PHYSICS

BOOKS - D MUKHERJEE PHYSICS (HINGLISH)

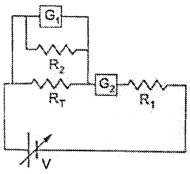
IIT QUESTIONS 4

Straight Objective Type

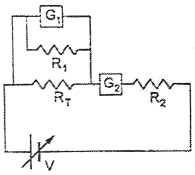
1. To verify Ohm's law, a student is provided with a test resistor R_T, a high resistance R_1, a

small resistance R_2, two identical galvanometer G_1 and G_2, and a variable voltage source V. The correct circuit to carry out the experiment is

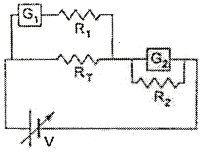
A. (a)



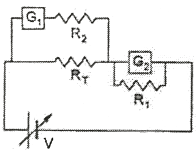
B. (b)



C. (c)



D. (d)



Answer: C

Watch Video Solution

2. Incandescent bulbs are designed by keeping in mind that the resistance of their filament increases with the increase in temperature. If at room temperature, $100W, 60W$ and $40W$ bulbs have filament resistances R_{100}, R_{60} and R_{40}, respectively, the relation between these resistances is

A. $\frac{1}{R_{100}} = \frac{1}{R_{40}} + \frac{1}{R_{60}}$

B. $R_{100} = R_{40} + R_{60}$

C. $R_{100} > R_{60} > R_{40}$

D. $\frac{1}{R_{100}} > \frac{1}{R_{60}} > \frac{1}{R_{40}}$

Answer: D

Watch Video Solution

3. A real gas behaves like an ideal gas if its

A. pressure and temperature are both high

B. pressure and temperature are both law

C. pressure is high and temperature is law

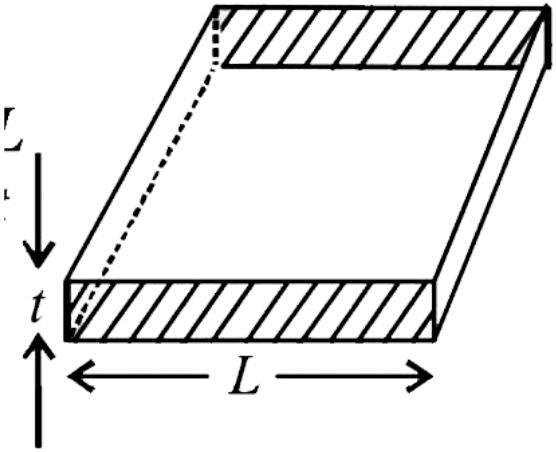
D. pressure is high and temperature is high

Answer: D

Watch Video Solution

4. Consider a thin square sheet of side L and thickness t, made of a material of resistivity ρ. The resistance between two opposite faces,

shown by the shaded areas in the figure is



A. directly proportional to L

B. directly proportional to t

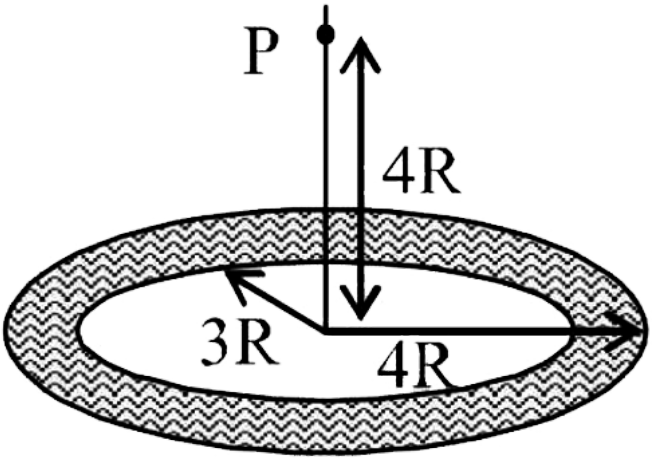
C. independent of L

D. independent of t

Answer: C

Watch Video Solution

5. A thin uniform disc (see figure) of mass M has outer radius 4R and inner radius 3R. The work required to take a unit mass for point P on its axis to infinity is



A. $\frac{2GM}{7R}\left(4\sqrt{2}-5\right)$

B. $-\frac{3GM}{7R}\left(4\sqrt{2}-5\right)$

C. $\frac{GM}{4R}$

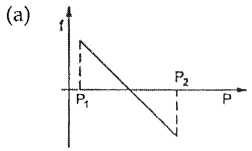
D. $\frac{2GM}{7R}\left(\sqrt{2}-1\right)$

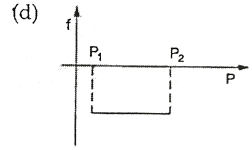
Answer: A

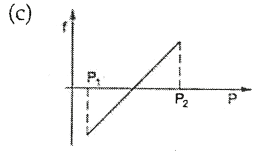
Watch Video Solution

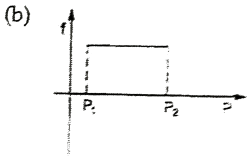
6. A block of mass m is on an inclined plane of angle θ. The coefficient of friction between the block and the plane is μ and $\tan\theta > \mu$. The block is held stationary by applying a force P

parallel to the plane. The direction of force pointing up the plane is taken to be positive. As P is varied from $P_1 = mg(\sin\theta - \mu\cos\theta)$ to $P_2 = mg(\sin\theta + \mu\cos\theta)$, the frictional force f versus P graph will look like

A. 

B. 

C. 

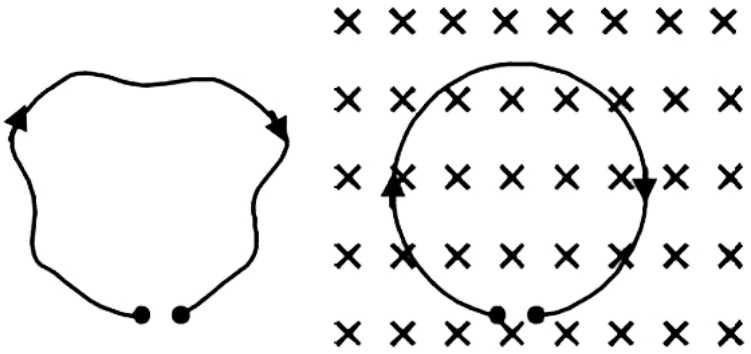
D. 

Answer: A

Watch Video Solution

7. A thin wire of length L is connected to two adjacent fixed points and carries a current I in the clockwise direction , as shown in the figure. When the system is put in a uniform magnetic field of strength B going into the plane of the paper , the wire takes the shape

of a circle . The tension in the wire is



A. IBL

B. $\frac{IBL}{\pi}$

C. $\frac{IBL}{2\pi}$

D. $\frac{IBL}{4\pi}$

Answer: C

Watch Video Solution

8. An AC voltage source of variable angular frequency (ω) and fixed amplitude V_0 is connected in series with a capacitance C and an electric bulb of resistance R (inductance zero). When (ω) is increased

A. the bulb glows dimmer

B. the bulb glows brighter

C. total impedance of the circuit is unchanged

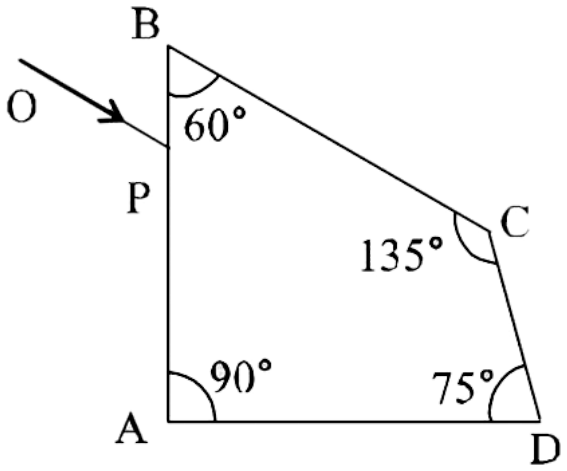
D. total impendance of the circuit increases

Answer: B

Watch Video Solution

9. A ray OP of monochromatic light is incident on the face AB of prism ABCD mear vertex B at an incident angle of $60 degree$ (see figure). If the refractive index of the material of the prism is $\sqrt{3}$, which of the following is (are) are

correct? `



A. The ray gets totally internally reflected at face CD.

B. The ray comes out through face AB

C. The angle between the incident ray and the emergent ray is 90°

D. The angle between the incident ray and the emergent ray is 120°

Answer: A::B::C

Watch Video Solution

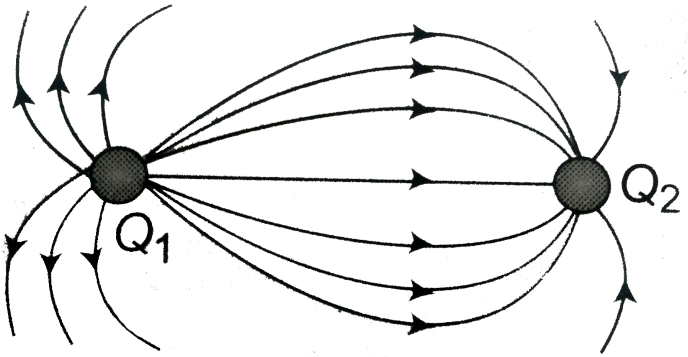
10. A few electric field lines for a system of two charges Q_1 and Q_2 fixed at two different points on the x-axis are shown in the figure. These lines suggest that

(i) $|Q_1| > |Q_2|$

(ii) $|Q_1| < |Q_2|$

(iii) At a finite distance to the left of Q_1 the electric field is zero

(iv) At a finite distance to the right of Q_2 the electric field is zero



A. $|Q_1| > |Q_2|$

B. $|Q_1| < |Q_2|$

C. at a finite distance to the left of $Q(1)$ the electric field is zero

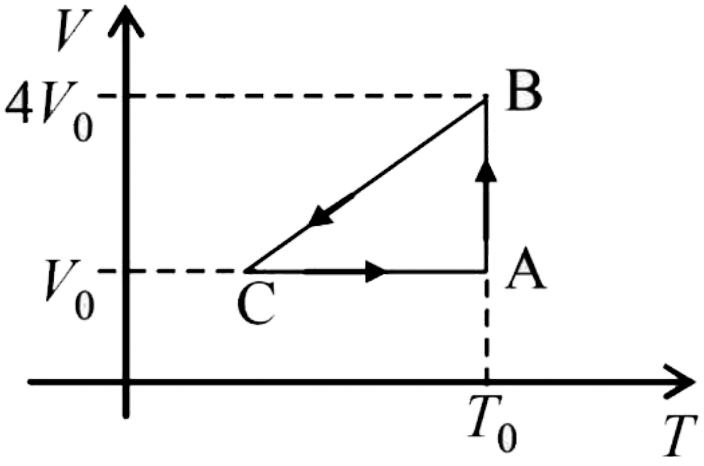
D. at a finite distance distance to the right of Q_2 the electric field is zero.

Answer: A::D

Watch Video Solution

11. One mole of an ideal gas in initial state A undergoes a cyclic process ABCA, as shown in the figure. Its pressure at A is P_0. Choose the

correct option (s) from the following



A. Internal energies at A and B are the same

B. Work done by the gas in process AB is P_0V_0 In 4

C. Pressure at C is $\frac{P_0}{4}$

D. Temperature at C is $\frac{T_0}{4}$

Answer: A::B::C

Watch Video Solution

12. A point mass of $1kg$ collides elastically with a stationary point mass of $5kg$. After their collision, the $1kg$, mass reverses its direction and moves with a speed of $2ms^{-1}$. Which of the following statement(s) is (are) correct for the system of these two masses?

A. Total momentum of the system is

$3kgms^{-1}$

B. Momentum of 5 kg mass after collision is

$4kgms^{-1}$

C. Kinetic energy of the centre of mass is

0.75 J

D. Total kinetic energy of the system is 4J

Answer: A::C

Watch Video Solution

13. A student uses a simple pendulum of exactly $1m$ length to determine g, the acceleration due ti gravity. He uses a stop watch with the least count of $1\,\mathrm{sec}$ for this and record $40\,\mathrm{sec}\,onds$ for 20 oscillations for this observation, which of the following statement $(s)is(are)$ true?

A. Error ΔT in measuring T, the time period, is 0.05 seconds

B. Error ΔT in measuring T, the time period , is 1 second

C. Percentage error in the determination of g is 5%

D. Percentage error in the determination of g is 2.5 %

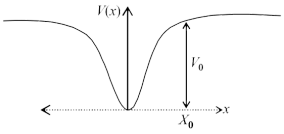
Answer: A::C

Watch Video Solution

Linked Comprehension Type

1. When a particle of mass m moves on the x-axis in a potential of the form $V(x) = kx^2$ it performs simple harmonic motion. The correspondubing time period is proprtional to $\frac{\sqrt{m}}{h}$, as can be seen easily using dimensional analusis. However, the motion of a particle can be periodic even when its potential energy increases on both sides of $x = 0$ in a way different from kx^2 and its total energy is such that the particle does not escape toin finity. Consider a particle of mass m moving on the x-axis. Its potential energy is

$V(x) = ax^4 (a > 0)$ for |x| neat the origin and becomes a constant equal to V_0 for |x|impliesX_(0)` (see figure).



If total energy of the particle is E, it will perform perildic motion only if.

A. $E < 0$

B. $E > 0$

C. $V_0 > E > 0$

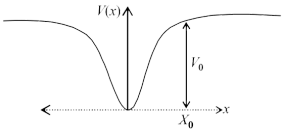
D. $E > V_0$

Answer: C

Watch Video Solution

2. When a particle of mass m moves on the x-axis in a potential of the form $V(x) = kx^2$ it performs simple harmonic motion. The correspondubing time period is proprtional to $\frac{\sqrt{m}}{h}$, as can be seen easily using dimensional analusis. However, the motion of a particle can be periodic even when its potential energy increases on both sides of $x = 0$ in a way

different from kx^2 and its total energy is such that the particle does not escape toin finity. Consider a particle of mass m moving on the x-axis. Its potential energy is $V(x) = ax^4 (a > 0)$ for |x| neat the origin and becomes a constant equal to V_0 for |x|impliesX_(0)` (see figure).



.

For periodic motion of small amplitude A,the time period (T) of thes particle is proportional to.

A. $A\sqrt{\frac{m}{\alpha}}$

B. $\frac{1}{A}\sqrt{\frac{m}{\alpha}}$

C. $A\sqrt{\frac{\alpha}{m}}$

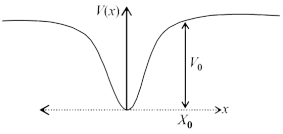
D. $\frac{1}{A}\sqrt{\frac{\alpha}{m}}$

Answer: B

Watch Video Solution

3. When a particle of mass m moves on the x-axis in a potential of the form $V(x) = kx^2$ it performs simple harmonic motion. The

correspondubing time period is proprtional to $\frac{\sqrt{m}}{h}$, as can be seen easily using dimensional analusis. However, the motion of a particle can be periodic even when its potential energy increases on both sides of $x = 0$ in a way different from kx^2 and its total energy is such that the particle does not escape toin finity. Consider a particle of mass m moving on the x-axis. Its potential energy is $V(x) = ax^4 (a > 0)$ for |x| neat the origin and becomes a constant equal to V_0 for |x|impliesX_(0)` (see figure).



.

The acceleration of this partile for $|x| > X_0$ is

(a) proprtional to V_0

(b) proportional to.

A. proportional to V_0

B. proportional to $\frac{V_0}{mX_0}$

C. proportional to $\sqrt{\frac{V_0}{mX_0}}$

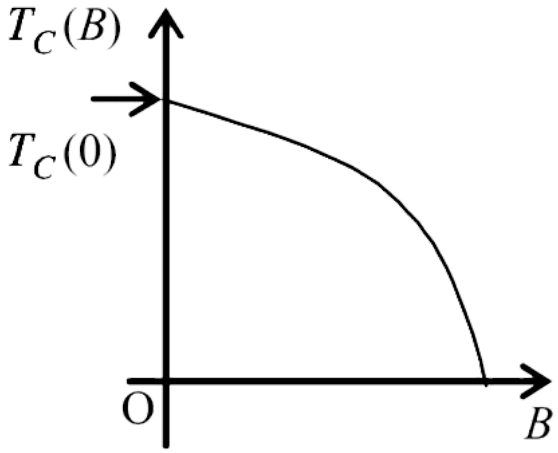
D. zero

Answer: D

Watch Video Solution

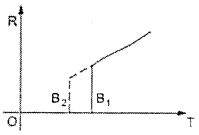
4. Electrical resistance of certain materials, known as superconductors, changes abruptly from a nonzero value of zero as their temperature is lowered below a critical temperature $T_C(0)$. An interesting property of super conductors is that their critical temperature becomes smaller than $T_C(0)$ if they are placed in a magnetic field, i.e., the critical temperature $T_C(B)$ is a function of the magnetic field strength B. The dependence of

$T_C(B)$ on B is shown in the figure.

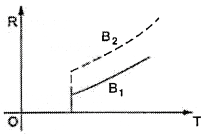


In the graphs below, the resistance R of a superconductor is shown as a function of its temperature T for two different magnetic fields B_1(solid line) and B_2 (dashed line). If B_2 is larget than B_1 which of the following graphs shows the correct variation of R with T in these fields?

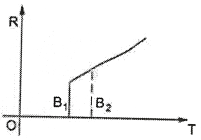
A. (a)



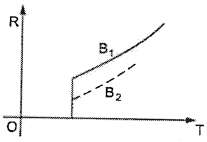
B. (b)



C. (c)



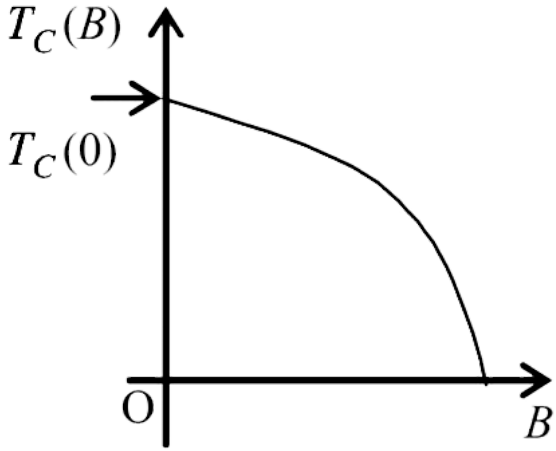
D. (d)



Answer: B

Watch Video Solution

5. Electrical resistance of certain materials, known as superconductors, changes abruptly from a nonzero value of zero as their temperature is lowered below a critical temperature $T_C(0)$. An interesting property of super conductors is that their critical temperature becomes smaller than $T_C(0)$ if they are placed in a magnetic field, i.e., the critical temperature $T_C(B)$ is a function of the magnetic field strength B. The dependence of $T_C(B)$ on B is shown in the figure.



A superconductor has $T_C(0) = 100K$. When a magnetic field of 7.5 Tesla is applied , its T_C decreases to 75 K. For this material one can difinitely say that when

A. $B = 5\text{Tesla}, T_c(B) = 80K$

B. B=5 Tesla, $75k < T_c(B) < 100K$

C. B=5 Tesla, $75k < T_c(B) < 100k$

D. $B = 10\text{Tesla}, T_c(B) = 70K$

Answer: B

Watch Video Solution

Integer Type

1. When two progressive waves $y_1 = 4\sin(2x - 6t)$ and $y_2 = 3\sin\left(2x - 6t - \frac{\pi}{2}\right)$ are superimposed, the amplitude of the resultant wave is

Watch Video Solution

2. A $0.1kg$ mass is suspended from a wire of negligible mass. The length of the wire is $1m$ and its cross - sectional area is $4.9 \times 10^{-7}m^2$. If the mass is pulled a little in the vertically downward direction and released , it performs SHM with angular frequency $140rads^{-1}$. If the young's modulus of the material of the wire is $p \times 10^9 Nm^{-2}$, find the value of p.

Watch Video Solution

3. A binary star consists of two stars $A(mass 2.2M_s)$ and B $(mass 11M_s)$ where M_s is the mass of the sun, they are separted by distane d and are rotating about their center of mass, which is stationary. The ratio of the total angular momentum of the binary to the angular momentum of star B about the centre of mass is

Watch Video Solution

4. Graviational acceleration on the surface of plane fo $\frac{\sqrt{6}}{11}g$. where g is the gracitational acceleration on the surface of the earth. The average mass density of the planet is $\frac{2}{3}$ times that of the earth. If the escape speed on the surface of the earht is taken to be $11kms^{-1}$ the escape speed on teh surface of the planet in kms^{-1} will be

Watch Video Solution

5. A piece of ice (heat capacity $= 2100 Jkg^{-1}.^{\circ} C^{-1}$ and latent heat $= 3.36 \times 10^{5} Jkg^{-1}$) of mass m grams is at $-5.^{\circ} C$ at atmospheric pressure. It is given 420 J of heat so that the ice starts melting. Finally when the ice . Water mixture is in equilibrium, it is found that 1 gm of ice has melted. Assuming there is no other heat exchange in the process, the value of m in gram is

Watch Video Solution

6. A stationary source is emitting sound at a fixed frequency f_0, which is reflected by two cars approaching the source. The difference between the frequencies of sound reflected from the cars is $1.2\,\%$ of f_0. What is the difference in the speeds of the cars (in km per hour) to the nearest integer ? The cars are moving at constant speeds much smaller than the speed of sound which is $330 ms^{-1}$.

Watch Video Solution

7. The focal length of thin biconvex lens is $20cm$. When an object is moved from a distance of $25cm$ in front of it to $50cm$, the magni- fication of its image changes from m_{25} to m_{50}. The ratio $\frac{m_{25}}{M_{50}}$ is

Watch Video Solution

8. A proton and an α-particle are accelerated, using the same potential difference. How are the de-Broglie wavelengths λ_p and λ_a related to each other?

Watch Video Solution

9. When two identical batteries of internal resistance 1Ω each are connected in series across a resistor R, the rate of heat produced in R is J_1. When the same batteries are connected in parallel across R, the rate is J_2 = 2.25 J_2$then the value of R \in$ Omega` is

Watch Video Solution

10. Two spherical bodies A (radius 6cm) and B (radius 18cm) are at temperature T_1 and T_2 respectively The maximum intensity in the emission spectrum of A is at $500nm$ and in that of B is at $1500nm$ considering them to be black bodies, what will be the ratio of the rate of total energy radiated by A to that of B . ?

Watch Video Solution