

JEE Main 2023 April 6 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. The temperature of an ideal gas is increased from 200 K to 800 K. If r.m.s. speed of gas at 200 K is v_0 , then r.m.s. speed of the gas at 800 K will be:

- (1) $4v_0$
- (2) $2v_0$
- (3) v_0
- (4) $v_0/4$

2. Given below are two statements: one is labelled as assertion A and the other is labelled as reason R.

Assertion A: The phase difference of two light wave change if they travel through different media having same thickness, but different indices of refraction.

Reason R: The wavelengths of waves are different in different media.

In the light of the above statements, choose the most appropriate answer from the options given below

- (1) Both A and R are correct and R is the correct explanation of A
- (2) A is not correct but R is correct
- (3) A is correct but R is not correct
- (4) Both A and R are correct but R is NOT the correct explanation of A

3. For an amplitude modulated wave the minimum amplitude is 3 V, while the modulation index is 60%. The maximum amplitude of the modulated wave is:

- (1) 10 V
 - (2) 12 V
 - (3) 15 V
 - (4) 5 V
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4. The ratio of speed of sound in hydrogen gas to the speed of sound in oxygen gas at the same temperature is:

- (1) 1 : 4
 - (2) 1 : 2
 - (3) 1 : 1
 - (4) 4 : 1
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5. A dipole comprises of two charged particles of identical magnitude q and opposite in nature. The mass m of the positive charged particle is half of the mass of the negative charged particle. The two charges are separated by a distance L . If the dipole is placed in a uniform electric field $\vec{E}$; in such a way that dipole axis makes a very small angle with the electric field, the angular frequency of the oscillations of the dipole when released is given by:

- (1) $\sqrt{\frac{4qE}{3ml}}$
 - (2) $\sqrt{\frac{8qE}{ml}}$
 - (3) $\sqrt{\frac{8qE}{3ml}}$
 - (4) $\sqrt{\frac{4qE}{ml}}$
-

6. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: When you squeeze one end of a tube to get toothpaste out from the other end, Pascal's principle is observed.

Reason R: A change in the pressure applied to an enclosed incompressible fluid is transmitted undiminished to every portion of the fluid and to the walls of its container.

In the light of the above statements, choose the most appropriate answer from the options given below

- (1) A is correct but R is not correct
 - (2) Both A and R are correct and R is the correct explanation of A
 - (3) A is not correct but R is correct
 - (4) Both A and R are correct but R is NOT the correct explanation of A
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7. A student is provided with a variable voltage source V , a test resistor $R_1 = 10\ \Omega$, two identical galvanometers G_1 and G_2 , and two additional resistors, $R_1 = 10\ M\Omega$ and $R_2 = 0.001\ \Omega$. For conducting an experiment to verify Ohm's law, the most suitable circuit is:

8. A body cools in 7 minutes from 60°C to 40°C . The temperature of the surrounding is 10°C . The temperature of the body after the next 7 minutes will be:

- (1) 30°C
 - (2) 34°C
 - (3) 32°C
 - (4) 28°C
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9. The energy density associated with the electric field $\vec{E}$ and magnetic field $\vec{B}$ of an electromagnetic wave in free space is given by (ϵ_0 - permittivity of free space, μ_0 - permeability of free space):

- (1) $U_E = \frac{\epsilon_0 E^2}{2}, \quad U_B = \frac{B^2}{2\mu_0}$
 - (2) $U_E = \frac{E^2}{2\epsilon_0}, \quad U_B = \frac{\mu_0 B^2}{2}$
 - (3) $U_E = \frac{E^2}{2\epsilon_0}, \quad U_B = \frac{B^2}{2\mu_0}$
 - (4) $U_E = \frac{\epsilon_0 E^2}{2}, \quad U_B = \frac{\mu_0 B^2}{2}$
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10. The weight of a body on the surface of the Earth is 100 N. The gravitational force on it when taken at a height, from the surface of the Earth, equal to one-fourth the radius of the Earth is:

- (1) 64 N
 - (2) 25 N
 - (3) 100 N
 - (4) 50 N
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11. A capacitor of capacitance $150.0\ \mu\text{F}$ is connected to an alternating source of emf given by $E = 36 \sin(120\pi t)\ \text{V}$. The maximum value of current in the circuit is approximately equal to:

- 1) $\sqrt{2}\ \text{A}$
 - 2) $2\sqrt{2}\ \text{A}$
 - 3) $\frac{1}{\sqrt{2}}\ \text{A}$
 - 4) $2\ \text{A}$
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12. A 2-meter-long scale with least count $0.2\ \text{cm}$ is used to measure the locations of objects on an optical bench. While measuring the focal length of a convex lens,

the object pin and the convex lens are placed at 80 cm and 1 m mark, respectively. The image of the object pin on the other side of the lens coincides with the image pin that is kept at 180 cm mark. The percentage error in the estimation of focal length is:

- 1) 0.51
 - 2) 1.02
 - 3) 0.85
 - 4) 1.70
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13. Figure shows a part of an electric circuit. The potentials at points a , b , and c are 30 V, 12 V, and 2 V respectively. The current through the 20Ω resistor will be:

- (1) 1.0 A
 - (2) 0.2 A
 - (3) 0.4 A
 - (4) 0.6 A
-

14. A small particle of mass m moves in such a way that its potential energy $U = \frac{1}{2}m\omega^2 r^2$, where ω is constant and r is the distance of the particle from the origin. Assuming Bohr's quantization of momentum and circular orbit, the radius of the n^{th} orbit will be proportional to:

- 1) n
 - 2) n^2
 - 3) $\frac{1}{n}$
 - 4) $\sqrt{n}$
-

15. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: Diffusion current in a p-n junction is greater than the drift current in magnitude if the junction is forward biased.

Reason R: Diffusion current in a p-n junction is from the n-side to the p-side if the junction is forward biased.

- 1) A is not correct but R is correct.
 - 2) Both A and R are correct and R is the correct explanation of A.
 - 3) Both A and R are correct but R is NOT the correct explanation of A.
 - 4) A is correct but R is not correct.
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16. Choose the incorrect statement from the following:

- 1) The linear speed of a planet revolving around the Sun remains constant.
- 2) The speed of a satellite in a given circular orbit remains constant.
- 3) When a body falls towards Earth, the displacement of Earth towards the body is negligible.

4) For a planet revolving around the Sun in an elliptical orbit, the total energy of the planet remains constant.

17. A child of mass 5 kg is going round a merry-go-round that makes 1 rotation in 3.14 s. The radius of the merry-go-round is 2 m. The centrifugal force on the child will be:

- 1) 40 N
 - 2) 100 N
 - 3) 80 N
 - 4) 50 N
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18. As shown in the figure, a particle is moving with constant speed π m/s. Considering its motion from A to B , the magnitude of the average velocity is:

- 1) π m/s
 - 2) $2\sqrt{3}$ m/s
 - 3) $\sqrt{3}$ m/s
 - 4) $1.5\sqrt{3}$ m/s
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19. The work functions of Aluminium and Gold are 4.1 eV and 5.1 eV respectively. The ratio of the slope of the stopping potential versus frequency plot for Gold to that of Aluminium is:

- 1) 1
 - 2) 2
 - 3) 1.24
 - 4) 1.5
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20. A particle starts with an initial velocity of 10.0 m/s along the x-direction and accelerates uniformly at the rate of 2.0 m/s^2 . The time taken by the particle to reach the velocity of 60.0 m/s is:

- (1) 3 s
 - (2) 6 s
 - (3) 25 s
 - (4) 30 s
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21. A simple pendulum with length 100 cm and bob of mass 250 g is executing S.H.M. of amplitude 10 cm. The maximum tension in the string is found to be $\frac{x}{40}$ N. The value of x is:

22. Experimentally, it is found that 12.8 eV energy is required to separate a hydrogen atom into a proton and an electron. The orbital radius of the electron in a hydrogen atom is $\frac{9}{x} \times 10^{-10}$ m. The value of x is:

23. A beam of light consisting of two wavelengths 7000 Å and 5500 Å is used to obtain an interference pattern in Young's double slit experiment. The distance between the slits is 2.5 mm, and the distance between the plane of slits and the screen is 150 cm. The least distance from the central fringe, where the bright fringes due to both the wavelengths coincide, is $n \times 10^{-5}$ m. The value of n is:

24. Two concentric circular coils with radii 1 cm and 1000 cm, and number of turns 10 and 200 respectively, are placed coaxially with centers coinciding. The mutual inductance of this arrangement will be $\text{-----} \times 10^{-8}$ H. (Take, $\pi^2 = 10$)

25. As shown in the figure, two parallel plate capacitors having equal plate area of 200 cm^2 are joined in such a way that $a \neq b$. The equivalent capacitance of the combination is $x \epsilon_0$ F. The value of x is:

26. A proton with a kinetic energy of 2.0 eV moves into a region of uniform magnetic field of magnitude $\frac{\pi}{2} \times 10^{-3}$ T. The angle between the direction of the magnetic field and velocity of the proton is 60° . The pitch of the helical path taken by the proton is ----- cm.

27. A body is dropped on the ground from a height h_1 and after hitting the ground, it rebounds to a height h_2 . If the ratio of velocities of the body just before and after hitting the ground is 4, then the percentage loss in kinetic energy of the body is $\frac{x}{4}$. The value of x is ----- .

28. A ring and a solid sphere rotating about an axis passing through their centers have the same radii of gyration. The axis of rotation is perpendicular to the plane of the ring. The ratio of the radius of the ring to that of the sphere is $\frac{\sqrt{2}}{\sqrt{x}}$. The value of x is ----- .

29. As shown in the figure, the voltmeter reads 2 V across a 5Ω resistor. The resistance of the voltmeter is $\text{-----} \Omega$.

30. A metal block of mass m is suspended from a rigid support through a metal wire of diameter 14 mm. The tensile stress developed in the wire under equilibrium state is $7 \times 10^5 \text{ N/m}^2$. The value of mass m is ----- kg.

(Take, $g = 9.8 \text{ m/s}^2$ and $\pi = \frac{22}{7}$.)