

JEE Main 2024 April 6 Shift 1 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.

Q.1. To find the spring constant (k) of a spring experimentally, a student commits 2% positive error in the measurement of time and 1% negative error in the measurement of mass. The percentage error in determining the value of k is:

- (1) 3%
- (2) 1%
- (3) 4%
- (4) 5%

Q.2. A bullet of mass 50 g is fired with a speed 100 m/s on a plywood and emerges with 40 m/s. The percentage loss of kinetic energy is:

- (1) 32%
- (2) 44%
- (3) 16%
- (4) 84%

Q.3. The ratio of the shortest wavelength of Balmer series to the shortest wavelength of Lyman series for hydrogen atom is:

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

(4) 2 : 1

Q.4. To project a body of mass m from earth's surface to infinity, the required kinetic energy is (assume, the radius of earth is R_E , g = acceleration due to gravity on the surface of earth):

- (1) $2mgR_E$
- (2) mgR_E
- (3) $\frac{1}{2}mgR_E$
- (4) $4mgR_E$

Q.5. Electromagnetic waves travel in a medium with speed $1.5 \times 10^8 \text{ ms}^{-1}$. The relative permeability of the medium is 2.0. The relative permittivity will be:

- (1) 5
- (2) 1
- (3) 4
- (4) 2

Q.6. Which of the following phenomena does not explain by wave nature of light?

- (A) reflection
- (B) diffraction
- (C) photoelectric effect
- (D) interference
- (E) polarization

Choose the **most appropriate** answer from the options given below:

- (1) E only
- (2) C only
- (3) B, D only
- (4) A, C only

Q.7. While measuring the diameter of a wire using a screw gauge, the following readings were noted. The main scale reading is 1 mm, and the circular scale reading is equal to 42 divisions. The pitch of the screw gauge is 1 mm, and it has 100 divisions on the circular scale. The diameter of the wire is $\frac{x}{50}$ mm. The value of x is:

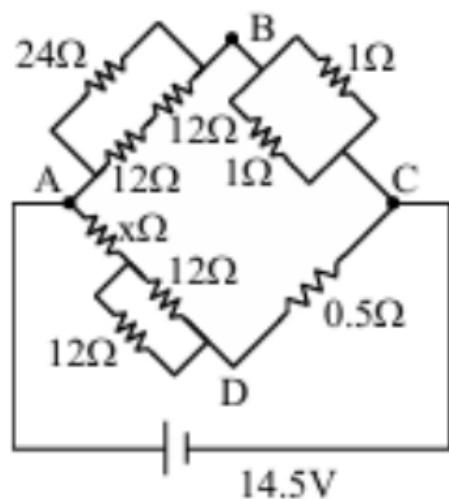
- (1) 142
- (2) 71
- (3) 42
- (4) 21

Q.8. σ is the uniform surface charge density of a thin spherical shell of radius R . The electric field at any point on the surface of the spherical shell is:

- (1) $\frac{\sigma}{\epsilon_0}$
- (2) $\frac{\sigma}{2\epsilon_0}$

- (3) $\frac{\sigma}{\epsilon_0 R}$
 (4) $\frac{\sigma}{4\epsilon_0}$

9. The value of unknown resistance (x) for which the potential difference between B and D will be zero in the arrangement shown, is:



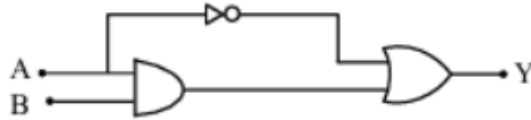
- (1) $3\ \Omega$
 (2) $9\ \Omega$
 (3) $6\ \Omega$
 (4) $42\ \Omega$

10. The specific heat at constant pressure of a real gas obeying $PV^2 = RT$ equation is:

- (1) $C_v + R$
 (2) $\frac{R}{3} + C_v$
 (3) R
 (4) $C_v + \frac{R}{2}$

Q11. Match List I with List II

List I	List II
A. Torque	I. $[ML^2T^{-2}]$
B. Magnetic field	II. $[MA^{-1}T^{-2}]$
C. Magnetic moment	III. $[AL^2]$
D. Permeability of free space	IV. $[MLT^{-2}A^{-2}]$



Options :

(1)

A	B	Y
0	0	0
0	1	1
1	0	0
1	1	1

(2)

A	B	Y
0	0	1
0	1	1
1	0	0
1	1	1

(3)

A	B	Y
0	0	1
0	1	1
1	0	0
1	1	0

(4)

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

Choose the correct answer from the options below:

1. A-I, B-III, C-II, D-IV
 2. A-IV, B-III, C-II, D-I
 3. A-III, B-I, C-II, D-IV
 4. A-IV, B-II, C-III, D-I
-

Q12. Given below are two statements:

Statement I: In an LCR series circuit, current is maximum at resonance.

Statement II: Current in a purely resistive circuit can never be less than that in a series LCR circuit when connected to the same voltage source.

In the light of the above statements, choose the correct option from the given below:

1. Statement I is true but Statement II is false.
 2. Statement I is false but Statement II is true.
 3. Both Statement I and Statement II are true.
 4. Both Statement I and Statement II are false.
-

Q13. The correct truth table for the following logic circuit is:

Q14. A sample contains a mixture of helium and oxygen gas. The ratio of root mean square speed of helium and oxygen in the sample, is:

Options:

1. $\frac{1}{32}$
 2. $\frac{2\sqrt{2}}{1}$
 3. $\frac{1}{4}$
 4. $\frac{1}{2\sqrt{2}}$
-

Q15. A light string passing over a smooth light pulley connects two blocks of masses m_1 and m_2 (where $m_2 > m_1$). If the acceleration of the system is $\frac{g}{\sqrt{2}}$, then the ratio of the masses $\frac{m_1}{m_2}$ is:

Options:

1. $\frac{\sqrt{2}-1}{\sqrt{2}+1}$
 2. $\frac{1+\sqrt{5}}{\sqrt{5}-1}$
 3. $\frac{1+\sqrt{5}}{\sqrt{2}-1}$
 4. $\frac{\sqrt{3}+1}{\sqrt{2}-1}$
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Q16. Four particles A, B, C, D of mass $\frac{m}{2}, m, 2m, 4m$, have the same momentum, respectively. The particle with maximum kinetic energy is:

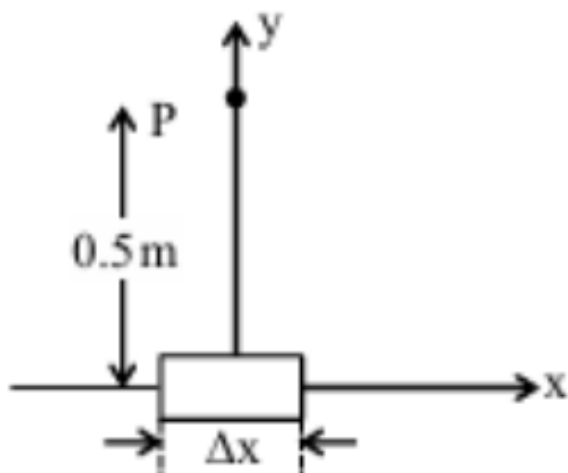
Options:

1. D
 2. C
 3. A
 4. B
-

Q.17 A train starting from rest first accelerates uniformly up to a speed of 80 km/h for time t , then it moves with a constant speed for time $3t$. The average speed of the train for this duration of the journey will be (in km/h):

- (1) 80
 - (2) 70
 - (3) 30
 - (4) 40
-

Q.18 An element $\Delta l = \Delta x \hat{i}$ is placed at the origin and carries a large current $I = 10$ A. The magnetic field on the y -axis at a distance of 0.5 m from the element Δx of 1 cm length is:



- (1) $4 \times 10^{-8} \text{ T}$
- (2) $8 \times 10^{-8} \text{ T}$
- (3) $12 \times 10^{-8} \text{ T}$
- (4) $10 \times 10^{-8} \text{ T}$

Q.19 A small ball of mass m and density ρ is dropped in a viscous liquid of density ρ_0 . After some time, the ball falls with constant velocity. The viscous force on the ball is:

- 1) $mg \left(\frac{\rho_0}{\rho} - 1 \right)$
- 2) $mg \left(1 + \frac{\rho}{\rho_0} \right)$
- 3) $mg (1 - \rho\rho_0)$
- 4) $mg \left(1 - \frac{\rho_0}{\rho} \right)$

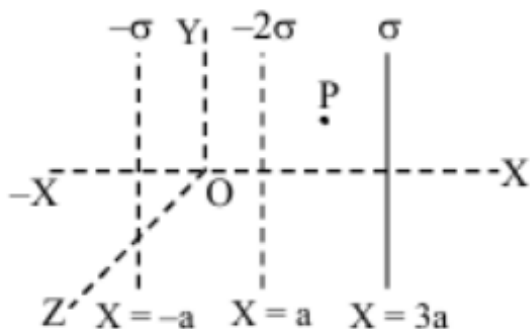
Q.20 In photoelectric experiment, energy of 2.48 eV irradiates a photo-sensitive material. The stopping potential was measured to be 0.5 V. Work function of the photo-sensitive material is:

- 1) 0.5 eV
- 2) 1.68 eV
- 3) 2.48 eV
- 4) 1.98 eV

Q.21 If the radius of earth is reduced to three-fourth of its present value without change in its mass, then value of duration of the day of earth will be ____ hours 30 minutes.

Q.22 Three infinitely long charged thin sheets are placed as shown in figure. The magnitude of electric field at the point P is $\frac{x\sigma}{\epsilon_0}$. The value of x is _____

(All quantities are measured in SI units).



Q 23. A big drop is formed by coalescing 1000 small droplets of water. The ratio of surface energy of 1000 droplets to that of energy of big drop is $\frac{10}{x}$.

The value of x is

Q24. When a DC voltage of 100 V is applied to an inductor, a DC current of 5 A flows through it. When an AC voltage of 200 V peak value is connected to the inductor, its inductive reactance is found to be $20\sqrt{3}\Omega$. The power dissipated in the circuit is W .

Q25. The refractive index of prism is $\mu = \sqrt{3}$ and the ratio of the angle of minimum deviation to the angle of prism is one. The value of angle of prism is $^\circ$.

Q26. A wire of resistance R and radius r is stretched till its radius became $r/2$. If the new resistance of the stretched wire is xR , then the value of x is

Q27. Radius of a certain orbit of hydrogen atom is $8.48\text{ \AA}$. If energy of electron in this orbit is E/x , then $x = \dots$.

(Given $a_0 = 0.529\text{ \AA}$, E = energy of electron in ground state)

Q28. A circular coil having 200 turns, $2.5 \times 10^{-4}\text{ m}^2$ area and carrying $100\mu\text{A}$ current is placed in a uniform magnetic field of 1 T . Initially the magnetic dipole moment ($\vec{M}$) was directed along $\vec{B}$. Amount of work, required to rotate the coil through 90° from its initial orientation such that $\vec{M}$ becomes perpendicular to $\vec{B}$, is μJ .

Q29. A particle is doing simple harmonic motion of amplitude 0.06 m and time period 3.14 s . The maximum velocity of the particle is cm/s .

Q30. For three vectors $\vec{A} = (-x\hat{i} - 6\hat{j} - 2\hat{k})$, $\vec{B} = (-\hat{i} + 4\hat{j} + 3\hat{k})$ and $\vec{C} = (-8\hat{i} - \hat{j} + 3\hat{k})$, if $\vec{A} \cdot (\vec{B} \times \vec{C}) = 0$, then the value of x is