46. Dimension of Planck's constant is equivalent to the dimension of which of the following quantities?

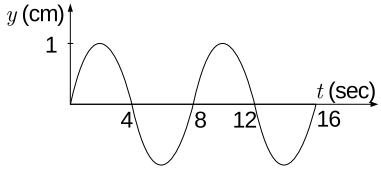
A. Force.

B. Energy.

C. Linear momentum.

D. Angular momentum.

47. The figure below shows the displacement vs time plot of a particle undergoing simple harmonic motion. The acceleration of the particle at time $t = \frac{4}{3}$ sec would be



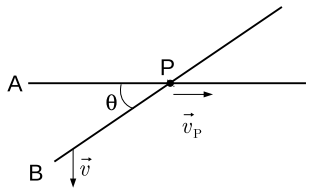
A. $\frac{\sqrt{3}\pi^2}{16}$ cm/sec^2.

B. $-\frac{\sqrt{3}\pi^2}{32}$ cm/sec^2.

C. $-\frac{\sqrt{3}\pi^2}{16}$ cm/sec^2.

D. $\frac{\sqrt{3}\pi^2}{32}$ cm/sec^2.

48. Two infinitely long rods are arranged on a plane making an angle θ with each other, as shown in the figure. The rod B starts to move with a uniform velocity $\vec{v}$, in a direction perpendicular to rod A. Thus, the point of intersection P moves with a horizontal velocity $\vec{v}_P$. Which of the following statements is true?



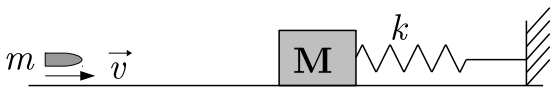
A. v_P increases with increasing θ.

B. v_P decreases with increasing θ.

C. v_P is independent of θ.

D. v_P is independent of v.

49. The figure shows a block of mass M, attached to an uncompressed spring of spring constant k, resting on a frictionless surface. A bullet of mass m, travelling with a constant horizontal velocity v hits the block and gets embedded inside. What is the maximum compression of the spring?



A. $v\frac{m}{k}$.

B. $v\sqrt{\frac{M}{k}}$.

C. $v\sqrt{\frac{m+M}{k}}$.

D. $v\sqrt{\frac{m}{k}}$.

50. An electron in a hydrogen atom falls from an orbit with principal quantum number $n = 2$ to $n = 1$. What is the wavelength (λ) of the emitted radiation? (where R denotes the Rydberg constant).

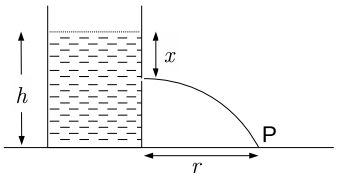
A. $\lambda = \frac{4}{3R}$.

B. $\lambda = \frac{4}{5R}$.

C. $\lambda = \frac{3R}{4}$.

D. $\lambda = -\frac{4}{3R}$.

51. The figure below shows a cylindrical tank filled with water upto a height h. A hole is punctured on the side of the tank, at a distance x below the water level. Water exits the hole and hits a point P (at a distance r from the base of the tank). Which of the following is true?



A. r is maximum when $x = \frac{h}{\sqrt{2}}$.

B. r is maximum when $x = \frac{h}{2}$.

C. r is maximum when $x = h$.

D. r is maximum when $x = \frac{2h}{3}$.

52. A tank with uniform cross-sectional area A is filled with a liquid of density ρ upto a height h. What is the potential erergy stored in the system? (where g denotes the acceleration due to gravity)

A. $\frac{1}{2}Ag\rho h^2$.

B. $Ag\rho h^2$.

C. $\frac{1}{2}Ag\rho h$.

D. $Ag\rho h$.

53. A sphere of radius R carries a positive charge density (ρ) that increases linearly with radial distance r from the centre ($\rho \propto r$). The radial dependence of the magnitude of electric field inside the sphere is given by

A. $E \propto r$.

B. $E \propto r^2$.

C. $E \propto r^{-1}$.

D. $E \propto r^{-2}$.

54. A magnet falling vertically under gravity, passes through a metal ring on its way. Which of the following is true about the acceleration a of the magnet? (where g denotes the acceleration due to gravity)

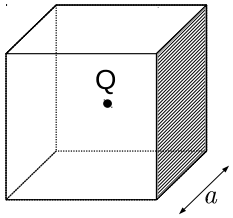
A. $a > g$ everywhere.

B. $a > g$ before crossing the ring and $a < g$ after crossing the ring.

C. $a < g$ before crossing the ring and $a > g$ after crossing the ring.

D. $a < g$ everywhere.

55. A point charge Q, is placed at the center of a cube of side a, in vacuum (permitivity ϵ_0). The flux of the electric field through the shaded face is given by



A. $\frac{Q}{\epsilon_0}$.

B. $\frac{Q}{4\epsilon_0}$.

C. $\frac{Q}{6\epsilon_0}$.

D. $\frac{Q}{8\epsilon_0}$.

56. Two isolated conducting spheres of radii 10 cm and 20 cm have charges Q_A and Q_B, respectively. What is the final charge on the first sphere if the spheres are brought in contact and separated subsequently?

A. $\frac{1}{3}(Q_A + Q_B)$.

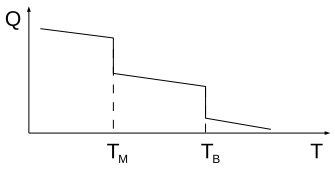
B. $\frac{2}{3}(Q_A + Q_B)$.

C. $\frac{1}{2}(Q_A + Q_B)$.

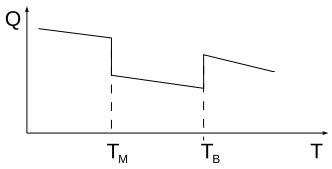
D. remains unchanged.

57. Heat (Q) is supplied to a solid to raise its temperature (T) across its melting point (T_M) and boiling point (T_B). Which of the following graphs correctly represents the relation between heat supplied and temperature?

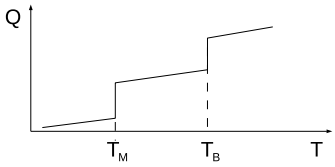
A.



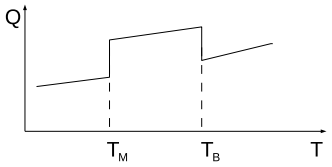
B.



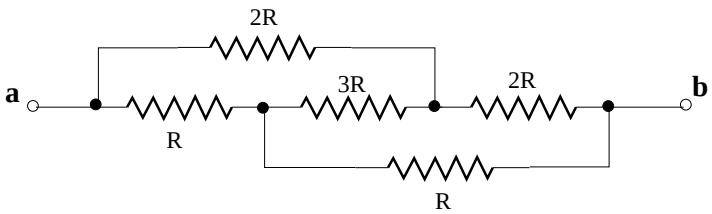
C.



D.



58. For the circuit given below, what is the effective resistance between points **a** and **b**.



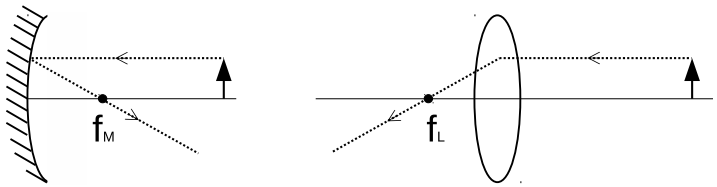
A. $3R/4$.

B. $3R/5$.

C. $4R/3$.

D. $5R/3$.

59. Consider the ray diagrams for a concave mirror (focal length f_M) and a convex lens (focal length f_L) in air, as shown in the figure below.



What happens to their focal lengths when they are immersed in a medium of refractive index higher than that of air?

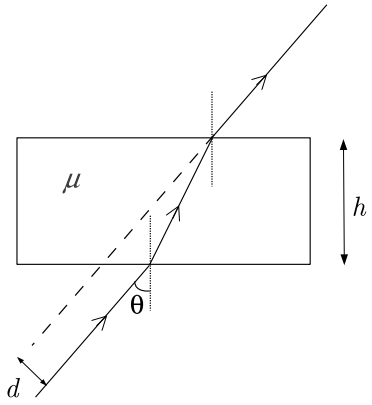
A. f_M changes and f_L stays same.

B. f_M stays same and f_L changes.

C. both f_M and f_L changes.

D. both f_M and f_L stay same.

60. Consider a ray of light passing through a rectangular slab of refractive index μ ($\mu > 1$) and thickness h as shown below.



This leads to a parallel shift d in the path of the ray, which varies between 0 to d_{max} as θ varies. How does d_{max} change with μ?

A. d_{max} increases with μ.

B. d_{max} decreases with μ.

C. d_{max} first increases then decreases with μ.

D. does not change with μ.