = \frac{20}{20} = 1$$

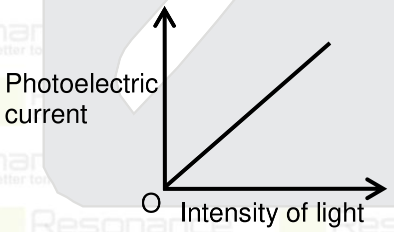
$\phi = 45°$

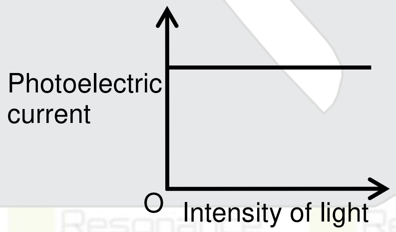
$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

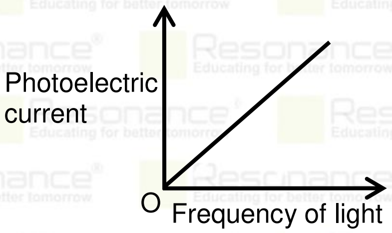
$Z = 20\sqrt{2}$

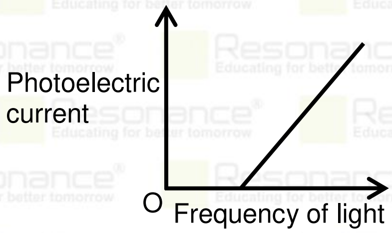
$$I = \frac{V_{rms}}{Z} = \frac{220}{20\sqrt{2}} = \frac{11}{\sqrt{2}} = 11 \times .7 = \approx 7.8$$

22. Which of the following options represent the variation of photoelectric current with property of light shown on the axis?

(A)


(B)


(C)


(D)


(1) A and D (2) B and D (3) A only (4) A and C

Ans. **(1)**

Sol. Theory Based

23. A pipe open at both ends has fundamental frequency f in air. The pipe is now dipped vertically in a water drum to half of its length. The fundamental frequency of the air column is now equal to :

(1) $\frac{3f}{2}$ (2) 2f (3) $\frac{f}{2}$ (4) f

Ans. (2)

Sol. $f = \frac{v}{2\ell}$

$f^1 = \frac{v}{2(\ell/2)} = \frac{2v}{2\ell} = 2f$ **Ans. (2)**

24. Two identical point masses P and Q, suspended from two separate massless springs of spring constants k_1 and k_2. respectively, oscillate vertically. If their maximum speed are the same, the ratio (A_Q/A_P) of the amplitude A_Q of mass Q to the amplitude A_P of mass P is :

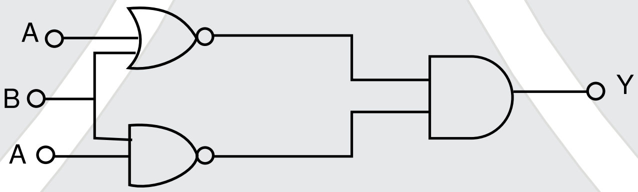
(1) $\sqrt{\frac{k_2}{k_1}}$ (2) $\sqrt{\frac{k_1}{k_2}}$ (3) $\frac{k_2}{k_1}$ (4) $\frac{k_1}{k_2}$

Ans. (1)

Sol. $A_P\sqrt{\frac{k_1}{m}} = A_Q\sqrt{\frac{k_2}{m}}$

$\frac{A_Q}{A_{P:}} = \sqrt{\frac{k_2}{k_1}}$

25. The output (Y) of the given logic implementation is similar to the output of an/a_______ gate.



(1) OR (2) NOR (3) AND (4) NAND

Ans. (2)

Sol. $\overline{(A+B)}\cdot\overline{(A\cdot B)}$ = NOR

A	B	$\overline{A+B}$	$\overline{(A\cdot B)}$	$\overline{A+B}$
0	0	1	1	1
0	1	0	1	0
1	0	0	1	0
1	1	0	0	0

26. An oxygen cylinder of volume 30 litre has 18.20 moles of oxygen. After some oxygen is withdrawn form the cylinder, its gauge pressure drops to 11 atmospheric pressure at temperature 27°C. The mass of the oxygen withdrawn from the cylinder is nearly equal to :

[Given, $R = \frac{100}{12}$ J $mol^{-1}K^{-1}$, and molecular mass of O_2 = 32, 1 atm pressure = 1.01×10^5 N/m]

(1) 0.116 kg (2) 0.156 kg (3) 0.125 kg (4) 0.144 kg

Ans. (2)

Sol. n = Oxygen cylinder 18.20

$P' = 11 \times 1.01 \times 10^5\ N/m^2$

Ideal gas equation P' V = n'RT

$$11 \times 1.01 \times 10^5 \times 30 \times 10^{-3} = n' \times \frac{100}{12} \times 300$$

n' = 13.38

With draw = (18.20 – 13.38)

$m \Rightarrow n \times M_\omega \Rightarrow 32\ (18.20 - 13.38)$

$\Rightarrow 32 \times 4.82$

$$\Rightarrow \frac{154.24}{1000}$$

$\Rightarrow$ .154 kg

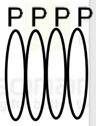
Approx. = $\Rightarrow$ .154 kg

27. In a certain camera, a combination of four similar thin convex lenses are arranged axially in contact, Then the power of the combination and the total magnification in comparison to the power (p) and magnification (m) for each lens will be, respectively-

(1) 4P and m^4 (2) P^4 and m^4 (3) 4P and 4m (4) P^4 and 4m

Ans. **(1)**

Sol.



Combination P + P + P + P = 4P

$m = m_1\, m_2\, m_3\, m_4 = m^4$

$m_1 = m_2 = m_3 = m_4 = m$

$\Rightarrow$ 4 P and m^4

28. Two gases A and B are filled at the same pressure in separate cylinders with movable piston of radius r_A and r_B, respectively, On supplying and equal amount of heat to both the systems reversibly under constant pressure, the pistons of gas A and B are displaced by 16 cm and 9 cm respectively. If the change in their internal energy is the same, then the ratio is $\frac{r_A}{r_B}$ equal to

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

Ans. **(4)**

Sol. $\Delta U_1 = \Delta U_2$

$n_1 R \Delta T_1 = n_2 R \Delta T_2$

$P\Delta V_1 = P\Delta V_2$

$A_1 \Delta X_1 = A_2 \Delta X_2$

$\pi r_A^2 16 = \pi r_B^2 (9)$

$$\frac{r_A}{r_B} = \sqrt{\frac{9}{16}} = \frac{3}{4}$$

29. A balloon is made of a material of surface tension S and its inflation outlet (from where gas is filled in it) has small area A. It is filled with a gas of density ρ and takes a spherical shape of radius R, When the gas is allowed to flow freely out of it, its radius r changes form R to 0 (zero) in time T, If the speed v(r) of gas coming out of the balloon depends on r as r^a and $T \propto S^{\alpha} A^{\beta} \rho^{\gamma} R^{\delta}$ then

(1) $a = -\frac{1}{2}, \alpha = -\frac{1}{2}, \beta = -1, \gamma = \frac{1}{2}, \delta = \frac{7}{2}$

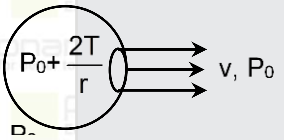
(2) $a = \frac{1}{2}, \alpha = \frac{1}{2}, \beta = -\frac{1}{2}, \gamma = -\frac{1}{2}, \delta = \frac{7}{2}$

(3) $a = \frac{1}{2}, \alpha = \frac{1}{2}, \beta = -1, \gamma = +1, \delta = \frac{3}{2}$

(4) $a = -\frac{1}{2}, \alpha = -\frac{1}{2}, \beta = -1, \gamma = -\frac{1}{2}, \delta = \frac{5}{2}$

Ans. **(1)**

Sol. **(i)**



Applying Bernoulli's equation between just inside and just outside:-

$P_1 + \frac{1}{2}\rho V_1^2 = P_2 + \frac{1}{2}\rho V_2^2$

$\left(P_0 + \frac{2T}{r}\right) + 0 = P_0 + \frac{1}{2}\rho V^2$

$\frac{1}{2}PV^2 = \frac{2T}{r} \Rightarrow V \propto r^{-\frac{1}{2}} \Rightarrow a = -\frac{1}{2}$

(ii) T = (some number) $S^{\alpha} A^{\beta} \delta^{r} R^{\delta}$

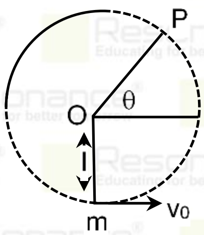
$M^0L^0T^1 = (M^1T^{-2})^{\alpha} (L^2)^{\beta} \left(\frac{M}{L3}\right)^{r} (L)^{\delta}$

$\alpha + r = 0,\ 2\beta - 3\gamma + \delta = 0,\ -2\alpha = 1$

$\Rightarrow \alpha = -\frac{1}{2}, \gamma = \frac{1}{2}, 2\beta + \delta = \frac{3}{2}$

In option (2) , $\beta = -1$, $\delta = \frac{7}{2}$ satisfy this equation, so the correct answer will be (2)

30. A bob of heavy mass m is suspended by a light string of length l, the bob is given a horizontal velocity v_0 as shown in figure. If the string gets slack at some point P making an angel q from the horizontal the ratio of the speed v of the bob at point P to its initial speed v_0 is ;



(1) $\left(\frac{\cos\theta}{2+3\sin\theta}\right)^{\frac{1}{2}}$ (2) $\left(\frac{\sin\theta}{2+3\sin\theta}\right)^{\frac{1}{2}}$ (3) $(\sin\theta)^{\frac{1}{2}}$ (4) $\left(\frac{1}{2+3\sin\theta}\right)^{\frac{1}{2}}$

Ans. **(2)**

Sol. $V_1 = \frac{mv^2}{l} = mg\sin\theta$

$V^2 = V_0^2 - 2g(l + l\sin\theta)$

$V^2 = V_0^2 - 2gl(1+\sin\theta)$ ______ (i)

$gl\sin\theta = V_0^2 - 2gl(l+\sin\theta)$

$V_0^2 = gl(2+3\sin\theta)$

$V_0^2 = gl(2+3\sin\theta)$

$V^2 = gl\sin\theta$

$\frac{V}{V_0} = \left(\frac{\sin\theta}{2+3\sin\theta}\right)^{\frac{1}{2}}$

31. A physical quantity P is related to four observation a, b, c and d as follows:

$P = a^3b^2 / c\sqrt{d}$

The percentage errors of measurement in a, b, c and d are 1%, 3%, 2% and 4% respectively. The percentage error in the quantity P is

(1) 13 % (2) 15% (3) 10% (4) 2%

Ans. **(1)**

Sol. $p = \frac{a^3b^2}{c\sqrt{d}} \Rightarrow \frac{\Delta P}{P}\times 100 = \frac{3\Delta a}{a}\times 100 + \frac{2\Delta b}{b}\times 100 + \frac{\Delta c}{c}\times 100 + \frac{1}{2}\frac{\Delta d}{d}\times 100$

$\frac{\Delta P}{P}\% = 3\times 1 + 2\times 3 + 2 + \frac{1}{2}\times 4$

$\Rightarrow 3 + 6 + 2 + 2 \Rightarrow 13\%$

32. The sun rotates around its centre once in 27 day. What will be the period of revolution if the Sun were to expand to twice its present radius without any external influence? Assume the sun to be a sphere of uniform density.

(1) 115 days (2) 108 days (3) 100 days (4) 105 days

Ans. **(2)**

Sol. $I_1w_1 = I_2w_2$

$I_1w_1 = 4I_1w_2$

$\frac{w_1}{w_2} = 4$

$\frac{T_1}{T_2} = \frac{1}{4}$

$T_2 = 4T_1$

$= 27 \times 4$

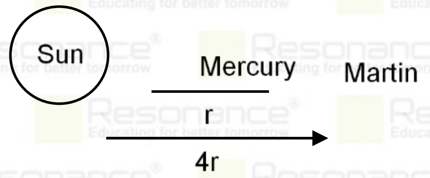
$= 108$ day

33. The radius of Martian orbit around the Sun is about 4 times the radius of the orbit of Mercury. The Martian year is 687 Earth days. Then which of the following is the length of

(1) 172 earth days (2) 124 earth days (3) 88 earth days (4) 225 earth days

Ans. (3)

Sol.



$T^2 \propto r^3$

$\frac{T_{MC}}{T_{Mr}} = \left(\frac{1}{4}\right)^{3/2}$

$\frac{T_{MC}}{T_{Mr}} = \frac{1}{8}, \; T_{MC} = \frac{T_{Mr}}{8}$

$= \frac{687}{8}$ earth days = 86 earth (approximate)

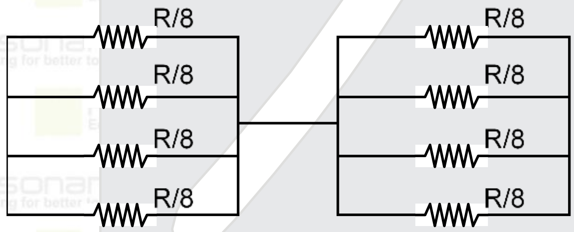
34. A wire of resistance R is cut into 8 equal pieces. From these pieces two equivalent resistance are made by adding four of these together in parallel. Then these two sets are added in series. The net effective resistance of the combination is

(1) $\frac{R}{16}$ (2) $\frac{R}{8}$ (3) $\frac{R}{64}$ (4) $\frac{R}{32}$

Ans. (1)

Sol. R/8

$\frac{R}{32} + \frac{R}{32} = \frac{R}{16}$



35. A photon and an electron (mass m) have the same energy E. The ratio of $(\lambda_{photon} / \lambda_{electron})$ their de Broglie wavelength is (c is the speed of light)

(1) $c\sqrt{\frac{2m}{E}}$ (2) $\frac{1}{c}\sqrt{\frac{E}{2m}}$ (3) $\sqrt{\frac{E}{2m}}$ (4) $c\sqrt{2mE}$

Ans. (1)

Sol. $\frac{\lambda_{proton}}{\lambda_{electron}}$

$E = \frac{P^2}{2m} = \frac{h^2}{\lambda_e^2 2m} = \frac{h_c}{\lambda_p}$

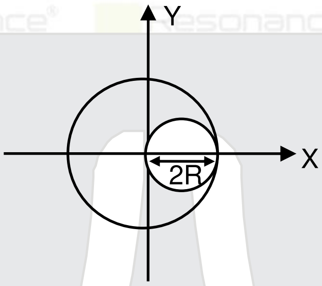
$\lambda_e = \sqrt{\frac{h^2}{2mE}} = \frac{h}{\sqrt{2mE}}$

$\lambda_p = \frac{h_c}{E}$

$$\frac{\lambda_p}{h_c} = \frac{h_c}{E}\times\frac{\sqrt{2mE}}{h}$$

$$= C\sqrt{\frac{2m}{E}}$$

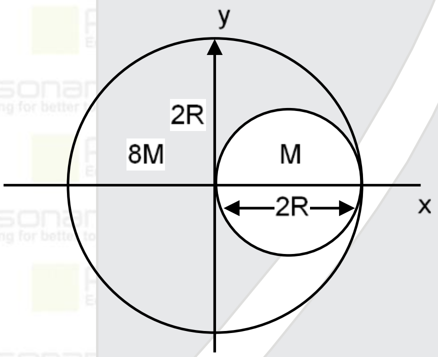
36. A sphere of radius R is cut from a larger solid sphere of radius 2R as shown in the figure. The ratio of the moment of inertia of the smaller sphere to that of the rest part of the sphere about the Y-axis is :



(1) $\frac{7}{57}$ (2) $\frac{7}{64}$ (3) $\frac{7}{8}$ (4) $\frac{7}{40}$

Ans. (1)

Sol.



$$I_{small} = \frac{2M(R^2)}{5} + MR^2 = \frac{7}{5}MR^2$$

$$\frac{2}{5}\left[8m(2R^2)\right] - \frac{7}{5}MR^2 = I_{rest\ part}$$

$$\frac{2}{5}\times 8 \times 4MR^2 - \frac{7}{5}MR^2 = I_{rest\ part}$$

$$\frac{57}{5}MR^2 = I_{rest\ part}$$

$$\frac{I_{small}}{I_{rest}} = \frac{7/5}{57/5} = \frac{7}{57}$$

37. An electron (mass 9×10^{-31} kg and charge 1.6×10^{-19}C) moving with speed c/100 (c = speed of light) is injected into a magnetic field $\vec{B}$ of magnitude 9×10^{-4} T perpendicular to its direction of motion. We wish to apply an uniform electric field $\vec{E}$ together with the magnetic field so that the electron does not defect from its path. Then (speed of light $c = 3\times 10^{8}\ ms^{-1}$)

(1) $\vec{E}$ is parallel to $\vec{B}$ and its magnitude is $27\times 10^{2}\ V\ m^{-1}$

(2) $\vec{E}$ is parallel to $\vec{B}$ and its magnitude is $27\times 10^{4}\ V\ m^{-1}$

(3) $\vec{E}$ is perpendicular to $\vec{B}$ and its magnitude is $27\times 10^{4}\ V\ m^{-1}$

(4) $\vec{E}$ is perpendicular to $\vec{B}$ and its magnitude is $27\times 10^{2}\ V\ m^{-1}$

Ans. **(4)**

Sol. eVB = eE

VB = E

$V = \frac{E}{B}$

E = BV

$= \frac{C}{100}\times 9\times 10^{-4}$

$= \frac{3\times 10^{8}}{100}\times 9\times 10^{-4}$

$= 27\times 10^{2}$

38. The electric field in a plane electromagnetic wave is given by

$E_z = 60\cos(5x + 1.5\times 10^{9}\,t)$ v/m.

Then expression for the corresponding magnetic field is (here subscripts denote the direction of the field)

(1) $B_z = 60\cos(5x + 1.5\times 10^{9}t)$ T

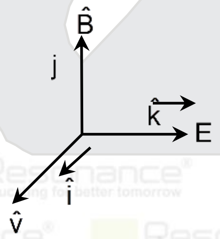
(2) $B_y = 60\sin(5x + 1.5\times 10^{9}t)$T

(3) $B_y = 2\times 10^{-7}\cos(5x + 1.5\times 10^{9}t)$ T

(4) $B_x = 2\times 10^{-7}\cos(5x + 1.5\times 10^{9}t)$T

Ans. **(3)**

Sol. $E_z = 60\cos(5x + 1.5 + 10^{9}\,t)$ v/m



$\hat{B} \Rightarrow \hat{J}$

$V = \frac{W}{k} = \frac{1.5\times 10^{9}}{5} = 3\times 10^{8}$

$B_0 = \frac{E_0}{V} = \frac{60}{3\times 10^{8}}$

$= 20\times 10^{-8}$

$= 2.0\times 10^{-7}$ units

$B_y = 2\times 10^{-7}\cos(5x + 1.5\times 10^{9}\,t)$ T

39. A body weighs 48N on the surface of the earth. The gravitational force experienced by the body due to the earth at a height equal to one -third the radius of the earth from its surface is :

(1) 32 N (2) 36 N (3) 16 N (4) 27 N

Ans. **(2)**

Sol. mg = 48 N

$$g_n = \frac{GM}{\left(R+\frac{R}{3}\right)^2} = \frac{9GM}{4\times 4R^2} = \frac{9}{16}g$$

$$W_n = mg_n$$

$$= m\left(\frac{9}{16}g\right)$$

$$= \frac{9}{4\times 4}mg$$

$$= \frac{9}{4\times 4}\times 48$$

= 36 N

40. An unpolarized light beam travelling in air is incident on a medium of refractive index at Brewster's angle. Then -

(1) both reflected an transmitted light are perfectly polarized with angles of reflection and refraction close to 60º and 30º respectively

(2) transmitted light is completely polarized with angle of refraction close to 30º

(3) reflected light is completely polarized and the angle of reflection is close to 60º

(4) reflected light is partially polarized and the angle of reflection is close to 30º

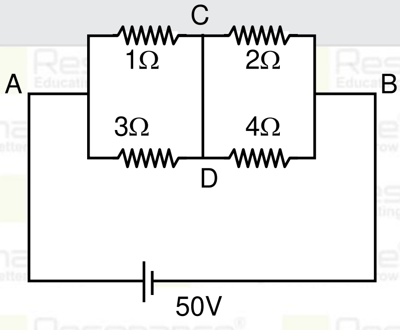
Ans. **(3)**

Sol. $\mu = \tan i_p$

$$\sqrt{3} = \tan i_p$$

$$i_p = 60°$$

41. A constant voltage of 50 V is maintained between the points A and B of the circuit shown in the figure. The current through the branch CD of the circuit is



(1) 2.5 A (2) 3.0 A (3) 1.5 A (4) 2.0 A

Ans. **(4)**

Sol. $R_{eq} = \frac{3}{4} + \frac{8}{6}$

$= \frac{3}{4} + \frac{4}{3}$

$= \frac{9+16}{12} = \frac{25}{12}$

$i = \frac{50}{25} \times 12 = 24\,A$

$i_{1\Omega} = \frac{1}{4} \times 24 = 6A$

$i_{2\Omega} = \frac{2}{6} \times 24 = 8A$

$i_{CD} = i_2 - i_1 = 8 - 6 = 2A$

42. The plates of a parallel plate capacitor are separated by d. two slabs of different dielectric constant K_1 and K_2 with thickness $\frac{3}{8}d$ and $\frac{d}{2}$, respectively are inserted in the capacitor. Due to this, the capacitance becomes two times larger than when there is nothing between the plates.

If $K_1 = 1.25\,K_2$, the value of K_1 is :

(1) 1.60 (2) 1.33 (3) 2.66 (4) 2.33

Ans. **(3)**

Sol. $\frac{\varepsilon_0 A}{\left[\frac{3d}{8k_1} + \frac{d}{2k_2} + \frac{d}{8(1)}\right]} = \frac{2\varepsilon_0 A}{d}$

$\frac{d}{2} = \frac{3d}{8(1.25)k_2} + \frac{d}{2k_2} + \frac{d}{8}$

$\frac{d}{2} = \frac{3d}{10k_2} + \frac{d}{2k_2} + \frac{d}{8}$

$\frac{d}{2} - \frac{d}{8} = \frac{3d}{10k_2} + \frac{d}{2k_2}$

$\frac{3}{8} = \frac{8}{10k_2}$

$10k_2 = \frac{64}{3}$

$k_2 = \frac{64}{30}$

$k_1 = 2.66$

43. Consider the diameter of a spherical object being measured with the help of a Vernier callipers. Suppose its 10 Vernier Scale Divisions (V.S.D) are equal to its 9 Main Scale Division (M.S.D). The least division in the M.S. is 0.1 cm and the zero of V.S. is at x = 0.1 cm when the jaws of vernier callipers are closed If the main scale reading for the diameter is M = 5 cm and the number of coinciding veriner division is 8, the measured diameter after zero error correction is

(1) 4.98 cm (2) 5.00 cm (3) 5.18 cm (4) 5.08 cm

Ans. **(1)**

Sol. 1 MSD = .1 cm

9 MSD = 10 VSD

$1 \text{ VSD} = \frac{9}{10} \text{ MSD} =$

LC = 1 MSD – 1 VSD

$= 1 \text{ MSD} - \frac{9}{10} \text{ MSD}$

$= \frac{1}{10} \text{ MSD}$

= (.01) cm

zero error = + .1 cm

MV = 5 + 8 (.01)

= 5 .08

AV = 5.08 – 0.10 = 4.98 cm

44. A 2 amp current is flowing through two different small circular copper coils having radii ratio 1 : 2. The ratio of their respective magnetic moments will be

(1) 2 : 1 (2) 4 : 1 (3) 1 : 4 (4) 1 : 2

Ans. **(3)**

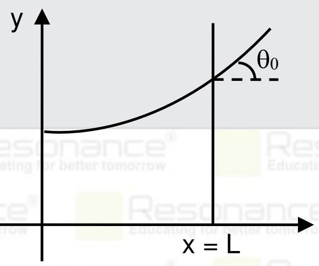
Sol. m = iA

$m \propto \pi r^2$

$m \propto r^2$

$\frac{M_1}{M_2} = \frac{r_1^2}{r_2^2} = \frac{1}{4}$

45. Consider a water tank shown in the figure. It has one wall at x = L and can be taken to be very wide in the z direction. When filled with a liquid of surface tension S and density ρ, the liquid surface makes angle θ_0 (θ_0 <<1) with the x-axis at x = L. If y(x) i/s the height of the surface then the equation of y(x) is :

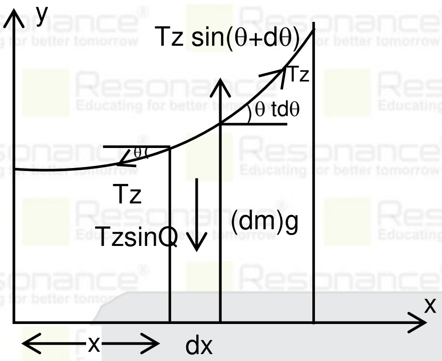


(take $\theta(x) = \sin\theta(x) = \tan\theta(x) = \frac{dy}{dx}$, g is the acceleration due to gravity)

(1) $\frac{d^2y}{dx^2} = \sqrt{\frac{\rho g}{S}}$ (2) $\frac{dy}{dx} = \sqrt{\frac{\rho g}{S}x}$ (3) $\frac{d^2y}{dx^2} = \frac{\rho g}{S}x$ (4) $\frac{d^2y}{dx^2} = \frac{\rho g}{S}y$

Ans. **(4)**

Sol.



$$Tz\sin(\theta+d\theta)-Tz\sin\theta=(dm)g,\quad \text{since } \theta = \text{very small } \sin\theta\approx\tan\theta$$

$$Tz(\tan(\theta+d\theta)-\tan\theta)=(\rho)(yzdx)g$$

$$\frac{\tan(\theta+d\theta)-\tan\theta}{dx}=\frac{\rho g}{T}y$$

$$\frac{d(\tan\theta)}{dx}=\frac{\rho g}{T}y \text{ where } \tan\theta=\text{slope}=\frac{dy}{dx}$$

$$\frac{d}{dx}\left(\frac{dy}{dx}\right)=\frac{\rho g}{T}y$$

$$\frac{d^2y}{dx^2}=\frac{\rho g}{T}y \text{ , answer will be (4)}$$

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