PHYSICS

BOOKS - D MUKHERJEE PHYSICS (HINGLISH)

IIT QUESTIONS 2

Straight Objective Type

1. a quantity X is given by $\varepsilon_0 L \frac{\Delta V}{\Delta t}$ where $\in_0$ is the permittivity of the free space, L is a

length, ΔV is a potential difference and Δt is a time interval. The dimensinal formula for X is the same as that of

A. resistance

B. charge

C. voltage

D. current

Answer: D

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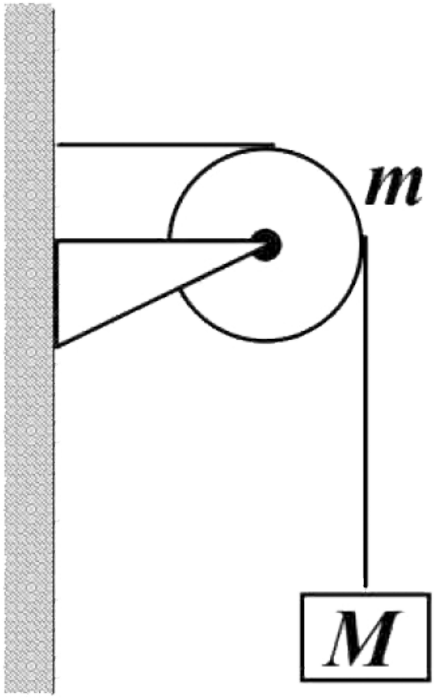
2. A string of negligible mass going over a clamped pulley of mass m supports a block of mass M as shown in the figure. The force on the pulley by the clamp is given by



A. $\sqrt{2}Mg$

B. $\sqrt{2}mg$

C. $\sqrt{(M+m)^2+m^2}.8$

D. $\sqrt{(M+m)^2+M^2}.8$

Answer: D

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3. Two particles of masses m_1 and m_2 in projectile motion have velocities $\overrightarrow{v}_1$ and $\overrightarrow{v}_2$, respectively , at time $t=0$. They collide at time t_0. Their velocities become $\overrightarrow{v'}_1$ and $\overrightarrow{v'}_2$ at time $2t_0$ while still moving in air. The value of

$$\left|\left(m_1\overrightarrow{v'}_1 + m_2\overrightarrow{v'}_2\right) - \left(m_1\overrightarrow{v}_1 + m_2\overrightarrow{v}_2\right)\right|$$

A. zero

B. $(m_1 + m_2)gt_0$

C. $2(m_1 + m_2)gt_0$

D. $\frac{1}{2}(m_1 + m_2)gt_0$

Answer: C

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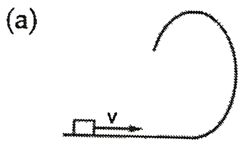
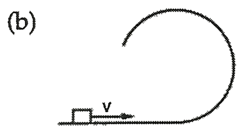
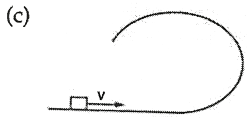
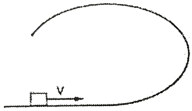
4. A small block is shot into each of the four tracks as shown below. Each of the tracks rises to the same height. The speed with which the block enters the track is the same in all cases. At the highest point of the track, the normal reaction is maximum in

A. 

B. 

C. 

(d)

D. 

Answer: A

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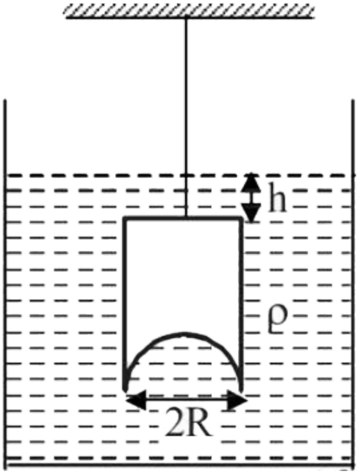
5. A hemispherical portion of radius R is removed from the bottom of a cylinder of radius R. The volume of the remaining cylinder is V and its mass M. It is suspended by a string in a liquid of density ρ where it stays vertical. The upper surface of the cylinder is at a depth h below the liquid surface. The force on the bottom of the cylinder by the liquid is



A. Mg

B. $Mg - V\rho g$

C. $Mg + \pi R^2 h\rho g$

D. $\rho g(V + \pi R^2 h)$

Answer: D

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6. The ends of a stretched wire of length L are fixed at $x = 0$ and $x = L$. In one experiment, the displacement of the wire is $y_1 = A \sin(\pi / L) \sin \omega t$ and energy is E_1 and in another experiment its displacement is $y_2 = A \sin(2\pi x / L) \sin 2\omega t$ and energy is E_2. Then

A. $E_2 = E_1$

B. $E_2 = 2E_1$

C. $E_2 = 4E_1$

D. $E_2 = 16E_1$

Answer: C

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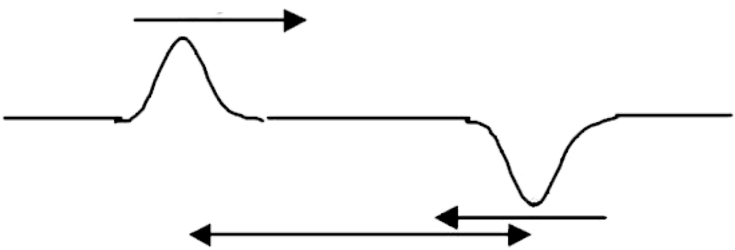
7. Two pulse in a stretched string whose centers are initially $8cm$ apart are moving towards each other as shown in the figure. The speed of each pulse is $2cm/s$. After $2\sec onds$

, the total energy of the pulse will be



A. zero

B. purely kinetic

C. purely potential

D. partly kinetic and partly potential

Answer: B

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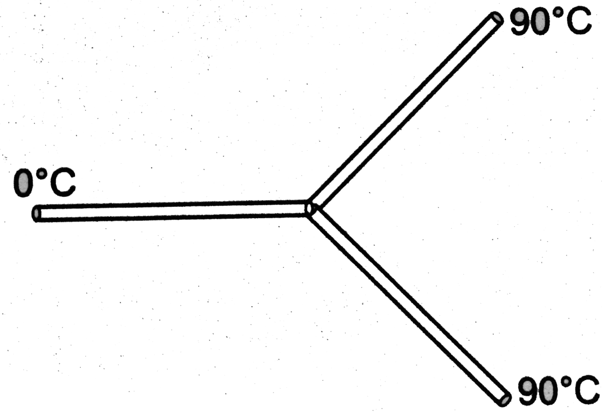
8. Three rods made of the same material and having the same cross-section have been joined as shown in the figure. Each rod is of the same length. The left and right ends are kept at $0^\circ C$ and $90^\circ C$, respectively. The temperature of junction of the three rods will be

(a) $45^\circ C$ (b) $60^\circ C$

(c) $30^{\circ} C$ (d) $20^{\circ} C$.



A. 45° C

B. 60° C

C. 30° C

D. 20° C

Answer: B

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9. When a block of iron in mercury at $0^\circ C$, fraction $K_1$of its volume is submerged, while at the temperature $60^\circ C$, a fraction K_2 is seen to be submerged. If the coefficient of volume expansion of iron is γ_{Fe} and that of mercury is γ_{Hg}, then the ratio $(K_1)/(K_2)$ can be expressed as

A. $\dfrac{1+(60^\circ C)\gamma_{\text{Fe}}}{1+(60^\circ C)\gamma_{\text{HG}}}$

B. $\dfrac{1-(60^\circ C)\gamma_{\text{Fe}}}{1+(60^\circ C)\gamma_{\text{HG}}}$

C. $\dfrac{1+(60^\circ C)\gamma_{\text{Fe}}}{1-(60^\circ C)\gamma_{\text{HG}}}$

D. $\dfrac{1+(60^\circ C)\gamma_{\text{HG}}}{1+(60^\circ C)\gamma_{\text{Fe}}}$

Answer: A

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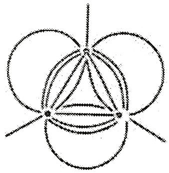
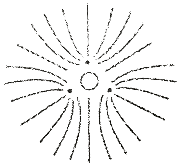
10. Three poistive charges of equal value q are placed at the vertices of an equilateral triangle. The resulting lines of force should be sketched as in

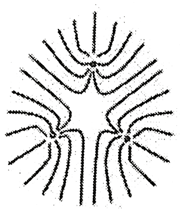
(a)

A. 

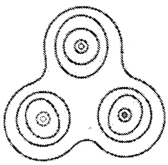
(b)

B. 

(c)

C. 

(d)

D. 

Answer: C

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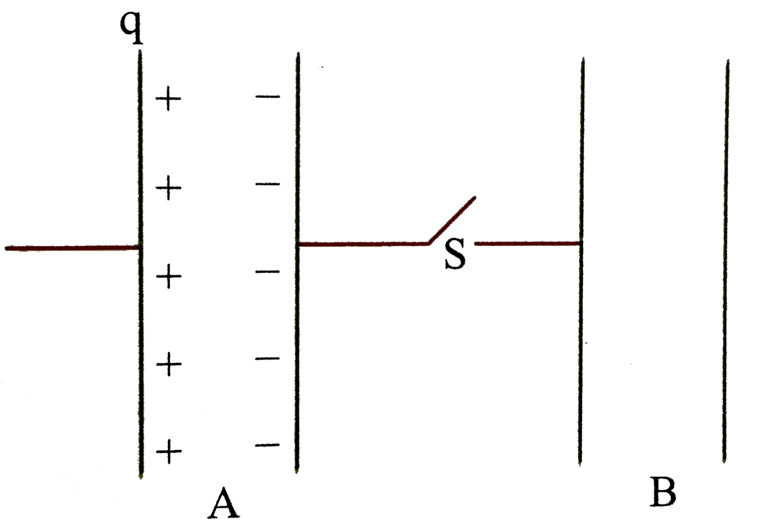
11. Consider the situation shown in the figure. The capacitor A has a charge q on it whereas B is uncharged. The charge appearing on the capacitor B a long 7 time after the switch is closed is :



A. zero

B. q/2

C. q

D. 2q

Answer: A

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12. A coil having N turns is wound tightly in the form of a spiral with inner and outer radii a and b respectively. A current I passes through the coil. The magnetic moment of the spiral is

A. $\frac{\mu_0 NI}{b}$

B. $\frac{2\mu_0 NI}{a}$

C. $\frac{\mu_0 NI}{2(b-a)} \text{In} \frac{b}{a}$

D. $\frac{2\mu_0 I^N}{2(b-a)} \text{In} \frac{b}{a}$

Answer: C

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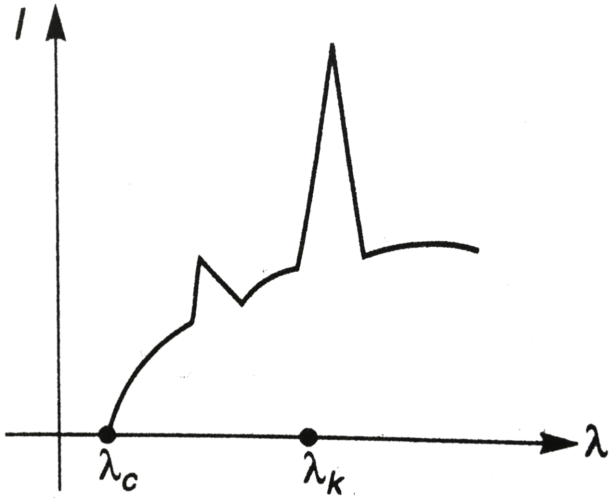
13. The intensity of X-rays form a Coolidge tube is plotted against wavelength λ as shown in the figure. The minimum wavelength found is λ_c and the wavelength of the K_α line is λ_k.

As the accelerating voltage is increased



(a) $\lambda_k - \lambda_c$ increases (b) $\lambda_k - \lambda_c$ decreases

(c) λ_k increases (d) λ_k decreases

A. $\lambda_K - \lambda_C$ increases

B. $\lambda_K - \lambda_C$ decreases

C. λ_K increases

D. λ_K decreases

Answer: A

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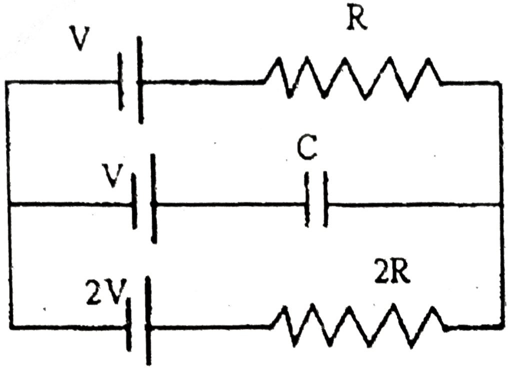
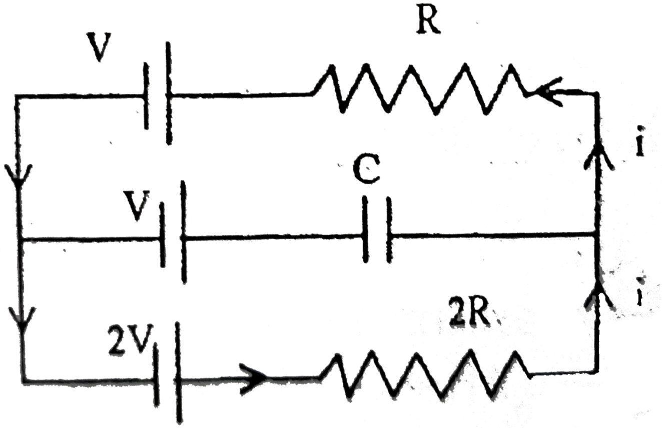
14. In the given circuit, with steady current, the potential drop across the capacitor must be





A. V

B. $\frac{V}{2}$

C. $\frac{V}{3}$

D. $\frac{2V}{3}$

Answer: C

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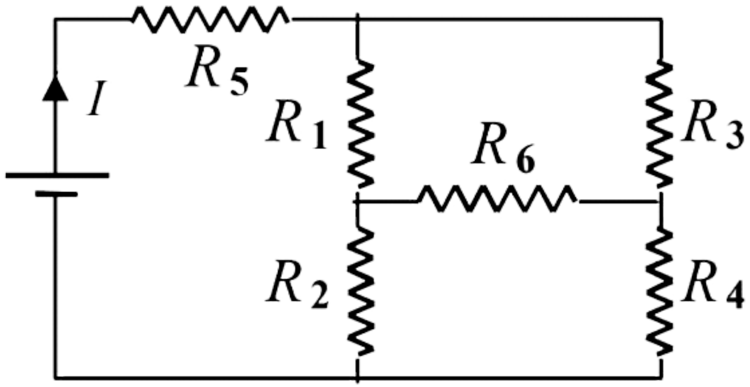
15. In the given circuit, it is observed that the current I is independent of the value of the resistance R_6. Then the resistance values must satisfy



.

A. $R_1R_2R_5 = R_3R_4R_6$

B. $\frac{1}{R_5} + \frac{1}{R_6} = \frac{1}{R_1 + R_2} + \frac{1}{R_3 + R_4}$

C. $R_1R_4 = R_2R_3$

D. $R_1R_3 = R_2R_4 = R_5R_6$

Answer: C

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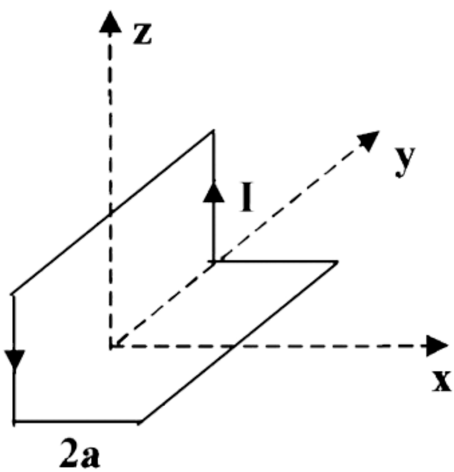
16. A non - popular loop of conducting wire carrying a current I is placed as shown in the figure . Each of the straighrt sections of the loop is of the length $2a$. The magnetic field due to this loop at the point $P(a, 0, a)$ points in the direction



A. $\frac{1}{\sqrt{2}}\left(-\overrightarrow{j}+\overrightarrow{k}\right)$

B. $\frac{1}{\sqrt{3}}\left(-\overrightarrow{j}+\overrightarrow{k}+\overrightarrow{i}\right)$

C. $\frac{1}{\sqrt{3}}\left(-\overrightarrow{i}+\overrightarrow{k}+\overrightarrow{k}\right)$

D. $\frac{1}{\sqrt{2}}\left(\overrightarrow{i}+\overrightarrow{k}\right)$

Answer: D

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Assertion Reason Type

1. Statement-1

If the accelerating potential in an X-ray tube is increased, the wavelength of the characterstic X-rays do not change.

because

Statement-2

When an electron beam strikes the target in an X-ray tube, part of the kinetic energy is converted into X-ray energy.

A. Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

B. Statement-1 is true, statement-2 is true and statement-2 is not the correct explanation for statement-1

C. Statement-1 is true, statement-2 is false

D. Statement-1 is false, statement-2 is true.

Answer: B

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2. In each of the questions, assertion(A) is given by corresponding statement of reason (R) of the statemens. Mark the correct answer.

Q. Statement I: The formula connecting u,v and f for a spherical mirror is valid only for mirrors whose sizes are very small compared to their radii of curvature.

Statement II: Laws of reflection are strictly valid for plane surfaces, but not for large spherical surfaces.

A. Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

B. Statement-1 is true, statement-2 is true and statement-2 is not the correct explanation for statement-1

C. Statement-1 is true, statement-2 is false

D. Statement-1 is false, statement-2 is true.

Answer: A

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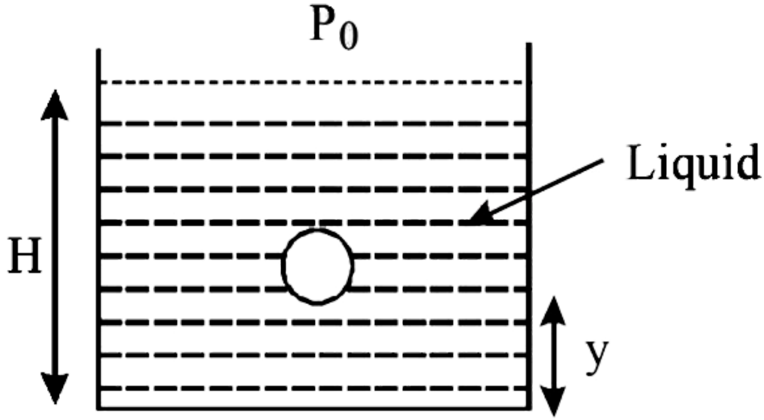
Linked Comprehension Type

1. A small spherical monoatomic ideal gas bubble ($\gamma = 5/3$) is trapped inside a liquid of density ρ (see figure). Assume that the bubble does not exchange any heat with the liquid. The bubble contains n moles of gas. The temperature of the gas when the bubble is at the bottom is T_0, the height of the liquid is H and the atmospheric pressure P_0 (Neglect surface tension).



As the bubble moves upwards, besides the buoyancy force the following forces are acting on it

A. Only the force of gravity

B. The force of gravity and the force due to the presure of the liquid

C. The force of gravity , the force due to the presure of the liquid, and the force but to the viscosity of the liquid

D. The force of gravity and the force due to the viscosity of the liquid

Answer: D

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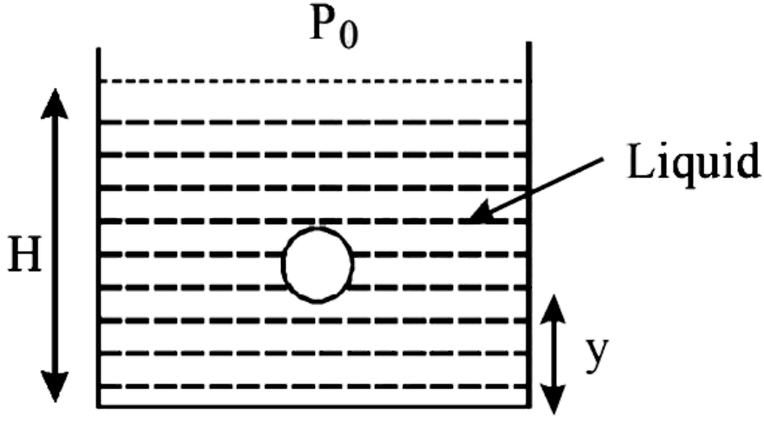
2. A small spherical monoatomic ideal gas bubble ($\gamma = 5/3$) is trapped inside a liquid of density ρ (see figure). Assume that the bubble does not exchange any heat with the liquid. The bubble contains n moles of gas. The temperature of the gas when the bubble is at the bottom is T_0, the height of the liquid is H and the atmospheric pressure P_0 (Neglect surface tension).



When the gas bubble is at a height y from the bottom, its temperature is-

A. $T_0\left(\frac{P_0+\rho g H}{P_0+\rho g y}\right)^{2/5}$

B. $T_0\left(\frac{P_0+\rho g(H-y)}{P_0+\rho g H}\right)^{2/5}$

C. $T_0\left(\frac{P_0+\rho g H}{P_0+\rho g y}\right)^{3/5}$

D. $T_0\left(\frac{P_0+\rho g(H-y)}{P_0+\rho g H}\right)^{3/5}$

Answer: B

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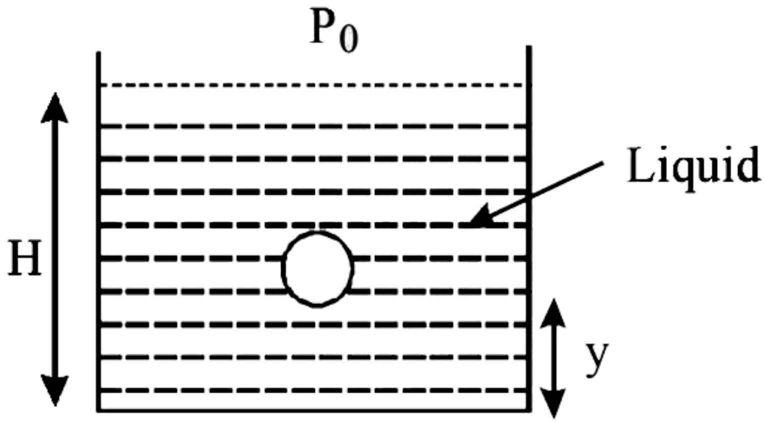
3. A small spherical monoatomic ideal gas bubble $(\gamma = 5/3)$ is trapped inside a liquid of density ρ (see figure). Assume that the bubble does not exchange any heat with the liquid. The bubble contains n moles of gas. The temperature of the gas when the bubble is at the bottom is T_0, the height of the liquid is H and the atmospheric pressure P_0 (Neglect surface tension).



The buoyancy force acting on the gas bubble is (Assume R is the universal gas constant)

A. $\rho_1 nRgT_0 \dfrac{(P_0+\rho_1 gH)^{2/5}}{(P_0+\rho_1 gy)^{7/5}}$

B. $\dfrac{\rho_1 RgT_0}{(P_0+\rho_1 gH)^{2/5}\{P_0+\rho g(H-y)\}^{3/5}}$

C. $\rho_1 nRgT_0 \dfrac{(P_0+\rho_1 gH)^{3/5}}{(P_0+\rho_1 gy)^{8/5}}$

D. $\dfrac{\rho_1 RgT_0}{(P_0+\rho_1 gH)^{3/5}\{P_0+\rho g(H-y)\}^{2/5}}$

Answer: B

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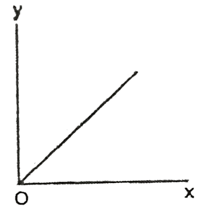
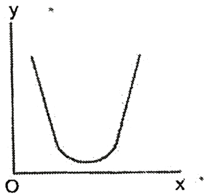
Matrix Matching Type

1. Column A gives a list of possible set of parameters measured in some experiments . The variations of the parameters in the form of graphs are shown in column B.

Column A	Column B
(i) The potential energy of a simple pendulum (y-axis) as a function of its displacement (x-axis)	(a) 
(ii) Displacement (y-axis) as a function of time (x-axis) for a one-dimensional motion at zero or constant acceleration when the body is moving along the positive x-direction	(b) 

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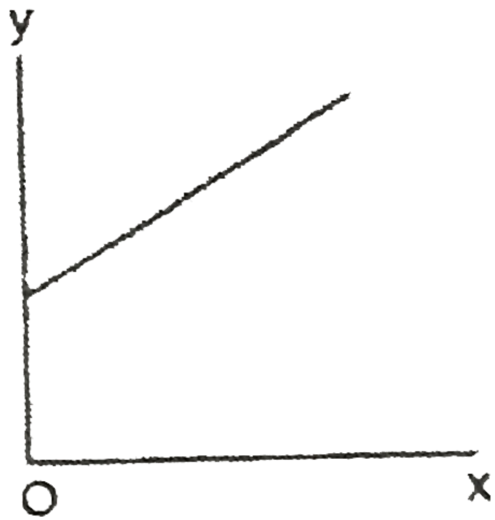

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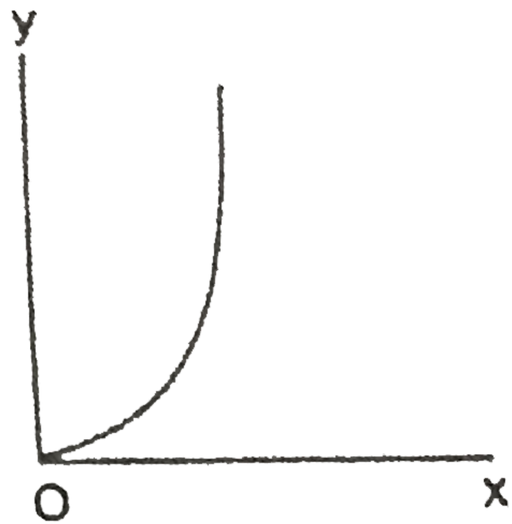

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