CAREER POINT

FACULTY SELECTION TEST

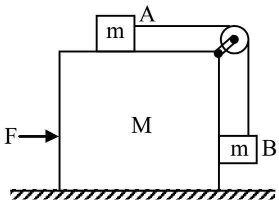
PHYSICS

[Time : 1 Hr.] **[Max. Marks : 120]**

INSTRUCTIONS :

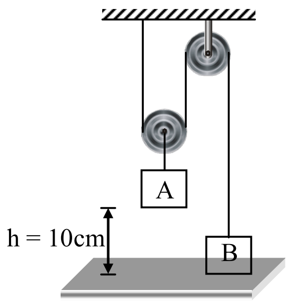
1. Attempt all questions.
2. Indicate your answer on the question paper itself.
3. Each question has four options. Out of these only one is the correct answer.
4. Each correct answer carries +4 marks. for each wrong answer 1 marks will be deducted.

Q.1 The horizontal surface below the bigger block is smooth. The coefficient of friction between the blocks is μ. The maximum force which can be applied to keep the smaller blocks at rest with respect to the bigger block is



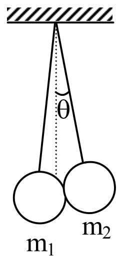
(1) $\left(\frac{1-\mu}{1+\mu}\right)(M+2m)g$ (2) $\left(\frac{1+\mu}{1-\mu}\right)(M+m)g$ (3) $\left(\frac{1+\mu}{1-\mu}\right)(M+2m)g$ (4) $(1+\mu)(M+2m)g$

Q.2 In the arrangement shown in figure the mass of two blocks *A* and *B* are 6 kg and 2 kg respectively. The height *h* = 10 cm. All the pulleys and threads are massless and frictionless. When the system is released from the instant shown, then the maximum height reached by block *B* is (g = 10 m/sec^2) –



(1) 20 cm (2) 25.7 cm (3) 30 cm (4) 35.2 cm

Q.3 Two spherical objects each of radii R and masses m_1 and m_2 are suspended using two strings of equal length L as shown in the figure (R << L). The angle, θ which mass m_2 makes with the vertical is approximately -

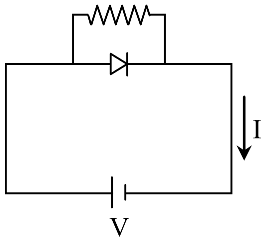


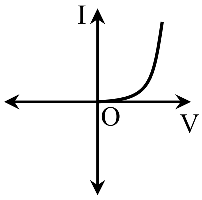
(1) $\frac{m_1R}{(m_1+m_2)L}$ (2) $\frac{m_2R}{(m_1+m_2)L}$ (3) $\frac{2m_2R}{(m_1+m_2)L}$ (4) $\frac{2m_1R}{(m_1+m_2)L}$

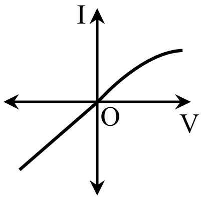
Q.4 An ideal choke takes a current of 10 amp when connected to an *AC* supply of 125 volt and 50 Hz. A pure resistor under the same conditions takes a current of 12.5 amp. If the two are connected to an *AC* supply of $100\sqrt{2}$ volt and 40 Hz, then the current in series combination of above resistor and inductor is :

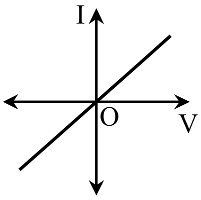
(1) 10 amp (2) 12.5 amp (3) 20 amp (4) 25 amp

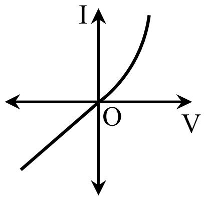
Q.5 For a diode connected in parallel with a resistor, which is the most likely current (I) – voltage (V) characteristic ?



(1) 

(2) 

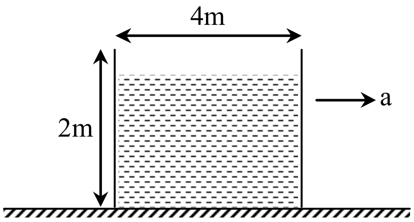
(3) 

(4) 

Q.6 Two spheres of different materials one with double the radius and one-fourth wall thickness of the other, are filled with ice. If the time taken for complete melting of ice in the large sphere is 25 minutes and that for smaller one is 16 minutes, the ratio of thermal conductivities of the materials of larger sphere to that of smaller sphere is –

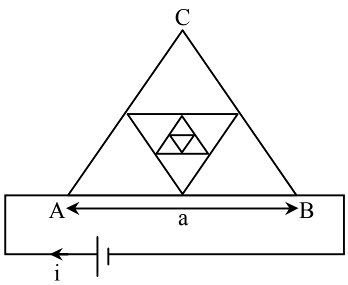
(1) 4 : 5 (2) 5 : 4 (3) 25 : 8 (4) 8 : 25

Q.7 A container of dimension 4m × 3m × 2m starts to move with uniform acceleration a = 1.25 m/s^2 at t = 0. The volume of liquid in vessel is 18 m^3. The speed of liquid coming out from a very small orifice made at bottom of right side wall at t = 4 sec, is - (Assume water will not come out before t = 4 sec.)



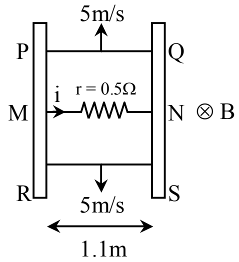
(1) zero (2) $\sqrt{30}$ m/sec (3) 5m/s (4) 10 m/s

Q.8 The frame ABC is in the form of equilateral triangle and the number of successively embedded equilateral triangle (with sides decreasing by half) tends to infinity if side of ABC is 'a' and resistance per unit length is 'r' find 'i' -



(1) $\frac{E}{ar}$ (2) $\frac{(2\sqrt{3}+1)E}{ar}$ (3) $\frac{(\sqrt{7}+1)E}{2ar}$ (4) zero

Q.9 Wires PQ and RS are free to slide on fixed rails separated by 1.1 m with constant velocity. If resistance of wires PQ and RS 1.5Ω and 1Ω respectively. If B = 2 tesla and r = 0.5 Ω then find current i = ?



(1) zero (2) 1A from M to N (3) 2A from N to M (4) None of these

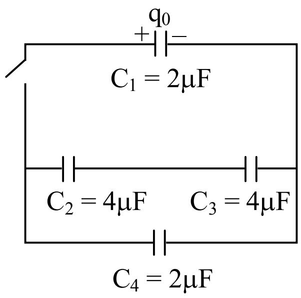
Q.10 A thin glass plate of thickness 0.2 μm and refractive index μ = 1.5 is placed just after upper slit in a young double slit experiment the intensity at the centre of the screen is I. What was the intensity at the same point prior to the introduction of the sheet ? (The wave length of light is 6000 Å) -

(1) I (2) I/2 (3) 4I/3 (4) 5I/4

Q.11 A close organ pipe of diameter 10 cm has length 42 cm. The air column in pipe vibrates in its second overtone with maximum amplitude ΔP_0. The pressure amplitude at middle of pipe is -

(1) ΔP_0 (2) $\frac{\Delta P_0}{\sqrt{2}}$ (3) $\frac{\sqrt{3}.\Delta P_0}{2}$ (4) None of these

Q.12 Initially charge on C_1 is q_0 and all other capacitors are uncharged. If switch is closed at $t = 0$, then the charge on C_4 after long time of closing the switch is -

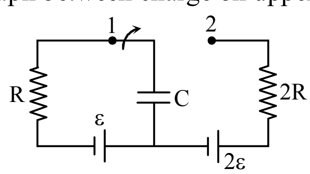


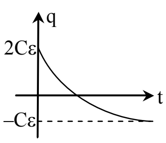
(1) q_0 (2) $\frac{q_0}{2}$ (3) $\frac{q_0}{3}$ (4) $\frac{q_0}{4}$

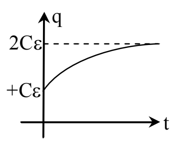
Q.13 A ring of radius 0.1 m is made out of a thin metallic wire of area of cross-section $10^{-6}m^2$. the ring has a uniform charge of π coulomb. Find change in the radius of the ring when a charge of 10^{-8} coulomb is placed at the centre of the ring. Young's modulus of the metal is 2×10^{11} N/m^2

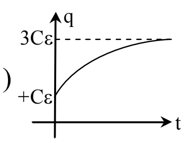
(1) 2.25×10^{-3}m (2) 0.225 m (3) 9×10^{-3} m (4) 5.0×10^{-2} m

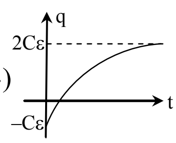
Q.14 In the circuit shown in figure, the switch is shifted from position 1 to 2 at t = 0. The switch was initially in position 1 since a long time. The graph between charge on upper plate of capacitor versus time –



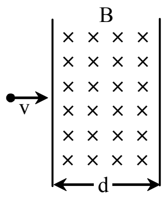
(1)


(2)


(3)


(4)


Q.15 A particle having charge to mass ratio $\frac{q}{m} = k$ is projected in a magnetic field B with a speed v = 2kBd as shown in figure, where d is the width of the region in which magnetic field is present. For this situation, mark the **incorrect** statement.



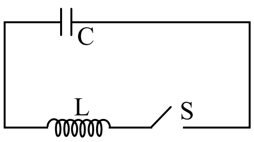
(1) Particle remains in the magnetic field for a time of $\frac{\pi}{6kB}$

(2) It travels a distance of $\frac{\pi d}{3}$ in the magnetic field

(3) The angle of deviation from its initial direction is 30º

(4) The displacement of particle in magnetic field is 2d sin 15º

Q.16 In the given circuit, initially the charge on capacitor is Q_0. At t = 0, the switch is closed. Which of the following statements are *wrong*



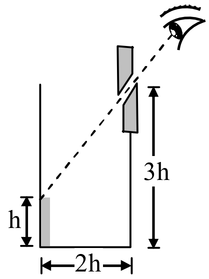
(1) Maximum current through inductor is $\frac{Q_0}{\sqrt{LC}}$

(2) Charge on capacitor is zero at $t = \frac{\pi}{2}\sqrt{LC}$

(3) Current through inductor is zero $t = \frac{\pi}{2}\sqrt{LC}$

(4) Maximum magnetic energy can be stored in the inductor is $\frac{Q_0^2}{2C}$

Q.17 An observer can see through a pin-hole the top end of a thin rod of height h, placed as shown in the figure. The beaker height is 3h and its radius h. When the beaker is filled with a liquid upto a height 2h, he can see the lower end of the rod. Then, the refractive index of the liquid is



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

Q.18 A stream of α-particle is incident on a sample of hydrogen gas. What should be the minimum kinetic energy of α-particles to ionize the hydrogen atoms -

(1) 68 eV
(2) 48 eV
(3) 58 eV
(4) None of these

Q.19 ${}_0^1n + {}_2^5X \rightarrow {}_1^2A + {}_2^4B$

A neutron of kinetic energy k_n strike with the stationary ${}_2^5X$ nuclei it is found that nuclei ${}_1^2A$ moves perpendicular to the direction of motion of neutron with kinetic energy $2k_n$ then find out the Q value of the nuclear reaction

(1) $\frac{9k_n}{4}$
(2) $\frac{7k_n}{4}$
(3) $\frac{5k_n}{4}$
(4) none of these

Q.20 The pitch of a screw gauge is 1 mm and there are 100 divisions on the circular scale. While measuring the diameter of a wire, the linear scale reads 1 mm & 47^{th} division on the circular scale coincides with the reference line. The length of the wire is 5.6 cm. The curved surface area (in cm^2) of the wire in appropriate number of significant figures – (use the value of $\pi = 3.14$)

(1) 2.58
(2) 2.584
(3) 2.6
(4) 2.7

Q.21 A particle is projected vertically upwards from O with velocity 'v' and a second particle is projected at the same instant from P (at a height h above O) with velocity 'v' at an angle of projection θ with horizontal. The time when the distance between them is minimum is – (Assume both in flying.)

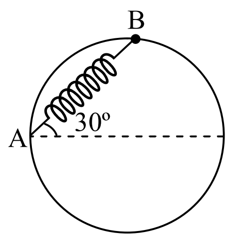
(1) $\frac{h}{2v\sin\theta}$
(2) $\frac{h}{2v\cos\theta}$
(3) $\frac{h}{v}$
(4) $\frac{h}{2v}$

Q.22 A particle moves in xy-plane. The position vector of particle at any time 't' is $\vec{r} = \{(2t)\hat{i} + (2t^2)\hat{j}\}$ m. The rate of change of θ at time t = 2 second. (where θ is the angle which its velocity vector makes with positive x-axis) is -

(1) $\frac{2}{17}$ rad/s
(2) $\frac{1}{14}$ rad/s
(3) $\frac{4}{7}$ rad/s
(4) $\frac{6}{5}$ rad/s

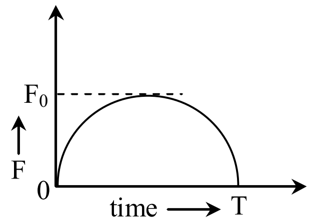
Q.23 A bead of mass 'm' is attached to one end of a spring of natural length R and spring constant $k = \frac{(\sqrt{3}+1)mg}{R}$.

The other end of the spring is fixed at point A on a smooth vertical ring of radius R as shown. The normal reaction at B just after it is released to move is -



(1) $\sqrt{3}mg$
(2) $3\sqrt{3}mg$
(3) $\frac{mg}{2}$
(4) $\frac{3\sqrt{3}mg}{2}$

Q.24 A particle of mass m, initially at rest, is acted upon by a variable force F for a brief interval of time T. It begins to move with a velocity 'u' after the force stops acting. F is shown in the graph as a function of time. The curve is a semicircle, then -



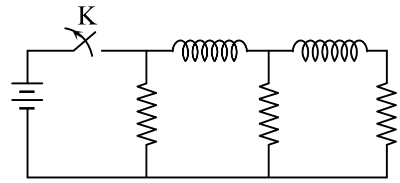
(1) $u = \frac{\pi F_0^2}{2m}$ (2) $u = \frac{\pi T^2}{8m}$ (3) $u = \frac{\pi F_0 T}{4m}$ (4) $u = \frac{F_0 T}{2m}$

Q.25 The moments of inertia of a non-uniform circular disc (of mass M and radius R) about four mutually perpendicular tangents AB, BC, CD, DA are I_1, I_2, I_3 and I_4, respectively (the square ABCD circumscribes the circle). The distance of the center of mass of the disc from its geometrical center is given by -

(1) $\frac{1}{4MR}\sqrt{(I_1 - I_3)^2 + (I_2 - I_4)^2}$ (2) $\frac{1}{12MR}\sqrt{(I_1 - I_3)^2 + (I_2 - I_4)^2}$

(3) $\frac{1}{3MR}\sqrt{(I_1 - I_2)^2 + (I_3 - I_4)^2}$ (4) $\frac{1}{2MR}\sqrt{(I_1 + I_3)^2 + (I_2 + I_4)^2}$

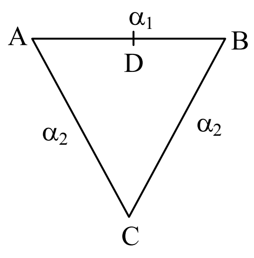
Q.26 In the circuit shown below, all the inductors (assumed ideal) and resistors are identical. The current through the resistance on the right is I after the key K has been switched on for along time. The currents through the three resistors (in order, from left to right) immediately after the key is switched off are -



(1) 2I downwards, I downwards and I downwards (2) 2I upwards, I downwards and I downwards
(3) I downwards, I downwards and I downwards (4) 0, I downwards and I downwards

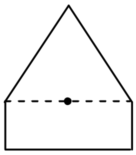
Q.27 If C_p and C_v denote the specific heat of nitrogen per unit mass at constant pressure and constant volume respectively, then -
(1) $C_p - C_v = 28$ R (2) $C_p - C_v = R/28$ (3) $C_p - C_v = R/14$ (4) $C_p - C_v = R$

Q.28 Three rods of equal length are joined to form an equilateral triangle ABC. D is the mid point of AB. Coefficient of linear expansion is α_1 for AB and α_2 for AC and BC. If distance DC remain constant for small change in temperature, then



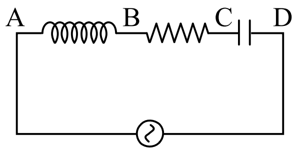
(1) $\alpha_1 = \alpha_2$ (2) $\alpha_1 = 2\alpha_2$ (3) $\alpha_1 = 4\alpha_2$ (4) $\alpha_1 = \alpha_2/2$

Q.29 Two uniform plates of the same thickness and area but of different materials, one shaped like an isosceles triangle and the other shaped like a rectangle are joined together to form a composite body as shown in the figure. If the centre of mass of the composite body is located at the midpoint of their common side, the ratio between masses of the triangle to that of the rectangle is -



(1) 1 : 1
(2) 4 : 3
(3) 3 : 4
(4) 2 : 1

Q.30 An ac voltmeter connected between points A and B in the circuit below reads 36 V. If it is connected between A and C, the reading is 39 V. The reading when it is connected between B and D is 25 V. What will the voltmeter read when it is connected between A and D ? (Assume that the voltmeter reads true rms voltage values and that the source generates a pure ac)



(1) $\sqrt{481}$ V
(2) 31V
(3) 61 V
(4) $\sqrt{3361}$ V