

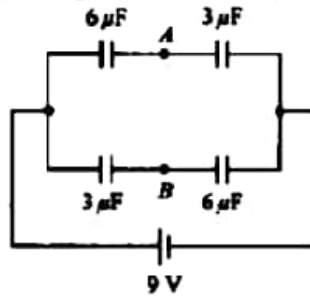
SECTION I : PHYSICS

This section contains **30 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct**.

1. An ideal gas is at absolute temperature T . Temperature coefficient of volume expansion for an isobaric process is

(A) $\frac{2}{T}$ (B) $\frac{1}{T}$ (C) $\frac{1}{T^2}$ (D) None

2. The potential difference between points A and B is



(A) 0 V (B) 6 V (C) 3 V (D) 9 V

3. Two uniformly charged non-conducting hemispherical shells each having uniform charge density σ and radius R form a complete sphere (not stuck together) and surround a concentric spherical conducting shell of radius $R/2$. If hemispherical parts are in equilibrium then minimum surface charge density of inner conducting shell is

(A) -2σ (B) $+2\sigma$ (C) $-\sigma$ (D) $-\sigma/2$

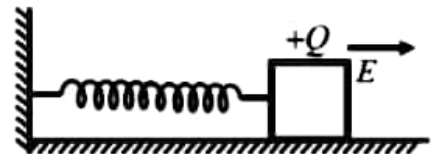
4. An electromagnetic wave going through vacuum is described by

$$E = E_0 \sin(kx - \omega t); B = B_0 \sin(kx - \omega t), \text{ then}$$

(A) $E_0 k = B_0 \omega$ (B) $E_0 B_0 = \omega k$ (C) $E_0 \omega = B_0 k$ (D) None

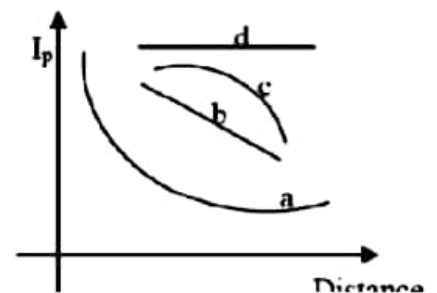
5. A spring-block system undergoes simple harmonic motion on a smooth horizontal surface. The block is now given some positive charge, and uniform horizontal electric field to the right is switched on. As a result,

(A) the time period of oscillation will increase
 (B) the time period of oscillation will decrease
 (C) the time period of oscillation will remain unaffected
 (D) the mean position of simple harmonic motion will shift to the left



6. A point source causes photoelectric effect from a small metal plate. Which of the curves may represent the saturation photocurrent as a function of distance between the source and the metal?

(A) a (B) b (C) c (D) d

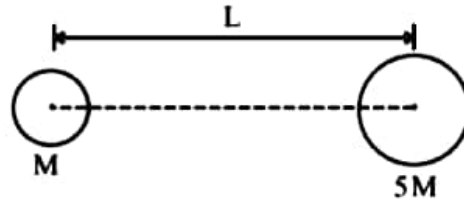




7. Two parallel long straight conductors lie on a smooth surface. Two other parallel conductors rest on them at right angles so as to form a square of side a initially. A uniform magnetic field B exists at right angles to the plane containing the conductors. Each wire starts moving with a constant velocity v perpendicular to its length increasing the size of the square uniformly. If r is the resistance per unit length of the wire, the current in the circuit will be

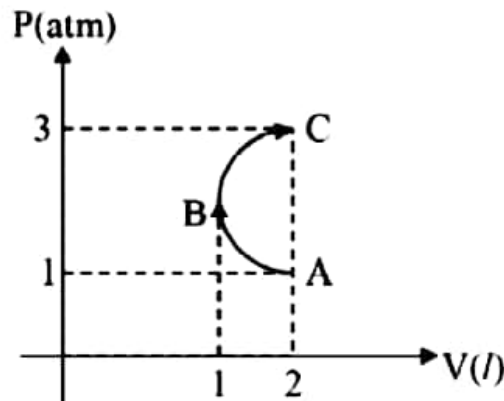
(A) $\frac{4Bv}{r}$ (B) $\frac{2Bv}{r}$ (C) $\frac{Bv}{2r}$ (D) $\frac{Bv}{r}$

8. Two stars of mass M and $5M$, which are at a distance L apart rotate about their centre of mass due to mutual gravitational attraction. The time of one rotation is



(A) $2\pi\sqrt{\frac{L^3}{3GM}}$ (B) $2\pi\sqrt{\frac{L^3}{6GM}}$ (C) $2\pi\sqrt{\frac{3L^3}{GM}}$ (D) None

9. In the P-V diagram shown in figure ABC is a semicircle. The work done by the gas in the process ABC is



(A) Zero (B) $\frac{\pi}{2}(atm - l)$ (C) $-\frac{\pi}{2}(atm - l)$ (D) $4(atm - l)$

10. Two waves having intensities in the ratio 25:4 produce interference. The ratio of maximum to minimum intensity is

(A) 49 : 9 (B) 5 : 2 (C) 7 : 3 (D) 7 : 4

11. The energy radiated by a black body at 2300K is found to have the maximum at a wavelength 1260 nm, its emissive power being 8000 Wm^{-2} . When the body is cooled to a temperature T K, the emissive power is found to decrease to 500 Wm^{-2} . Find the temperature T

(A) 1200K (B) 1350K (C) 1050K (D) 1150K



20. Statement-1: If a convex lens is placed in liquid, it can behave as diverging lens.
Statement-2: The focal length of a lens is independent of the refractive index of the material of the lens.
(A) Statement 1 is True, Statement 2 is True; Statement 2 is correct explanation for Statement 1
(B) Statement 1 is True, Statement 2 is True; Statement 2 is NOT a correct explanation for Statement 1
(C) Statement 1 is True, Statement 2 is False,
(D) Statement 1 is False, Statement -2 is True
21. Half-life of a radioactive substance A is two times the half-life of another radioactive substance B. Initially the number of nuclei of A and B are N_A and N_B respectively. After three half lives of A number of nuclei of both are equal. Then the ratio N_A/N_B is:
(A) 1/4 (B) 1/8 (C) 1/3 (D) 1/6
22. A vessel containing a liquid is heated with its contents. The pressure at the bottom of vessel due to the liquid (No evaporation and no spilling takes place)
(A) increase (B) decrease
(C) increase if $\gamma_{liq} > 3\alpha_{vessel}$ (D) decrease if $\gamma_{liq} > 3\alpha_{vessel}$
23. A particle of mass m moves along a circle of radius R with a normal acceleration varying with time as $a_n = kt^4$ where k is a constant. The average value of the power over the first t seconds after the beginning of the motion will be
(A) zero (B) $\frac{mkRt}{2}$ (C) $\frac{mkRt^3}{2}$ (D) none
24. A cylinder is pure rolling up an incline plane. It stops momentarily and then rolls back. The force of friction
(A) on the cylinder is zero throughout the journey
(B) is directed opposite to the velocity of the centre of mass throughout the journey
(C) is directed up the plane throughout the journey
(D) is directed down the plane throughout the journey
25. In an experiment of resonance tube to measure the velocity of sound, first resonance occurs at $l = 10\text{cm}$ from the open end of the tube. End correction of the tube is 1.0cm and the frequency of tuning fork is 700Hz .
(I) Velocity of sound is 308m/s
(II) Next resonance will occur at $l = 32\text{cm}$ from the open end of the tube
(III) Radius of resonance tube is 1.67cm
The correct statement is/are
(A) I, II (B) I, III (C) II, III (D) I, II, III
26. The focal length of the objective lens of a compound microscope
(A) Equal to the focal length of its eye piece
(B) Greater than the focal length of eye piece
(C) Less than the focal length of eye piece
(D) Any of the above three



27. A nucleus with mass number 220 initially at rest emits an α -particle. If the Q-value of the reaction is 5.5 MeV, the kinetic energy of the α -particle is
(A) 4.4 MeV (B) 5.4 MeV (C) 5.6 MeV (D) 6.5 MeV
28. Two full turns of the circular scale of a screw gauge cover a distance of 1 mm on its main scale. The total number of divisions on the circular scale is 50. Further, it is found that the screw gauge has a zero error of -0.03 mm while measuring the diameter of a thin wire, a student notes the main scale reading of 3 mm and the number of circular scale divisions in line with the main scale as 35. The diameter of the wire is
(A) 3.38 mm (B) 3.73 mm (C) 3.67 mm (D) 3.32 mm
29. The electric field intensity in a region is given by $\vec{E} = -(y\hat{i} + x\hat{j})$ V/m where x, y are in metres. The shape of equipotential curves on X-Y plane is
(A) parallel lines making 45° with the positive X and Y axes.
(B) concurrent lines passing through the origin.
(C) concentric circles with origin as centre
(D) rectangular hyperbola
30. Statement 1: A charged particle cannot be accelerated by magnetic field.
Statement 2: Work done by magnetic field force on the moving charge particle is always zero.
(A) Statement 1 is True, Statement 2 is True; Statement 2 is correct explanation for Statement 1
(B) Statement 1 is True, Statement 2 is True; Statement 2 is NOT a correct explanation for Statement 1
(C) Statement 1 is True, Statement 2 is False,
(D) Statement 1 is False, Statement -2 is True