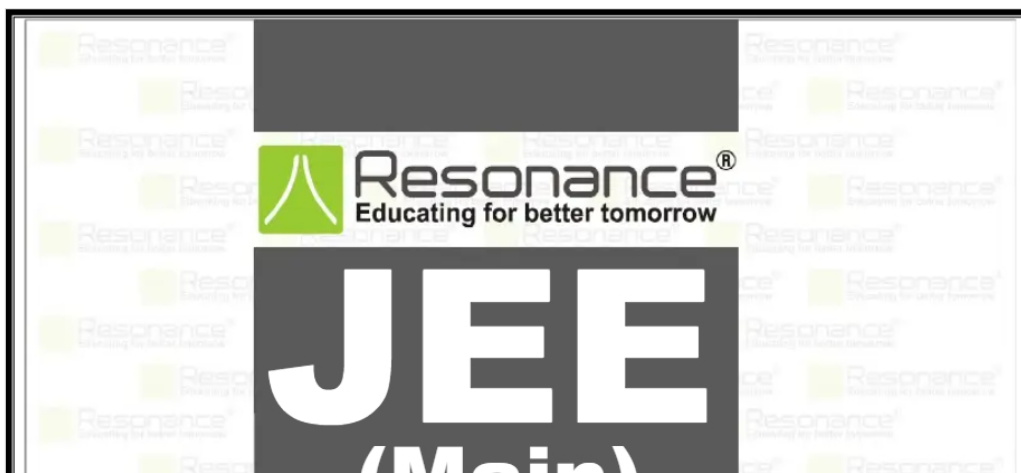
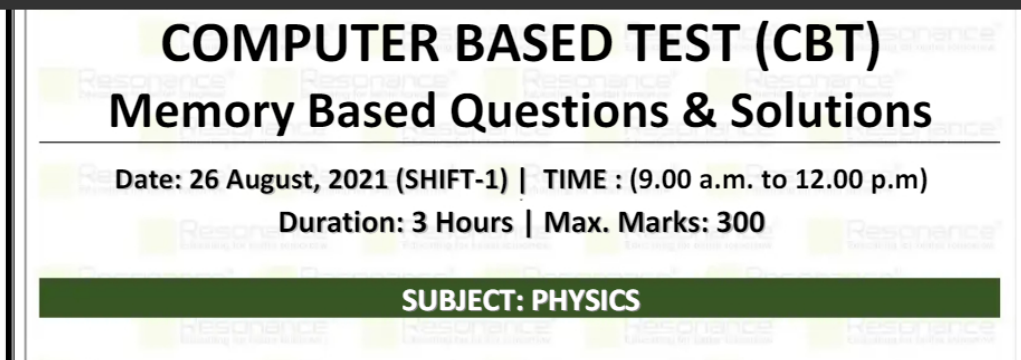




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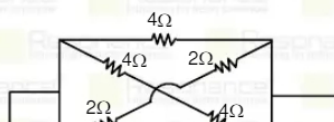
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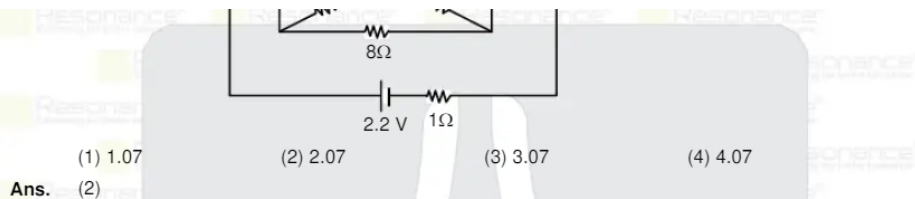


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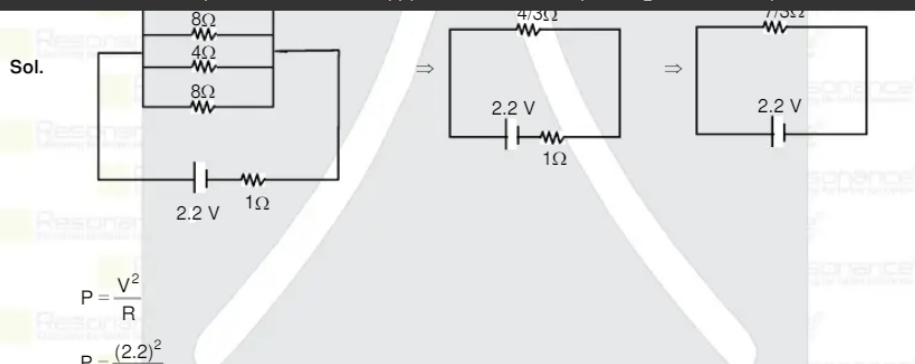
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1. In the given circuit, find the power consumed by the circuit.





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2. Find the dimensions of $A \times (B + C)D$ where A is mass, dimension of B is unknown, C is energy and D is dimension less constant :

- (1) $M^2L^2T^{-1}$ (2) $M^2L^2T^{-2}$ (3) $M^2L^1T^{-2}$ (4) $M^1L^2T^{-2}$

Ans. (2)

Sol. Dimension of $A \times (B + C)D$ equal to dimension of $A \times C \times D$ is :

$$M \times ML^2T^{-2} = M^2L^2T^{-2} \quad \text{Ans.}$$

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3. Two Balls are projected vertically upward with same speed 35 m/s in 3 second interval, find height at

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Ans. (1)

Sol. $S_1 = S_2$

$$35t + \frac{1}{2}(-g)t^2 = 35(t-3) + \frac{1}{2}(-g)(t-3)^2$$

$$35t - \frac{1}{2}gt^2 = 35t - 35 \times 3 - \frac{1}{2}g(t^2 - 6t + 9)$$

$$35 \times 3 + 45 = 30t$$

$$t = \frac{150}{30} = 5$$

$$\text{height } h = 35 \times 5 - \frac{1}{2} \times 10 \times 5^2$$

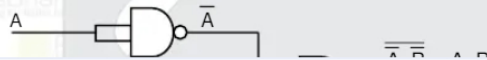
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4. Find equivalent gate



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

Ans. (4)



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

OR GATE

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5. Two cars A and B moving on a straight road Car B passes car A by a relative speed of 45 m/s. At what speed the driver of car B observes car A in the side mirror of focal length 10 cm when car A is at a

- (1) $\frac{9}{80}$ (2) $-\frac{9}{80}$ (3) $-\frac{7}{80}$ (4) $\frac{7}{80}$

Ans. (2)

Sol. $u = -1.9 \text{ m}$

$$f = 10 \text{ cm}$$

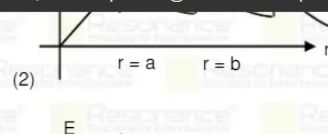
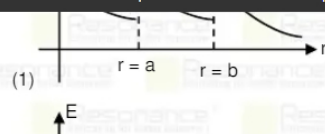
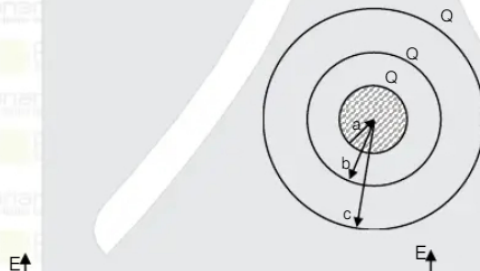
$$m = \frac{f}{f - u} = \frac{10}{10 - (-190)}$$

$$m = \frac{10}{200} = \frac{1}{20}$$

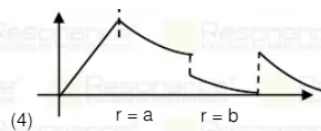
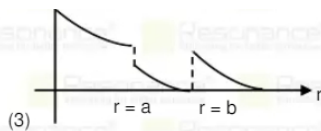
$$V_i = -m^2 V_o = -\left(\frac{1}{20}\right)^2 \times 45$$

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6. Find the graph between electric field intensity and distance 'r' from the center. For the given arrangement of concentric spheres. Charge in inner solid sphere is uniformly distributed in volume.



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Ans. (2)

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Sol. $0 < r < a$ $E = \frac{KQr}{R^3}$

$b < r < c$ $E = \frac{2KQ}{r^2}$

$r > c$ $E = \frac{3kQ}{r^2}$

7. Given statements are based on Bohr's atomic model for hydrogen like atom :

Statement-1. As principle quantum number increases, the speed of electron also increases.

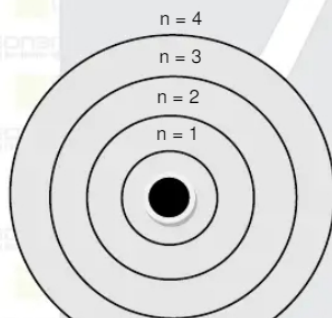
Statement-2. Speed of electron increases as energy increases.

(1) Both Statement-1 and Statement-2 are true

(2) Only Statement-1 is true

(3) Only Statement-2 is true

Sol.



Velocity of Electron $V = \frac{V_0 Z}{n}$ as n increases, velocity decreases

Energy of Electron $E = \frac{-13.6 Z^2}{n^2}$ as n increases, energy increases

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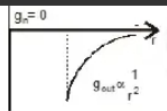
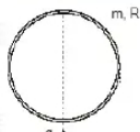
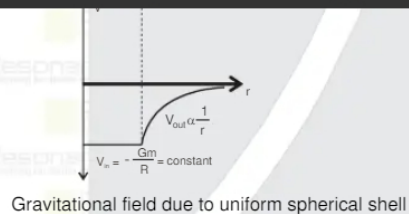
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8. A spherical shell of mass 'm' and radius 'R' is given, then which of the following is incorrect for inside the shell.

- (1) Gravitation field is zero. (2) Gravitation potential is zero
(3) Gravitational field is same every where (4) Gravitational potential is same everywhere.

Ans. (2)

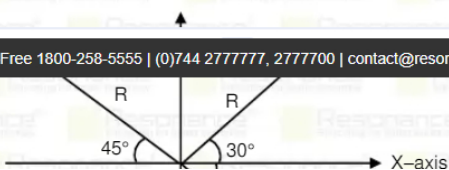
Sol. Gravitational potential due to uniform spherical shell

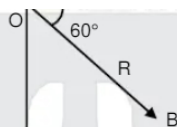


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9. Three vector of equal magnitude are given as shown in figure. Find the angle of $\vec{OA} + \vec{OB} - \vec{OC}$ with the x-axis :





(1) $\tan^{-1} \left[\frac{1+\sqrt{3}+\sqrt{2}}{1-\sqrt{3}-\sqrt{2}} \right]$ (2) $\tan^{-1} \left[\frac{1-\sqrt{3}-\sqrt{2}}{1+\sqrt{3}+\sqrt{2}} \right]$ (3) $\tan^{-1} \left[\frac{1-\sqrt{3}+\sqrt{2}}{1+\sqrt{3}-\sqrt{2}} \right]$ (4) $\tan^{-1} \left[\frac{1+\sqrt{3}-\sqrt{2}}{1-\sqrt{3}+\sqrt{2}} \right]$

Ans. (2)

Sol. $\vec{OA} = R[\cos 30^\circ \hat{i} + \sin 30^\circ \hat{j}]$

$\vec{OC} = R[-\cos 45^\circ \hat{i} + \sin 45^\circ \hat{j}]$

$\vec{OA} + \vec{OB} - \vec{OC} = R \left[\frac{1}{2} + \frac{\sqrt{3}}{2} + \frac{1}{\sqrt{2}} \right] \hat{i} + R \left[\frac{1}{2} - \frac{\sqrt{3}}{2} - \frac{1}{\sqrt{2}} \right] \hat{j}$

angle with the x-axis

$\tan \alpha = \frac{\frac{1}{2} - \frac{\sqrt{3}}{2} - \frac{1}{\sqrt{2}}}{\frac{1}{2} + \frac{\sqrt{3}}{2} + \frac{1}{\sqrt{2}}} = \frac{1-\sqrt{3}-\sqrt{2}}{1+\sqrt{3}+\sqrt{2}}$

$\alpha = \tan^{-1} \left[\frac{1-\sqrt{3}-\sqrt{2}}{1+\sqrt{3}+\sqrt{2}} \right]$

dimension of mass $M = [E^a P^b G^c]$. Then $a + b + c = ?$

(1) $\frac{1}{3}$ (2) $\frac{1}{5}$ (3) $\frac{1}{6}$ (4) $\frac{1}{10}$

Ans. (2)

Sol. $ML^0 T^0 = [ML^2 T^{-2}]^a [ML^2 T^{-1}]^b [M^{-1} L^3 T^{-2}]^c$

$a + b - c = 1 \quad \dots(i)$

$2a + 2b + 3c = 0 \quad \dots(ii)$

$-2a - b - 2c = 0 \quad \dots(iii)$

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$\Rightarrow -2c - 3c = 2 \Rightarrow c = -\frac{2}{5}$

From (2) + (3)

$b = \frac{1}{5}$

$a = \frac{1}{5}$

$a + b + c = \frac{1}{5} + \frac{1}{5} - \frac{2}{5} = \frac{0}{5} = 0$

11. Heater is supplying heat at the rate of 6000 J/min. If power produced by gas is 90 W. Find the time taken to increase internal energy by 2.5×10^3 J?

(1) 250 s (2) 150 s (3) 500 s (4) 100 s

Ans. (1)

Sol.

$$6000 \text{ J/min} = \frac{6000}{60} \text{ J/s} = 100 \text{ J/s}$$

$$\Delta U = Q - W$$

$$2500 = 100t - 90t$$

$$t = 250 \text{ s}$$

12. Compare the RMS speed of hydrogen, oxygen and carbon dioxide at the same temperature?

$$(1) V_{H_2} < V_{O_2} < V_{CO_2} \quad (2) V_{H_2} > V_{O_2} > V_{CO_2} \quad (3) V_{H_2} > V_{O_2} < V_{CO_2} \quad (4) V_{O_2} < V_{H_2} > V_{CO_2}$$

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Sol. $V_{rms} = \sqrt{\frac{3RT}{M}} \propto \frac{1}{\sqrt{M}}$

$$M_{H_2} < M_{O_2} < M_{CO_2}$$

$$V_{H_2} > V_{O_2} < V_{CO_2}$$

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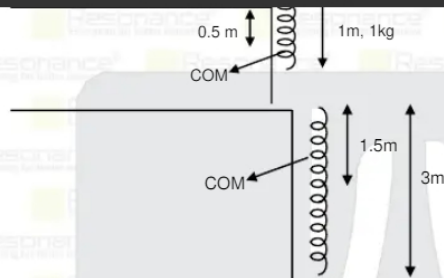
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13. A long chain of length 3m of mass 3kg is placed on a table with 1m length hanging on the table. Find the kinetic energy of chain when it slips from the table completely?

$$(1) 40 \text{ J} \quad (2) 30 \text{ J} \quad (3) 25 \text{ J} \quad (4) 15 \text{ J}$$

Ans.
Sol.

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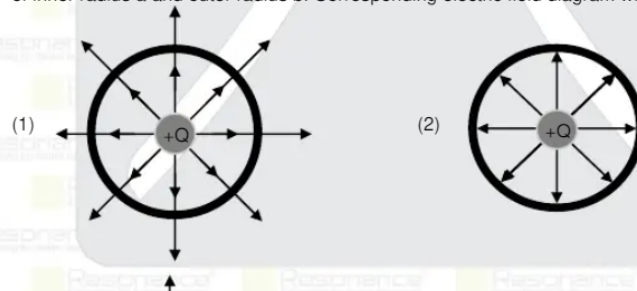


Apply conservation of energy $U_i + K_i = U_f + K_f$

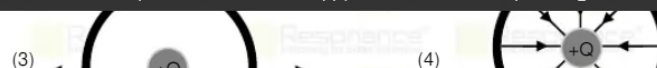
$$-1 \times 10 \times \left(\frac{1}{2}\right) + 0 = -3 \times 10 \times 1.5 + KE$$

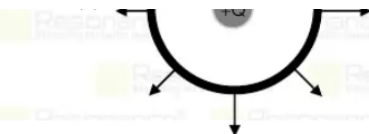
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14. Charge Q is given to a spherical conductor of radius R. It is surrounded by a concentric conducting shell of inner radius a and outer radius b. Corresponding electric field diagram will be :



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Ans. (1)

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15. If the wavelength of incident light changes from 300 nm to 400 nm, then find the change in stopping potential. If the work function of metal = 2.5 eV ?

(1) 1.03 eV (2) 2.10 eV (3) 1.85 eV (4) 2.03 eV

Ans. (1)

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$$eV_1 = \frac{hc}{300\text{nm}} - \phi$$

$$eV_2 = \frac{hc}{400\text{nm}} - \phi$$

$$e(V_1 - V_2) = 1240 \left(\frac{100}{300 \times 400} \right) = 1.03\text{eV}$$

16. In YDSE, d is the distance between slits and D is the distance between screen and slit plane. if y_1 is the distance of 1st maxima from central maxima for red light and y_2 is the distance for violet light then what is the difference between the wavelength of red & violet

Sol. $y_1 = \frac{\lambda_r D}{d}$

$$y_2 = \frac{\lambda_v D}{d}$$

$$\lambda_r - \lambda_v = (y_1 - y_2) \frac{d}{D}$$

17. An observer and a source both are moving away with velocity 20 m/s each in opposite direction. If frequency of sound observed is 1800 Hz, then what is the actual frequency (Velocity of sound = 340 m/s)

(1) 1906 (2) 1903 (3) 1912 (4) 1947

Ans. (1)

Sol. $f' = f \left(\frac{v - v_0}{v} \right)$

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$$1800 = f \left[\frac{340 - 20}{340 + 20} \right]$$

$$f = \frac{1800 \times 360}{340}$$

$$\approx 1906 \text{ Hz}$$

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18. Find the capacitance in a series LCR circuit in order to get maximum power. ($X_L = 250\Omega$ and $f = 50$ Hz)

- (1) $10.7 \mu\text{F}$ (2) $12.7 \mu\text{F}$ (3) $14.7 \mu\text{F}$ (4) $14.9 \mu\text{F}$

Ans. (2)

Sol.

At resonance $\omega = 2\pi f$

$$\frac{1}{\omega C} = \omega L$$

$$\frac{1}{\omega C} = 250$$

$$C = \frac{1}{100\pi \times 250} = 12.7 \mu\text{F}$$

19. For hydrogen like atom, the frequency of transition from $n = 3$ to $n = 1$ is 192×10^{15} Hz, then find the frequency of transition from $n = 2$ to $n = 1$

- (1) 162×10^{15} Hz (2) 227×10^{15} Hz (3) 162×10^{18} Hz (4) None

Ans. (1)

Sol. $\nu \propto \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$

$$\therefore \nu \propto \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$$

$$\frac{192 \times 10^{15}}{\nu} = \frac{\left[\frac{1}{1} - \frac{1}{9} \right]}{\left[\frac{1}{1} - \frac{1}{4} \right]}$$

$$\nu = 192 \times 10^{15} \times \frac{3}{4} \times \frac{9}{8}$$

$$\nu = 162 \times 10^{15} \text{ Hz}$$

20. Initial fuel of Rocket is 1000 kg. If it was given acceleration of 20 m/s^2 . Velocity of fuel with respect to rocket is 500 m/s . Find the rate of consumption of fuel.

- (1) 30 kg/s (2) 60 kg/s (3) 900 kg/s (4) 80 kg/s

$$\frac{dm}{dt} v_r = mg + ma$$

$$\frac{dm}{dt} 500 = 1000 (10 + 20)$$

$$\frac{dm}{dt} = 60 \text{ Kg/s}$$

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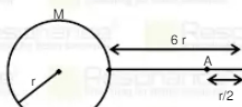
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21. Find the moment of inertia for a badminton racket about an axis passing through 'A' and perpendicular to plane as shown in figure. Mass of circular position is M and mass of straight position is m.



- (1) $\frac{Mr^2}{4} + \frac{m(6r)^2}{4}$ (2) $\frac{Mr^2}{4} + \frac{m(6r)^2}{4}$

$$(3) \frac{173mr^2}{4} + \frac{37Mr^2}{4}$$

$$(4) \frac{173mr^2}{4} + \frac{37Mr^2}{4}$$

Ans. (1)

$$\begin{aligned} \text{Sol. } I_A &= \left[Mr^2 + M \left(7r - \frac{r}{2} \right)^2 \right] + \left[\frac{m(6r)^2}{12} + m \left(3r - \frac{r}{2} \right)^2 \right] \\ &= \left\{ Mr^2 + M \frac{(169)r^2}{4} \right\} + \left\{ m3r^2 + \frac{m25r^2}{4} \right\} \\ &= \frac{173Mr^2}{4} + \frac{37mr^2}{4} \end{aligned}$$

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22. Two travelling waves produce a standing wave represented by equation $y = 1.0 \text{ mm} \cos(1.57 \text{ cm}^{-1} x) \sin(78.5 \text{ s}^{-1} t)$ the node closest to the origin in the region $x > 0$ will be at x ____ cm

Ans. 1

Sol. at Node

$$y = 0$$

$$1 \cos(1.57x) \sin(178.5)t = 0$$

$$\cos(1.57x) = 0$$

$$1.57x = \frac{\pi}{2}$$

$$x = 1 \text{ cm}$$

23. An amplitude modulated wave is represented by $C_m = 10 (1 + 0.2 \sin 12560 t) \sin (1.11 \times 10^4 t) \text{ V}$. The modulating frequency in KHz will be.

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$$\text{Sol. } C_m = A_c \left[1 + \frac{A_m}{A_c} \sin 2\pi f_m t \right]$$

$$2\pi f_m = 12560$$

$$f_m = 2000 \text{ Hz} = 2 \text{ KHz}$$

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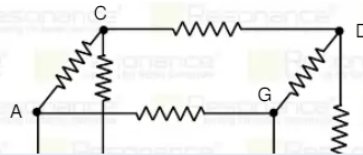
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24. A cube made up of wire each of resistance R. Then find equivalent resistance across its diagonal.



$$(1) \frac{5R}{6}$$

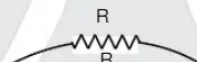
$$(2) \frac{3R}{4}$$

$$(3) \frac{7R}{12}$$

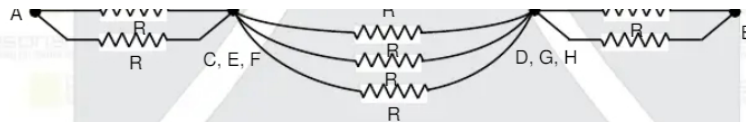
$$(4) R$$

Ans. (1)

Sol. Due to symmetry C, E, F, – same potential
and G, D, H, – same potential



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$$R_{AB} = \frac{R}{3} + \frac{R}{6} + \frac{R}{3} = \frac{2R + R + 2R}{6} = \frac{5R}{6}$$

25. Find the difference in heights in limbs as shown for the given data. Surface tension $T = 7.3 \times 10^{-2} \text{ N/m}$, density of water $\rho = 1000 \text{ kg/m}^3$ and angle of contact $\theta = 0^\circ$.



- (1) 1.19 mm (2) 2.19 mm (3) 3.19 mm (4) 4.19 mm

Ans. (2)

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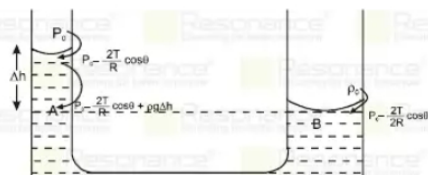
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Sol.



$$P_0 - \frac{2T}{R_1} + h_1 \rho g = P_0 - \frac{2T}{R_2} + h_2 \rho g$$

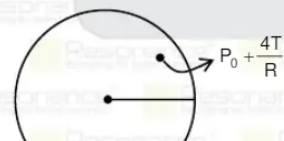
$$(h_1 - h_2) \rho g = 2T \left[\frac{1}{\frac{5}{2} \times 10^{-3}} - \frac{1}{\frac{8}{2} \times 10^{-3}} \right]$$

$$h_1 - h_2 = \frac{2 \times 7.3 \times 10^{-2}}{1000 \times 10 \times 10^{-3}} \times \frac{3}{20} = 2.19 \text{ mm}$$

26. There is a soap Bubble of radius 6 cm and it has another soap bubble of radius 3 cm inside it. Find the equivalent radius of the soap bubble which has same excess pressure, as pressure inside the bubble of radius 3 cm.

- (1) 2 cm (2) 1 cm (3) 9 cm (4) 3 cm

Ans. (1)
Sol.



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$$P_0 + \frac{4T}{6} + \frac{4T}{3} = P_0 + \frac{4T}{R}$$

$$\frac{1}{6} + \frac{1}{3} = \frac{1}{R}$$

$$R = 2 \text{ cm}$$

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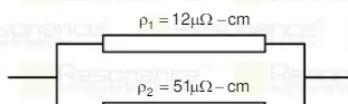
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27. Two wires of equal length and diameters 2 mm each having resistivity $\rho_1 = 12 \mu\Omega\text{-cm}$ and $\rho_2 = 51 \mu\Omega\text{-cm}$ respectively are connected in parallel so that their equivalent resistance is 3Ω . Find the length of wire.



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- (1) 50 m (2) 97 m (3) 194 m (4) 291 m

Ans. (2)

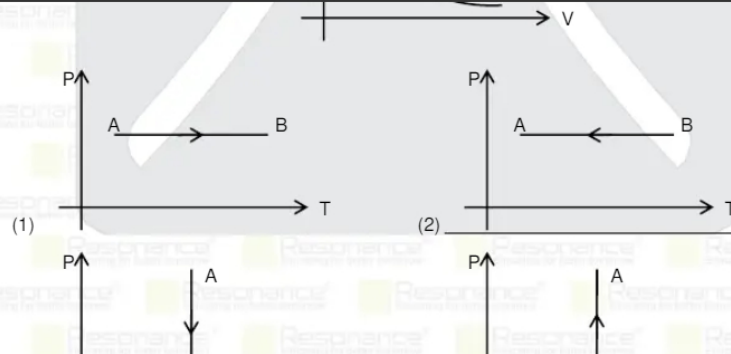
Sol. $\frac{R_1 R_2}{R_1 + R_2} = 3\Omega$

$$\frac{\rho_1 \rho_2}{\rho_1 + \rho_2} \times \frac{\ell}{A} = 3\Omega ; \ell = 3 \times A \times \frac{(\rho_1 + \rho_2)}{\rho_1 \rho_2} = \frac{3 \times \pi (10^{-3})^2 \times 63 \times 10^{-8}}{12 \times 51 \times 10^{-16}} ; \ell = 97 \text{ m}$$

28. Assume an Ideal gas is taken from state A to state B. The process is isothermal. Then corresponding P-T graph will be



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- Ans. (3)
Sol. T = Constant
 $P \propto \frac{1}{V}$

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