# JEE MAIN-2018

PHYSICS

This section contains 30 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which Only One is correct.

1. It is found that if a neutron suffers an elastic collinear collision with deuterium at rest, fractional loss of its energy is p_d, while for its similar collision with carbon nucleus at rest, fractional loss of energy is p_c. The values of p_d and p_c are respectively :

   (1) $(0,0)$

   (2) $(0,1)$

   (3) $(.89,.28)$

   (4) $(.28,.89)$
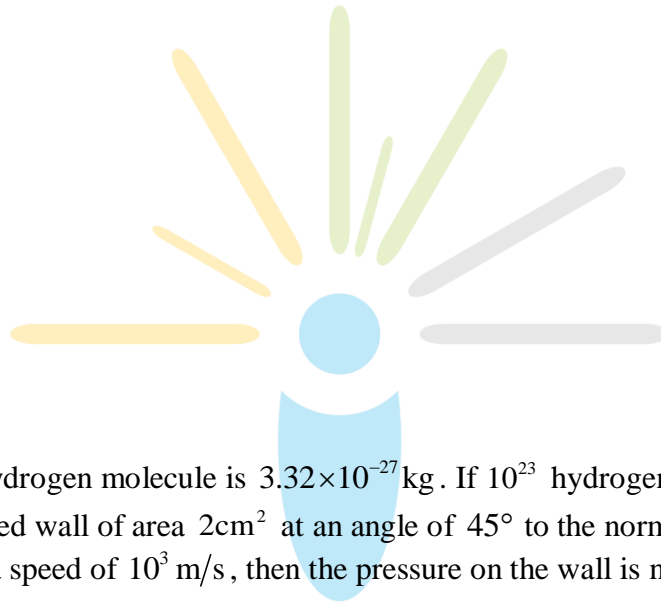
2. The mass of a hydrogen molecule is $3.32 \times 10^{-27}\,\text{kg}$. If 10^{23} hydrogen molecules strike, per second, a fixed wall of area $2\,\text{cm}^2$ at an angle of $45°$ to the normal, and rebound elastically with a speed of $10^3\,\text{m/s}$, then the pressure on the wall is nearly :

   (1) $2.35 \times 10^2\,\text{N/m}^2$

   (2) $4.70 \times 10^2\,\text{N/m}^2$

   (3) $2.35 \times 10^3\,\text{N/m}^2$

   (4) $4.70 \times 10^3\,\text{N/m}^2$

1

3. A solid sphere of radius r made of a soft material of bulk modulus K is surrounded by a liquid in a cylindrical container. A massless piston of area a floats on the surface of the liquid, covering entire cross section of cylindrical container. When a mass m is placed on the surface of the piston to compress the liquid, the fractional decrement in the radius of the sphere, $\left(\dfrac{dr}{r}\right)$ is

(1) $\dfrac{mg}{3Ka}$

(2) $\dfrac{mg}{Ka}$

(3) $\dfrac{Ka}{mg}$

(4) $\dfrac{Ka}{3mg}$

4. Two batteries with e.m.f $12V$ and $13V$ are connected in parallel across a load resistor of 10Ω. The internal resistance of the two batteries are 1Ω and 2Ω respectively. The voltage across the load lies between :

(1) $11.4V$ and $11.5V$

(2) $11.7V$ and $11.8V$

(3) $11.6V$ and $11.7V$

(4) $11.5V$ and $11.6V$

5. A particle is moving in a circular path of radius a under the action of an attractive potential $U = -\dfrac{k}{2r^2}$. Its total energy is :
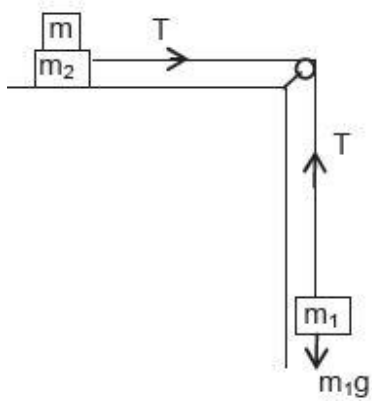
(1) zero

(2) $-\dfrac{3}{2}\dfrac{k}{a^2}$

(3) $-\dfrac{k}{4a^2}$

(4) $\dfrac{k}{2a^2}$

6. Two masses $m_1 = 5\text{kg}$ and $m_2 = 10\text{kg}$ connected by an inextensible string over a frictionless pulley are moving as shown in the figure. The coefficient of friction of horizontal surface is 0.15. The minimum weight m that should be put on top of m_2 to stop the motion is :

(1) $43.3\,\text{kg}$

(2) $10.3\,\text{kg}$

(3) $18.3\,\text{kg}$

(4) $27.3\,\text{kg}$

7. If the series limit frequency of the Lyman series is v_L, then the series limit frequency of the P fund series is :

(1) $v_L/16$

(2) $v_L/25$

(3) $25v_L$

(4) $16v_L$

8. Un polarized light of intensity I passes through an ideal polarizer A. Another identical polarizer B is placed behind A. The intensity of light beyond B is found to be $\dfrac{I}{2}$. Now another identical polarizer C is placed between A and B. The intensity beyond B is now found to be $\dfrac{I}{8}$. The angle between polarizer A and C is :

(1) 45°

(2) 60°

(3) 0°

(4) 30°

9. An electron from various excited states of hydrogen atom emit radiation to come to the ground state. Let λ_n, λ_g be the de Broglie wavelength of the electron in the nth state and the ground state respectively. Let Λ_n be the wavelength of the emitted photon in transition from the nth state to the ground state. For large n, (A, B are constants)

(1) $\Lambda_n^2 \approx A + B\lambda_n^2$

(2) $\Lambda_n^2 \approx \lambda$

(3) $\Lambda_n \approx A + \dfrac{B}{\lambda_n^2}$

(4) $\Lambda_n \approx A + B\lambda_n$

10. The reading of the ammeter for a silicon diode in the given circuit is :
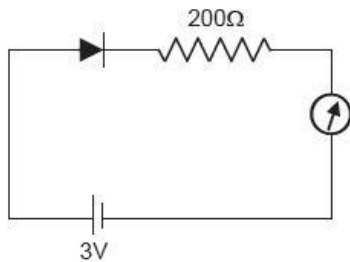
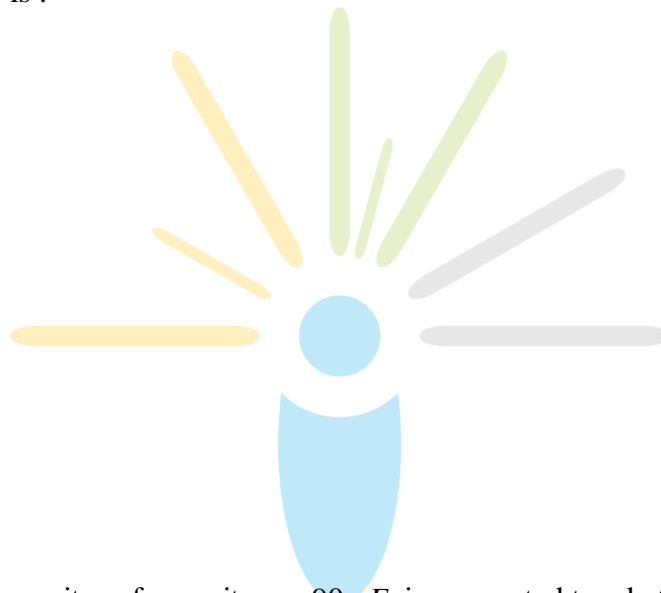(1) $11.5\,mA$

(2) $13.5\,mA$

(3) 0

(4) $15\,mA$

11. An electron, a proton and an alpha particle having the same kinetic energy are moving in circular orbits of radii r_e, r_p, r_α respectively in uniform magnetic field B. The relation between r_e, r_p, r_α is :

(1) $r_e < r_p < r_\alpha$

(2) $r_e < r_\alpha < r_p$

(3) $r_e > r_p = r_\alpha$

(4) $r_e < r_p = r_\alpha$

12. A parallel plate capacitor of capacitance $90\,pF$ is connected to a battery of emf $20V$. If a dielectric material of dielectric constant $K = \dfrac{5}{3}$ is inserted between the plates, the magnitude of the induced charge will be :

(1) $2.4\,nC$

(2) $0.9\,nC$

(3) $1.2\,nC$

(4) $0.3\,nC$

13. current exhibits resonance. The quality factor, Q is given by

(1) $\dfrac{R}{(\omega_0 C)}$

(2) $\dfrac{CR}{\omega_0}$

(3) $\dfrac{\omega_0 L}{R}$

(4) $\dfrac{\omega_0 R}{L}$

14. A telephonic communication service is working at carrier frequency of $10\,\text{GHz}$. Only 10% of it is utilized for transmission. How many telephonic channels can be transmitted simultaneously if each channel requires a bandwidth of $5\,\text{kHz}$?

(1) 2×10^5

(2) 2×10^6

(3) 2×10^3

(4) 2×10^4

15. A granite rod of $60\,\text{cm}$ length is clamped at its middle point and is set into longitudinal vibrations. The density of granite is $2.7\times10^3\,\text{kg}/\text{m}^3$ and its Young's modulus is 9.27×10^{10} Pa. What will be the fundamental frequency of the longitudinal vibrations ?

(1) $10\,\text{kHz}$
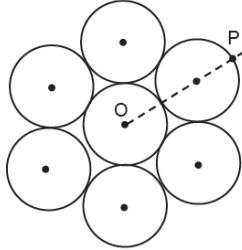
(2) $7.5\,\text{kHz}$

(3) $5\,\text{kHz}$

(4) $2.5\,\text{kHz}$
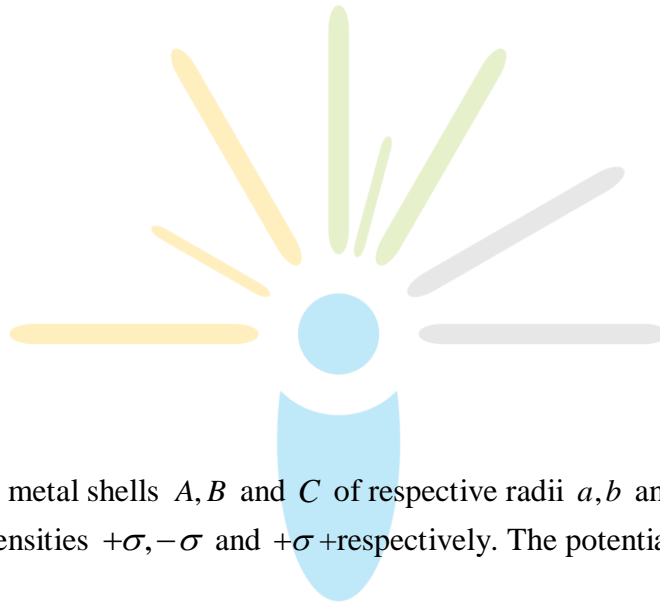
16. Seven identical circular planar disks, each of mass M and radius R are welded symmetrically as shown. The moment of inertia of the arrangement about the axis normal to the plane and passing through the point P is :

(1) $\dfrac{73}{2} MR^2$

(2) $\dfrac{181}{2} MR^2$

(3) $\dfrac{19}{2} MR^2$

(4) $\dfrac{55}{2} MR^2$

17. Three concentric metal shells A, B and C of respective radii a, b and $c \left(a < b < c \right)$ have surface charge densities $+\sigma, -\sigma$ and $+\sigma$ +respectively. The potential of shell B is :

(1) $\dfrac{\sigma}{\varepsilon_0} \left[\dfrac{b^2 - c^2}{b} + a \right]$

(2) $\dfrac{\sigma}{\varepsilon_0} \left[\dfrac{b^2 - c^2}{c} + a \right]$

(3) $\dfrac{\sigma}{\varepsilon_0} \left[\dfrac{a^2 - b^2}{a} + c \right]$

(4) $\dfrac{\sigma}{\varepsilon_0} \left[\dfrac{a^2 - b^2}{b} + c \right]$

18. In a potentiometer experiment, it is found that no current passes through the galvanometer when the terminals of the cell are connected across $52\,\text{cm}$ of the potentiometer wire. If the cell is shunted by resistance of 5Ω, a balance is found when the cell is connected across $40\,\text{cm}$ of the wire. Find the internal resistance of the cell.

(1) 2Ω

(2) 2.5Ω

(3) 1Ω

(4) 1.5Ω

19. An EM wave from air enters a medium. The electric fields are

$$\vec{E}_1 = E_{01}\hat{x}\cos\left[2\pi v\left(\frac{z}{c}-t\right)\right]$$ in air and $$\vec{E}_2 = E_{02}\hat{x}\cos\left[k\left(2z-ct\right)\right]$$ in medium, where the

wave number k and frequency v refer to their values in air. The medium is non-magnetic. If ε_{r_1} and ε_{r_2} refer to relative permittivities of air and medium respectively, which of the following options is correct ?

(1) $\dfrac{\varepsilon_{r_1}}{\varepsilon_{r_2}} = \dfrac{1}{4}$

(2) $\dfrac{\varepsilon_{r_1}}{\varepsilon_{r_2}} = \dfrac{1}{2}$

(3) $\dfrac{\varepsilon_{r_1}}{\varepsilon_{r_2}} = 4$

(4) $\dfrac{\varepsilon_{r_1}}{\varepsilon_{r_2}} = 2$

20. The angular width of the central maximum in a single slit diffraction pattern is $60°$. The width of the slit is $1\mu m$. The slit is illuminated by monochromatic plane waves. If another slit of same width is made near it, Young's fringes can be observed on a screen placed at a distance $50\,\text{cm}$ from the slits. If the observed fringe width is $1\,\text{cm}$, what is slit separation distance?

(i.e. distance between the centres of each slit.)

(1) $75\,\mu m$

(2) $100\,\mu m$

(3) $25\,\mu m$

(4) $50\,\mu m$

21. A sliver atom in a solid oscillates in simple harmonic motion in some direction with a frequency of $10^{12}/\text{sec}$. What is the force constant of the bonds connecting one atom with the other ? (Mole wt. of siver $=108$ and Avagadro number $=6.02\times10^{23}\,\text{gm mole}^{-1}$)

(1) $2.2\,\text{N/m}$

(2) $5.5\,\text{N/m}$

(3) $6.4\,\text{N/m}$

(4) $7.1\,\text{N/m}$
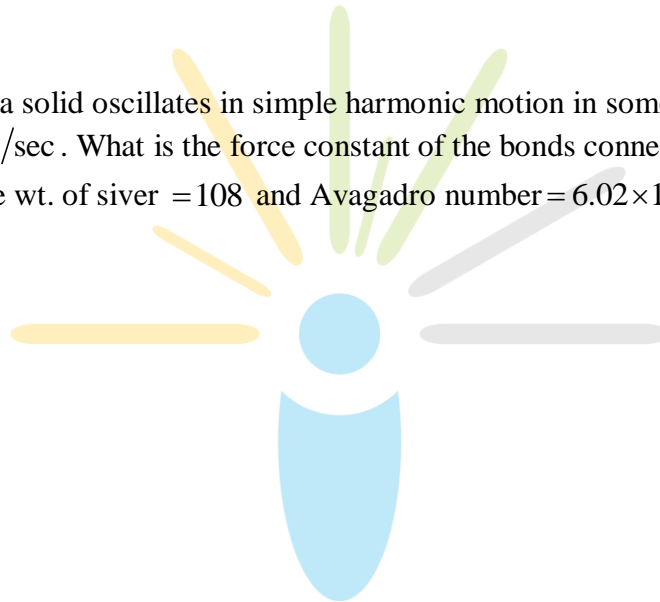
22. From a uniform circular disc of radius R and mass $9M$, a small disc of radius $\dfrac{R}{3}$ is removed as shown in the figure. The moment of inertia of the remaining disc about an axis perpendicular to the plane of the disc and passing through centre of disc is :

(1) $10MR^2$

(2) $\dfrac{37}{9}MR^2$

(3) $4MR^2$

(4) $\dfrac{40}{9}MR^2$

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23. In a collinear collision, a particle with an initial speed v_0 strikes a stationary particle of the same mass. If the final kinetic energy 50% greater than the original kinetic energy, the magnitude of the relative velocity between the two particles, after collision, is :

(1) $\dfrac{v_0}{2}$

(2) $\dfrac{v_0}{\sqrt{2}}$

(3) $\dfrac{v_0}{4}$

(4) $\sqrt{2}v_0$

24. The dipole moment of a circular loop carrying a current I, is m and the magnetic field at the centre of the loop is B_1. When the dipole moment is double by keeping the current constant, the magnetic field at the centre of loop is B_2. The ratio $\dfrac{B_1}{B_2}$ is :

(1) $\sqrt{2}$
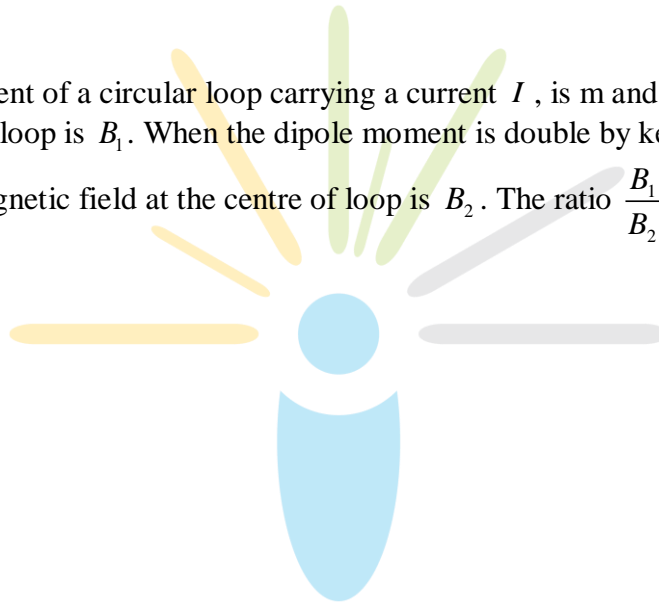
(2) $\dfrac{1}{\sqrt{2}}$

(3) 2

(4) $\sqrt{3}$

25. The density of a material in the shape of a cube is determined by measuring three sides of the cube and its mass. If the relative errors in measuring the mass and length are respectively 1.5% and 1% the maximum error in determining the density is :

(1) 4.5%

(2) 6%

(3) 2.5%

(4) 3.5%

26. On interchanging the resistances, the balance point of a meter bridge shifts to the left by 10 cm . The resistance of their series combination is 1KΩ . How much was the resistance on the left slot before interchanging the resistances ?

(1) 550Ω

(2) 910Ω

(3) 990Ω

(4) 505Ω

27. In an a.c circuit, the instantaneous e.m.f and current are given by

$e = 100\sin 30t$

$i = 20\sin\left(30t - \dfrac{\pi}{4}\right)$

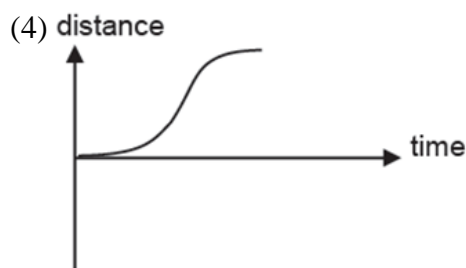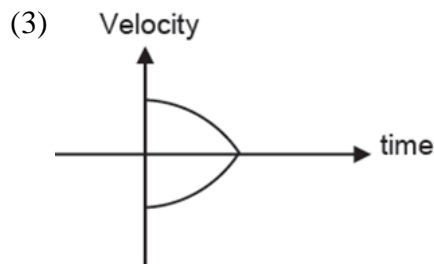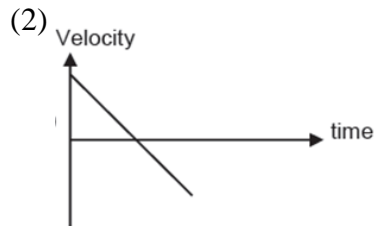In one cycle of $a.c$ the average power consumed by the circuit and the wattless current are, respectively : $a.c$
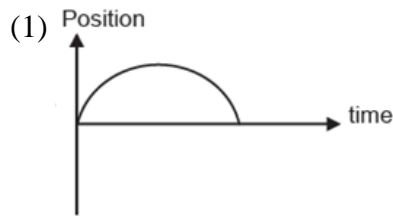
(1) $\dfrac{50}{\sqrt{2}}, 0$

(2) $50, 0$

(3) $50, 10$

(4) $\dfrac{1000}{\sqrt{2}}, 10$

28. All the graphs below are intended to represent the same motion. One of them does it incorrectly. Pick it up.

(1) Position

time

(2) Velocity

time

(3) Velocity

time

(4) distance

time
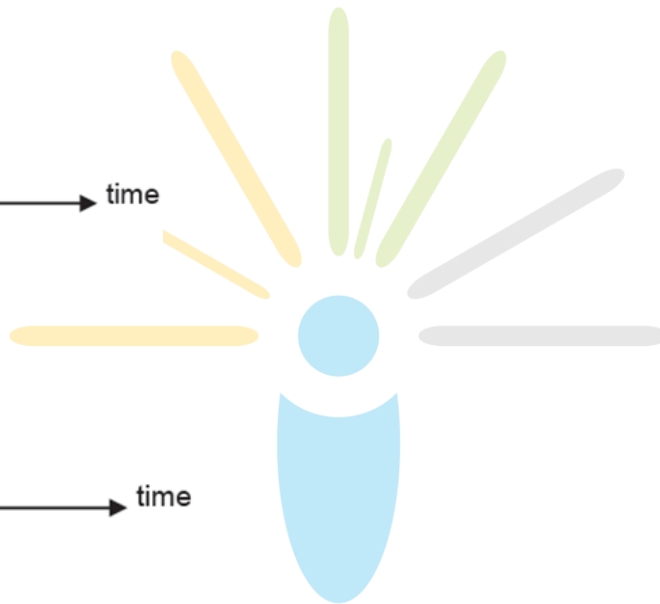
29. Two moles of an ideal monoatomic gas occupies a volume V at $27°C$. The gas expands adiabatically to a volume $2V$. Calculate (a) the final temperature of the gas and (b) change in its internal energy.

(1) (a) 189K (b) -2.7kJ

(2) (a) 195K (b) -2.7kJ

(3) (a) 189K (b) 2.7kJ

(4) (a) 195K (b) -2.7kj

30. A particle is moving with a uniform speed in a circular orbit of radius R in a central force inversely proportional to the nth power of R. If the period of rotation of the particle is T, then :

(1) $T \alpha R^{(n+1)/2}$

(2) $T \alpha R^{n/2}$

(3) $T \alpha R^{3/2}$ For any n

(4) $T \alpha R^{\frac{n}{2}+1}$

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