JEE Main 2024 Physics Question Paper April 4 Shift 1

Time Allowed :3 Hours	Maximum Marks :300	Total Questions :90

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, out of which 75 are to attempted. 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

Physics

1. A metallic wire of uniform mass density having mass M and length L is bent to form a semicircle. A point mass m is kept at the centre of the semicircle. Find the gravitational force experienced by m.

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2. 5 convex lenses are kept together, each having a power of 25 D. Find the focal length.

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3. Position of a particle is related to time as given equation:

$$x = t^4 + 6t^2 + 2t$$

Find its acceleration at $t = 5$ sec.

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4. A body moving with constant acceleration covers 102.5 m in the nth second of its motion and covers 115.0 m in $(n+2)$th second then find its acceleration.

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5. A particle of mass m is dropped from height h above the ground. After collision, rises to height $h/2$, Then loss in energy during collision and speed of particle just before collision respectively are.

(1) 50%, $\sqrt{2gh}$
(2) 40%, $\sqrt{2gh}$
(3) 50%, $\sqrt{gh}$
(4) 40%, $\sqrt{gh}$

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6. If the electric field vector at a point in an electromagnetic wave is given by

$$\mathbf{E} = 40\cos\left(\frac{t-z}{c}\right)\hat{i} \quad \text{then corresponding} \mathbf{B} \text{ will be:}$$

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7. Infinite charge sheet in the xy-plane of surface charge density σ and infinite long wire of linear charge density λ placed at (0, 0, 4) and $\sigma = 2\,\mathrm{C/m^2}$. Then net electric field at (0, 0, 2).

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8. A hollow cylinder and solid sphere of same mass and radius are rolling with same initial velocity v on a rough inclined plane. Find the ratios of their kinetic energies and maximum height reached by them.

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9. In the given equation $y = 2A\sin\left(\frac{2\pi nt}{\lambda}\right)\cos\left(\frac{2\pi x}{\lambda}\right)$, find the dimension of n.

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10. When a conducting platinum wire is placed in ice, its resistance is 8 Ω and when placed in steam, it is 10 Ω. Find the resistance of the wire at 400°C.

11. Fractional error in image distance and object distance are

$$\frac{dv}{v} \quad \text{and} \quad \frac{du}{u}$$

Then find the fractional error in focal length of the given spherical mirror.

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12. Instantaneous current in a circuit is zero. In which of the options will voltage be maximum?
(a) L (b) R (c) C (d) LC

(1) ABD
(2) B
(3) BC
(4) D

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13. The x and y coordinates of a body performing some motion is given as:

$$x = 3 + 4t \quad \text{and} \quad y = 3t^2 + 4t$$

Identify the trajectory of motion.

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14. Choose the correct graph for kinetic energy vs r for an electron revolving around an infinite line of charge.

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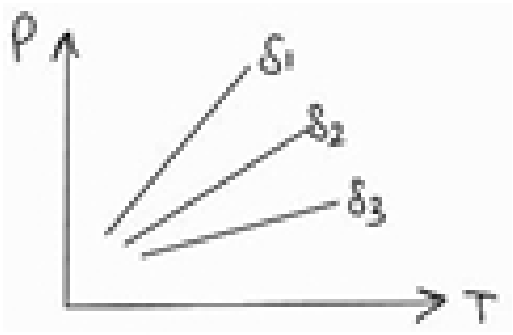
15. Pressure vs temperature graph is given for gas of different density. Compare ρ_1, ρ_2 and ρ_3?



16. Work done to expand the bubble of diameter 7 cm and surface tension 40 dyne/cm is 36960 erg. Find the radius of the expanded bubble.

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17. De-Broglie wavelength of electron moving from $n = 4$ to $n = 3$ of a hydrogen atom is $b\lambda$; where b is Bohr radius of the hydrogen atom. Find the value of b.

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18. An elastic string under tension of 3N has a length of a. If length is b, then tension is 2N. Find tension when length is $3a - 2b$.

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19. An electron projected inside the solenoid along its axis which carries constant current, then its trajectory would be: (a) Straight line (b) Circular (c) Helical (d) Parabolic

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20. Current as a function of time is given as $i = 6 + \sqrt{56}\sin\left(100t + \frac{\pi}{3}\right)$ A. Find rms value of current.

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21. In Celsius the temperature of a body increases by 40°C. The increasing temperature on the Fahrenheit scale is:

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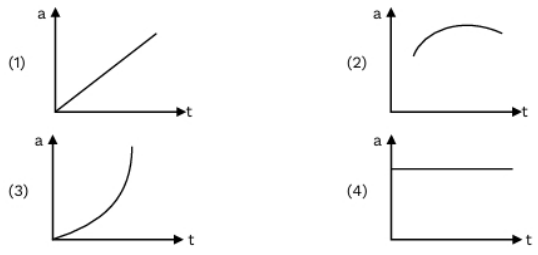
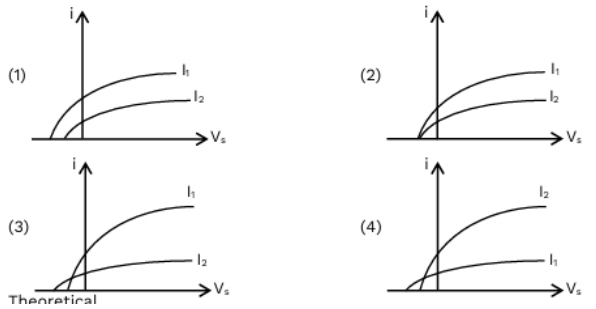
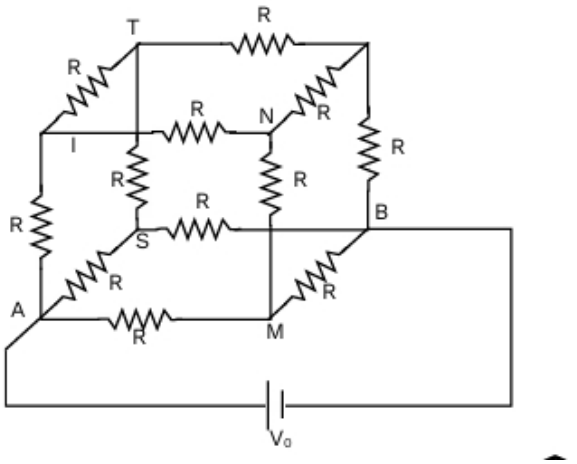
22. Force on a particle varies linearly with time ($F \propto t$). Then select the correct acceleration vs time graph.



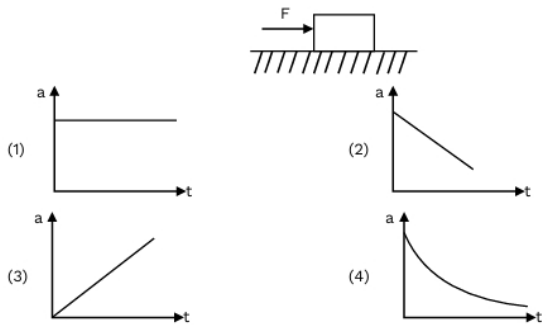
23. Which graph correctly represents the photo current (i) vs stopping potential (V_s) for the same frequency but different intensity? (Here $I_1 > I_2$)



24. A cubical arrangement of 12 resistors each having resistance R is shown. Find the current I in the given circuit.



25. A wooden block is initially at rest on a smooth surface. Now a horizontal force is applied on the block which increases linearly with time. The acceleration time ($a - t$) graph for the block would be:



26. Find $R_{\mathbf{eq}}$?