

JEE Main 2024 April 9 Shift 2 Physics Question Paper

Time Allowed :1 Hour	Maximum Marks :100	Total Questions :30
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General Instructions

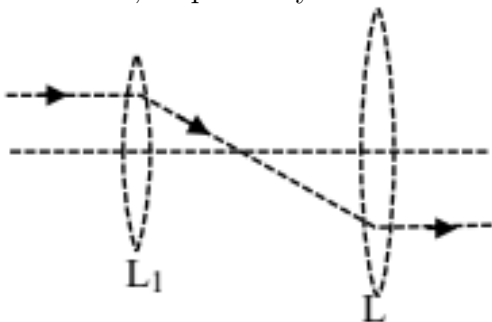
Read the following instructions very carefully and strictly follow them:

1. The test is of 3 hours duration.
2. The question paper consists of 90 questions. The maximum marks are 300.
3. There are three parts in the question paper consisting of Physics, Chemistry and Mathematics having 30 questions in each part of equal weightage.
4. Each part (subject) has two sections.
 - (i) Section-A: This section contains 20 multiple choice questions which have only one correct answer. Each question carries 4 marks for correct answer and -1 mark for wrong answer.
 - (ii) Section-B: This section contains 10 questions. In Section-B, attempt any five questions out of 10. The answer to each of the questions is a numerical value. Each question carries 4 marks for correct answer and -1 mark for wrong answer. For Section-B, the answer should be rounded off to the nearest integer.

1. A nucleus at rest disintegrates into two smaller nuclei with their masses in the ratio 2:1. After disintegration, they will move:

- (1) In opposite directions with speed in the ratio of 1:2 respectively
- (2) In opposite directions with speed in the ratio of 2:1 respectively
- (3) In the same direction with the same speed
- (4) In opposite directions with the same speed

2. The following figure represents two biconvex lenses L_1 and L_2 having focal lengths 10 cm and 15 cm, respectively. The distance between L_1 and L_2 is:



- (1) 10 cm
- (2) 15 cm
- (3) 25 cm
- (4) 35 cm

3. The temperature of a gas is -78°C , and the average translational kinetic energy of its molecules is K . The temperature at which the average translational kinetic energy of the molecules of the same gas becomes $2K$ is:

- (1) -39°C
- (2) 117°C
- (3) 127°C
- (4) -78°C

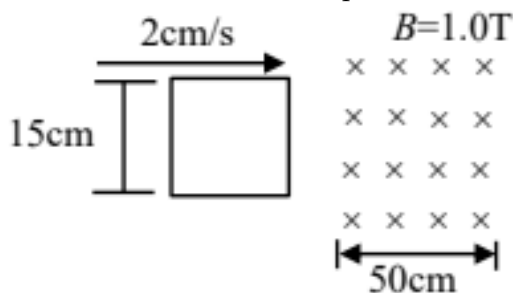
4. A hydrogen atom in ground state is given an energy of 10.2 eV. How many spectral lines will be emitted due to the transition of electrons?

- (1) 6
- (2) 3
- (3) 10
- (4) 1

5. The magnetic field in a plane electromagnetic wave is $B_y = (3.5 \times 10^{-7}) \sin(1.5 \times 10^3 x + 0.5 \times 10^{11} t)$ T. The corresponding electric field will be:

- (1) $E_y = 1.17 \sin(1.5 \times 10^3 x + 0.5 \times 10^{11} t)$ V/m
- (2) $E_z = 105 \sin(1.5 \times 10^3 x + 0.5 \times 10^{11} t)$ V/m
- (3) $E_z = 1.17 \sin(1.5 \times 10^3 x + 0.5 \times 10^{11} t)$ V/m
- (4) $E_y = 10.5 \sin(1.5 \times 10^3 x + 0.5 \times 10^{11} t)$ V/m

6. A square loop of side 15 cm is being moved towards right at a constant speed of 2 cm/s, as shown in the figure. The front edge enters the 50 cm wide magnetic field at $t = 0$. The value of induced emf in the loop at $t = 10$ s will be:

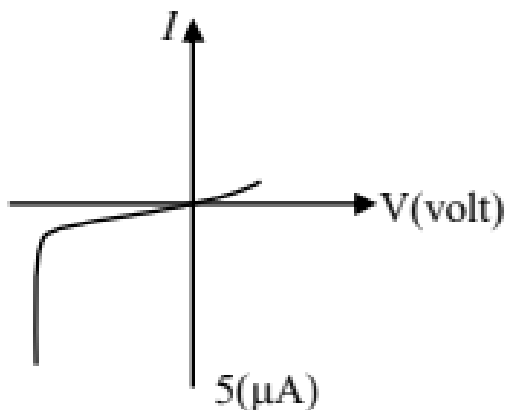


- (1) 0.3 mV
- (2) 4.5 mV
- (3) zero
- (4) 3 mV

7. Two cars are travelling towards each other at a speed of 20 m/s each. When the cars are 300 m apart, both drivers apply brakes, and the cars retard at the rate of 2 m/s^2 . The distance between them when they come to rest is:

- (1) 200 m
- (2) 50 m
- (3) 100 m
- (4) 25 m

8. The I-V characteristics of an electronic device shown in the figure. The device is:



- (1) Solar cell
- (2) Transistor which can be used as an amplifier
- (3) Zener diode which can be used as a voltage regulator
- (4) Diode which can be used as a rectifier

9. The excess pressure inside a soap bubble is three times the excess pressure inside a second soap bubble. The ratio between the volume of the first and the second bubble is:

- (1) 1 : 9
- (2) 1 : 3
- (3) 1 : 81
- (4) 1 : 27

10. The de-Broglie wavelength associated with a particle of mass m and energy E is $\lambda = \frac{h}{\sqrt{2mE}}$. The dimensional formula for Planck's constant is:

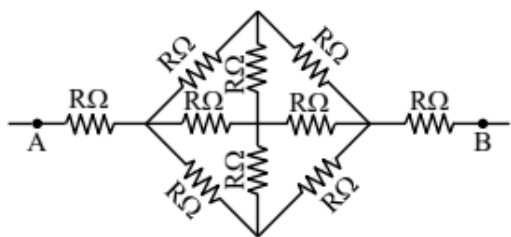
- (1) $[ML^{-1}T^{-2}]$
- (2) $[ML^2T^{-1}]$
- (3) $[MLT^{-2}]$
- (4) $[ML^2T^{-2}]$

11. A satellite of 10^3 kg mass is revolving in a circular orbit of radius $2R$. If $\frac{10^4 R}{6}$ joules of energy is supplied to the satellite, it would revolve in a new circular orbit of radius:

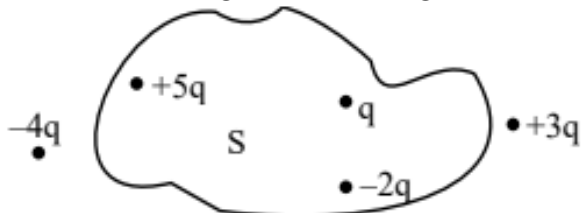
- (1) $2.5R$
- (2) $3R$
- (3) $4R$
- (4) $6R$

12. The effective resistance between A and B , if the resistance of each resistor is R , will be:

- (1) $\frac{2}{5}R$
- (2) $\frac{8}{3}R$
- (3) $\frac{5}{3}R$
- (4) $\frac{2}{3}R$



13. Five charges $+q, +5q, -2q, +3q, -4q$ are situated as shown in the figure. The electric flux due to this configuration through the surface S is:



- (1) $\frac{5q}{\epsilon_0}$
- (2) $\frac{4q}{\epsilon_0}$
- (3) $\frac{3q}{\epsilon_0}$
- (4) $\frac{q}{\epsilon_0}$

14. A proton and a deuteron ($q = +e, m = 2.0u$) having the same kinetic energies enter a region of uniform magnetic field $\vec{B}$, moving perpendicular to $\vec{B}$. The ratio of the radius r_d of the deuteron path to the radius r_p of the proton path is:

- (1) 1 : 1
- (2) 1 : $\sqrt{2}$
- (3) $\sqrt{2}$: 1
- (4) 1 : 2

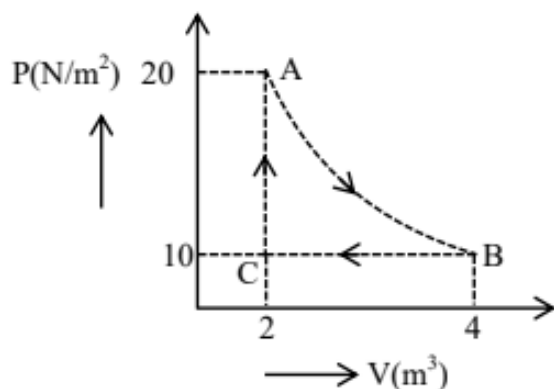
15. UV light of 4.13 eV is incident on a photosensitive metal surface having a work function of 3.13 eV. The maximum kinetic energy of the ejected photoelectrons will be:

- (1) 4.13 eV
- (2) 1 eV
- (3) 3.13 eV
- (4) 7.26 eV

16. The energy released in the fusion of 2 kg of hydrogen deep in the sun is E_H and the energy released in the fission of 2 kg of ^{235}U is E_U . The ratio $\frac{E_H}{E_U}$ is approximately:

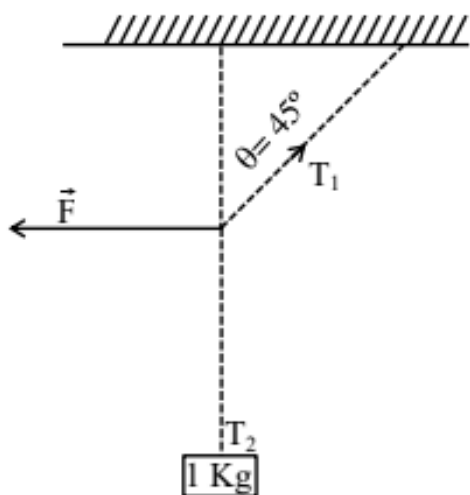
- (1) 9.13
- (2) 15.04
- (3) 7.62
- (4) 25.6

17. A real gas within a closed chamber at 27°C undergoes the cyclic process as shown in the figure. The gas obeys the $PV^3 = RT$ equation for the path A to B . The net work done in the complete cycle is (assuming $R = 8 \text{ J/mol}\cdot\text{K}$):



- (1) 225 J
- (2) 205 J
- (3) 20 J
- (4) -20 J

18. A 1 kg mass is suspended from the ceiling by a rope of length 4 m. A horizontal force F is applied at the midpoint of the rope so that the rope makes an angle of 45° with respect to the vertical axis as shown in the figure. The magnitude of F is:

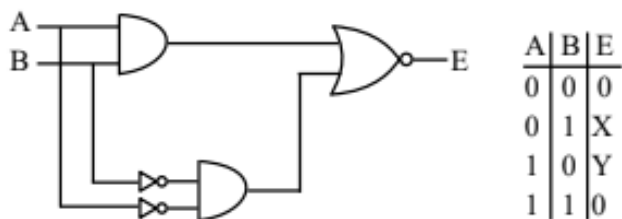


- (1) $\frac{10}{\sqrt{2}}$ N
- (2) 1 N
- (3) $\frac{1}{10 \times \sqrt{2}}$ N
- (4) 10 N

19. A spherical ball of radius 1×10^{-4} m and density 10^5 kg/m^3 falls freely under gravity through a distance h before entering a tank of water. If after entering the water the velocity of the ball does not change, then the value of h is approximately:

- (1) 2296 m
- (2) 2249 m
- (3) 2518 m
- (4) 2396 m

20. In the truth table of the above circuit, the value of X and Y are:



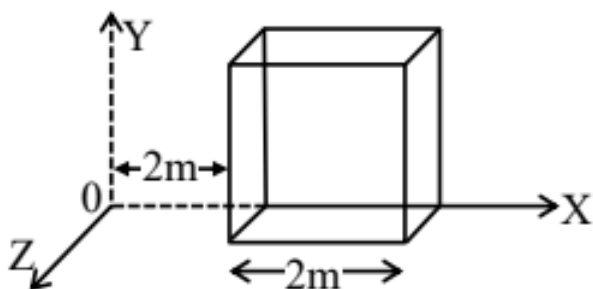
- (1) 1, 1
 (2) 1, 0
 (3) 0, 1
 (4) 0, 0

21. A straight magnetic strip has a magnetic moment of 44 Am^2 . If the strip is bent in a semicircular shape, its magnetic moment will be Am^2 .

22. A particle of mass 0.50 kg executes simple harmonic motion under force $F = -50 (\text{Nm}^{-1})x$. The time period of oscillation is $\frac{x}{35} \text{ s}$. The value of x is ...
 (Given $\pi = \frac{22}{7}$)

23. A capacitor of reactance $4\sqrt{3} \Omega$ and a resistor of resistance 4Ω are connected in series with an AC source of peak value $8\sqrt{2} \text{ V}$. The power dissipation in the circuit is ...

24. An electric field $\vec{E} = (2x)\hat{i} \text{ N/C}$ exists in space. A cube of side 2 m is placed in the space as shown. The electric flux through the cube is ...



25. A circular disc reaches from top to bottom of an inclined plane of length l . When it slips down, it takes $t \text{ s}$. When it rolls down, it takes $(\frac{\alpha}{2})^{1/2} t \text{ s}$, where α is ...

26. To determine the resistance (R) of a wire, a circuit is designed below. The V-I characteristic curve for this circuit is plotted for the voltmeter and the ammeter readings as shown in the figure. The value of R is ...

27. The resultant of two vectors $\vec{A}$ and $\vec{B}$ is perpendicular to $\vec{A}$ and its magnitude is half that

of $\vec{B}$. The angle between vectors $\vec{A}$ and $\vec{B}$ is ...

28. Monochromatic light of wavelength 500 nm is used in Young's double-slit experiment. An interference pattern is obtained on a screen. When one of the slits is covered with a very thin glass plate (refractive index $\mu = 1.5$), the central maximum is shifted to a position previously occupied by the 4th bright fringe. The thickness of the glass plate is ...

29. A force $(3x^2 + 2x - 5)$ N displaces a body from $x = 2$ m to $x = 4$ m. Work done by this force is J

30. At room temperature (27°C), the resistance of a heating element is $50\,\Omega$. The temperature coefficient of the material is $2.4 \times 10^{-4}\,^\circ\text{C}^{-1}$. The temperature of the element, when its resistance is $62\,\Omega$, is ...