

TEST PAPER OF JEE(MAIN) EXAMINATION – 2019
(Held On Friday 11th JANUARY, 2019) TIME : 02 : 30 PM To 05 : 30 PM
PHYSICS

1. A paramagnetic substance in the form of a cube with sides 1 cm has a magnetic dipole moment of 20×10^{-6} J/T when a magnetic intensity of 60×10^3 A/m is applied. Its magnetic susceptibility is :-

- (1) 2.3×10^{-2} (2) 3.3×10^{-2}
(3) 3.3×10^{-4} (4) 4.3×10^{-2}

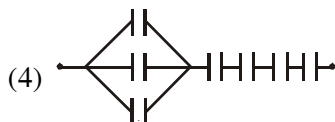
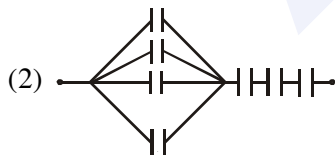
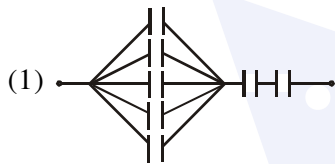
Ans. (3)

2. A particle of mass m is moving in a straight line with momentum p . Starting at time $t = 0$, a force $F = kt$ acts in the same direction on the moving particle during time interval T so that its momentum changes from p to $3p$. Here k is a constant. The value of T is :-

- (1) $2\sqrt{\frac{p}{k}}$ (2) $\sqrt{\frac{2p}{k}}$ (3) $\sqrt{\frac{2k}{p}}$ (4) $2\sqrt{\frac{k}{p}}$

Ans. (1)

3. Seven capacitors, each of capacitance $2 \mu\text{F}$, are to be connected in a configuration to obtain an effective capacitance of $\left(\frac{6}{13}\right) \mu\text{F}$. Which of the combinations, shown in figures below, will achieve the desired value ?



Ans. (4)

4. An electric field of 1000 V/m is applied to an electric dipole at angle of 45° . The value of electric dipole moment is 10^{-29} C.m. What is the potential energy of the electric dipole ?

- (1) -9×10^{-20} J
(2) -7×10^{-27} J
(3) -10×10^{-29} J
(4) -20×10^{-18} J

Ans. (2)

5. A simple pendulum of length 1 m is oscillating with an angular frequency 10 rad/s. The support of the pendulum starts oscillating up and down with a small angular frequency of 1 rad/s and an amplitude of 10^{-2} m. The relative change in the angular frequency of the pendulum is best given by :-

- (1) 10^{-3} rad/s
(2) 10^{-1} rad/s
(3) 1 rad/s
(4) 10^{-5} rad/s

Ans. (1)

6. Two rods A and B of identical dimensions are at temperature 30°C . If A is heated upto 180°C and B upto $T^\circ\text{C}$, then the new lengths are the same. If the ratio of the coefficients of linear expansion of A and B is 4 : 3, then the value of T is :-

- (1) 270°C (2) 230°C
(3) 250°C (4) 200°C

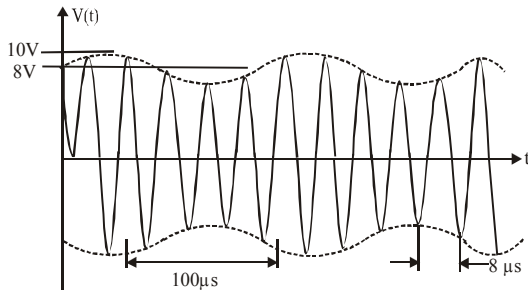
Ans. (2)

7. In a double-slit experiment, green light (5303 \AA) falls on a double slit having a separation of $19.44 \mu\text{m}$ and a width of $4.05 \mu\text{m}$. The number of bright fringes between the first and the second diffraction minima is :-

- (1) 09 (2) 10
(3) 04 (4) 05

Ans. (4)

8. An amplitude modulated signal is plotted below :-

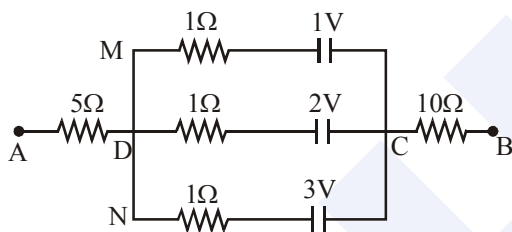


Which one of the following best describes the above signal ?

- (1) $(9 + \sin(2.5\pi \times 10^5 t)) \sin(2\pi \times 10^4 t)V$
- (2) $(9 + \sin(4\pi \times 10^4 t)) \sin(5\pi \times 10^5 t)V$
- (3) $(1 + 9\sin(2\pi \times 10^4 t)) \sin(2.5\pi \times 10^5 t)V$
- (4) $(9 + \sin(2\pi \times 10^4 t)) \sin(2.5\pi \times 10^5 t)V$

Ans. (4)

9. In the circuit, the potential difference between A and B is :-



- (1) 6 V (2) 1 V (3) 3 V (4) 2 V

Ans. (4)

10. A 27 mW laser beam has a cross-sectional area of 10 mm^2 . The magnitude of the maximum electric field in this electromagnetic wave is given by [Given permittivity of space $\epsilon_0 = 9 \times 10^{-12} \text{ SI units}$, Speed of light $c = 3 \times 10^8 \text{ m/s}$:-

- (1) 1 kV/m (2) 2 kV/m
- (3) 1.4 kV/m (4) 0.7 kV/m

Ans. (3)

11. A pendulum is executing simple harmonic motion and its maximum kinetic energy is K_1 . If the length of the pendulum is doubled and it performs simple harmonic motion with the same amplitude as in the first case, its maximum kinetic energy is K_2 . Then :-

- (1) $K_2 = \frac{K_1}{4}$ (2) $K_2 = \frac{K_1}{2}$
- (3) $K_2 = 2K_1$ (4) $K_2 = K_1$

Ans. (3)

12. In a hydrogen like atom, when an electron jumps from the M - shell to the L - shell, the wavelength of emitted radiation is λ . If an electron jumps from N-shell to the L-shell, the wavelength of emitted radiation will be :-

- (1) $\frac{27}{20}\lambda$ (2) $\frac{16}{25}\lambda$ (3) $\frac{20}{27}\lambda$ (4) $\frac{25}{16}\lambda$

Ans. (3)

13. If speed (V), acceleration (A) and force (F) are considered as fundamental units, the dimension of Young's modulus will be :-

- (1) $V^{-2} A^2 F^2$ (2) $V^{-4} A^2 F$
- (3) $V^{-4} A^{-2} F$ (4) $V^{-2} A^2 F^{-2}$

Ans. (2)

14. A particle moves from the point $(2.0\hat{i} + 4.0\hat{j}) \text{ m}$, at $t = 0$, with an initial velocity $(5.0\hat{i} + 4.0\hat{j}) \text{ ms}^{-1}$.

It is acted upon by a constant force which produces a constant acceleration $(4.0\hat{i} + 4.0\hat{j}) \text{ ms}^{-2}$. What is the distance of the particle from the origin at time 2 s ?

- (1) $20\sqrt{2} \text{ m}$ (2) $10\sqrt{2} \text{ m}$
- (3) 5 m (4) 15 m

Ans. (1)

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15. A monochromatic light is incident at a certain angle on an equilateral triangular prism and suffers minimum deviation. If the refractive index of the material of the prism is $\sqrt{3}$, then the angle of incidence is :-

- (1) 30° (2) 45°
(3) 90° (4) 60°

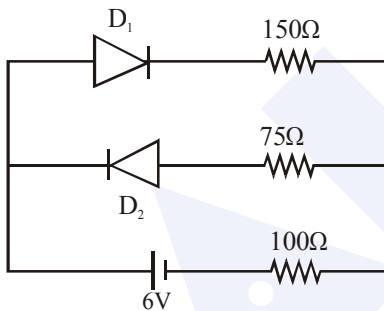
Ans. (4)

16. A galvanometer having a resistance of $20\ \Omega$ and 30 divisions on both sides has figure of merit 0.005 ampere/division. The resistance that should be connected in series such that it can be used as a voltmeter upto 15 volt, is :-

- (1) $80\ \Omega$ (2) $120\ \Omega$
(3) $125\ \Omega$ (4) $100\ \Omega$

Ans. (1)

17. The circuit shown below contains two ideal diodes, each with a forward resistance of $50\ \Omega$. If the battery voltage is 6 V, the current through the $100\ \Omega$ resistance (in Amperes) is :-



- (1) 0.027 (2) 0.020
(3) 0.030 (4) 0.036

Ans. (2)

18. When 100 g of a liquid A at 100°C is added to 50 g of a liquid B at temperature 75°C , the temperature of the mixture becomes 90°C . The temperature of the mixture, if 100 g of liquid A at 100°C is added to 50 g of liquid B at 50°C , will be :-

- (1) 80°C (2) 60°C
(3) 70°C (4) 85°C

Ans. (1)

19. The mass and the diameter of a planet are three times the respective values for the Earth. The period of oscillation of a simple pendulum on the Earth is 2s. The period of oscillation of the same pendulum on the planet would be :-

- (1) $\frac{2}{\sqrt{3}}\text{s}$ (2) $2\sqrt{3}\text{s}$
(3) $\frac{\sqrt{3}}{2}\text{s}$ (4) $\frac{3}{2}\text{s}$

Ans. (2)

20. The region between $y = 0$ and $y = d$ contains a magnetic field $\vec{B} = B\hat{z}$. A particle of mass m and charge q enters the region with a velocity

$\vec{v} = v\hat{i}$. If $d = \frac{mv}{2qB}$, the acceleration of the

charged particle at the point of its emergence at the other side is :-

- (1) $\frac{qvB}{m} \left(\frac{\hat{i} + \hat{j}}{\sqrt{2}} \right)$
(2) $\frac{qvB}{m} \left(\frac{1}{2}\hat{i} - \frac{\sqrt{3}}{\sqrt{2}}\hat{j} \right)$
(3) $\frac{qvB}{m} \left(\frac{-\hat{j} + \hat{i}}{\sqrt{2}} \right)$
(4) $\frac{qvB}{m} \left(\frac{\sqrt{3}}{2}\hat{i} + \frac{1}{2}\hat{j} \right)$

Ans. (BONUS)

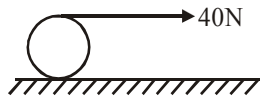
21. A thermometer graduated according to a linear scale reads a value x_0 when in contact with boiling water, and $x_0/3$ when in contact with ice.

What is the temperature of an object in 0°C , if this thermometer in the contact with the object reads $x_0/2$?

- (1) 35 (2) 25
(3) 60 (4) 40

Ans. (2)

22. A string is wound around a hollow cylinder of mass 5 kg and radius 0.5 m. If the string is now pulled with a horizontal force of 40 N, and the cylinder is rolling without slipping on a horizontal surface (see figure), then the angular acceleration of the cylinder will be (Neglect the mass and thickness of the string) :-



- (1) 12 rad/s²
(2) 16 rad/s²
(3) 10 rad/s²
(4) 20 rad/s²

Ans. (2)

23. In a process, temperature and volume of one mole of an ideal monoatomic gas are varied according to the relation $VT = K$, where K is a constant. In this process the temperature of the gas is increased by ΔT . The amount of heat absorbed by gas is (R is gas constant) :

- (1) $\frac{1}{2}R\Delta T$
(2) $\frac{3}{2}R\Delta T$
(3) $\frac{1}{2}KR\Delta T$
(4) $\frac{2K}{3}\Delta T$

Ans. (1)

24. In a photoelectric experiment, the wavelength of the light incident on a metal is changed from 300 nm to 400 nm. The decrease in the stopping

potential is close to : $\left(\frac{hc}{e} = 1240 \text{ nm} - V \right)$

- (1) 0.5 V (2) 1.0 V
(3) 2.0 V (4) 1.5 V

Ans. (2)

25. A metal ball of mass 0.1 kg is heated upto 500°C and dropped into a vessel of heat capacity 800 JK⁻¹ and containing 0.5 kg water. The initial temperature of water and vessel is 30°C. What is the approximate percentage increment in the temperature of the water ? [Specific Heat Capacities of water and metal are, respectively, 4200 Jkg⁻¹K⁻¹ and 400 Jkg⁻¹K⁻¹]

- (1) 30%
(2) 20%
(3) 25%
(4) 15%

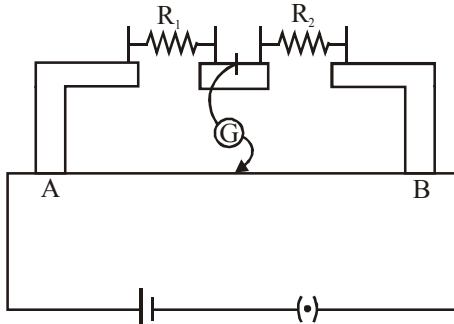
Ans. (2)

26. The magnitude of torque on a particle of mass 1kg is 2.5 Nm about the origin. If the force acting on it is 1 N, and the distance of the particle from the origin is 5m, the angle between the force and the position vector is (in radians) :-

- (1) $\frac{\pi}{8}$
(2) $\frac{\pi}{6}$
(3) $\frac{\pi}{4}$
(4) $\frac{\pi}{3}$

Ans. (2)

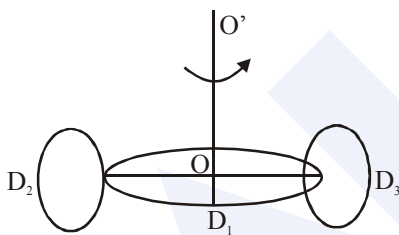
27. In the experimental set up of metre bridge shown in the figure, the null point is obtained at a distance of 40 cm from A. If a 10Ω resistor is connected in series with R_1 , the null point shifts by 10 cm. The resistance that should be connected in parallel with $(R_1 + 10)\Omega$ such that the null point shifts back to its initial position is



- (1) 40Ω (2) 60Ω (3) 20Ω (4) 30Ω

Ans. (2)

28. A circular disc D_1 of mass M and radius R has two identical discs D_2 and D_3 of the same mass M and radius R attached rigidly at its opposite ends (see figure). The moment of inertia of the system about the axis OO' , passing through the centre of D_1 , as shown in the figure, will be:-



- (1) $3MR^2$ (2) $\frac{2}{3}MR^2$
(3) MR^2 (4) $\frac{4}{5}MR^2$

Ans. (1)

29. A copper wire is wound on a wooden frame, whose shape is that of an equilateral triangle. If the linear dimension of each side of the frame is increased by a factor of 3, keeping the number of turns of the coil per unit length of the frame the same, then the self inductance of the coil :

- (1) Decreases by a factor of $9\sqrt{3}$
(2) Increases by a factor of 3
(3) Decreases by a factor of 9
(4) Increases by a factor of 27

Ans. (2)

30. A particle of mass m and charge q is in an electric and magnetic field given by

$$\vec{E} = 2\hat{i} + 3\hat{j} ; \vec{B} = 4\hat{j} + 6\hat{k}.$$

The charged particle is shifted from the origin to the point $P(x = 1 ; y = 1)$ along a straight path. The magnitude of the total work done is :-

- (1) $(0.35)q$
(2) $(0.15)q$
(3) $(2.5)q$
(4) $5q$

Ans. (4)

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