JEE Main 2023 April 10 Shift 2 Physics Question Paper

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

Section-A

31. Given below are two statements:

Statement I: Rotation of the earth shows effect on the value of acceleration due to gravity (g)

Statement II: The effect of rotation of the earth on the value of 'g' at the equator is minimum and that at the pole is maximum.

In the light of the above statements, choose the correct answer from the options given below.

(1) Both Statement I and Statement II are true

(2) Both Statement I and Statement II are false

(3) Statement I is false but statement II is true

(4) Statement I is true but statement II is false

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32. The ratio of intensities at two points P and Q on the screen in a Young's double slit experiment where phase difference between two waves of same amplitude are $\frac{\pi}{3}$ and $\frac{\pi}{2}$, respectively, are:

(1) $3:2$

(2) $3:1$

(3) $2:3$

(4) $1:3$

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33. The time period of a satellite, revolving above Earth's surface at a height equal to R will be (Given $g = \pi^2$ m/s^2, $R =$ radius of earth):

(1) $\sqrt{32R}$

(2) $\sqrt{4R}$

(3) $\sqrt{2R}$

(4) $\sqrt{8R}$

34. In a metallic conductor, under the effect of applied electric field, the free electrons of the conductor:

(1) Move with the uniform velocity throughout from lower potential to higher potential

(2) Move in the curved paths from lower potential to higher potential

(3) Move in the straight line paths in the same direction

(4) Drift from higher potential to lower potential

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35. A message signal of frequency 3kHz is used to modulate a carrier signal of frequency 1.5 MHz. The bandwidth of the amplitude modulated wave is:

(1) 6 kHz

(2) 3 kHz

(3) 6 MHz

(4) 3 MHz

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36. In an experiment with vernier calipers of least count 0.1 mm, when two jaws are joined together the zero of the vernier scale lies right to the zero of the main scale and 6th division of vernier scale coincides with the main scale division. While measuring the diameter of a spherical bob, the zero of the vernier scale lies in between 3 cm and 3.3 cm marks, and 4th division of vernier scale coincides with the main scale division. The diameter of the bob is measured as:

(1) 3.25 cm

(2) 3.22 cm

(3) 3.18 cm

(4) 3.26 cm

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37. Two projectiles are projected at 30° and 60° with the horizontal the same speed. The ratio of the maximum height attained by the two projectiles respectively is:

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

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

(3) $\sqrt{3} : 1$

(4) $1 : 3$

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

Assertion A: An electric fan continues to rotate for some time after the current is switched off.

Reason R: Fan continues to rotate due to inertia of motion.

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

(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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39. The distance between two plates of a capacitor is d and its capacitance is C_1, when air is the medium between the plates. If a metal sheet of thickness $\frac{2d}{3}$ and of the same area as the plate is introduced between the plates, the capacitance of the capacitor becomes C_2. The ratio $\frac{C_2}{C_1}$ is:

(1) $4 : 1$

(2) $3 : 1$

(3) $2 : 1$

(4) $1 : 1$

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40. The amplitude of magnetic field in an electromagnetic wave propagating along y-axis is 6.0×10^{-7} T. The maximum value of electric field in the electromagnetic wave is:

(1) $2 \times 10^{15}\,\mathrm{Vm}^{-1}$

(2) $2 \times 10^{14}\,\mathrm{Vm}^{-1}$

(3) $6.0 \times 10^{-7}\,\mathrm{Vm}^{-1}$

(4) $180\,\mathrm{Vm}^{-1}$

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41. If each diode has a forward bias resistance of 25 Ω in the below circuit,

(1) $\frac{I_1}{I_2} = 2$

(2) $\frac{I_2}{I_3} = 1$

(3) $\frac{I_3}{I_4} = 1$

(4) $\frac{I_1}{I_2} = 1$

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42. A gas mixture consists of 2 moles of oxygen and 4 moles of neon at temperature T. Neglecting all vibrational modes, the total internal energy of the system will be:

(1) $4RT$

(2) $11RT$

(3) $8RT$

(4) $16RT$

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43. For a periodic motion represented by the equation $y = \sin\omega t + \cos\omega t$, the amplitude of the motion is:

(1) 0.5

(2) 1

(3) 2

(4) $\sqrt{2}$

44. A person travels x distance with velocity v_1 and then x distance with velocity v_2 in the same direction. The average velocity of the person is v, then the relation between v, v_1, and v_2 will be:

(1) $v = v_1 + v_2$

(2) $\frac{1}{v} = \frac{1}{v_1} + \frac{1}{v_2}$

(3) $\frac{2}{v} = \frac{1}{v_1} + \frac{1}{v_2}$

(4) $v = \frac{v_1+v_2}{2}$

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45. The half-life of a radioactive substance is T. The time taken for disintegrating $\frac{7}{8}$ part of its original mass will be:

(1) T

(2) $2T$

(3) $3T$

(4) $8T$

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46. A gas is compressed adiabatically, which one of the following statements is NOT true.

(1) There is no change in the internal energy

(2) The temperature of the gas increases

(3) The change in the internal energy is equal to the work done on the gas

(4) There is no heat supplied to the system

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47. Given below are two statements:

Statement I: For diamagnetic substance, $-1 \leq X < 0$, where X is the magnetic susceptibility.

Statement II: Diamagnetic substances when placed in an external magnetic field, tend to move from stronger to weaker part of the field.

In the light of the above statements, choose the correct answer from the options given below.

(1) Both Statement I and Statement II are false

(2) Statement I is incorrect but Statement II is true

(3) Both Statement I and Statement II are true

(4) Statement I is correct but Statement II is false

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48. Young's moduli of the material of wires A and B are in the ratio 1:4, while its area of cross sections are in the ratio 1:3. If the same amount of load is applied to both the wires, the amount of elongation produced in the wires A and B will be in the ratio of:

[Assume length of wires A and B are same]

(1) 12 : 1

(2) 1 : 36

(3) 1 : 12

(4) 36 : 1

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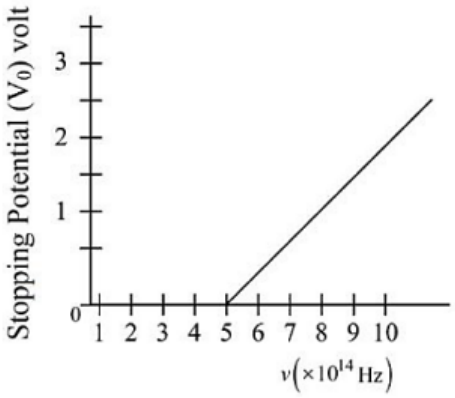
49. The variation of stopping potential (V_0) as a function of the frequency (υ) of the incident light for a metal is shown in the figure. The work function of the surface is:



(1) 2.07 eV

(2) 18.6 eV

(3) 2.98 eV

(4) 1.36 eV

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50. A bar magnet is released from rest along the axis of a very long vertical copper tube. After some time, the magnet will:

(1) Oscillate inside the tube

(2) Move down with an acceleration greater than g

(3) Move down with almost constant speed

(4) Move down with an acceleration equal to g

SECTION-B

51. If 917 Å be the lowest wavelength of Lyman series, then the lowest wavelength of Balmer series will be _____ Å.

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52. A square loop of side 2.0 cm is placed inside a long solenoid that has 50 turns per centimeter and carries a sinusoidally varying current of amplitude 2.5 A and angular frequency 700 **rad/s**$^{-1}$**. The central axes of the loop and solenoid coincide. The amplitude of the emf induced in the loop is** $x \times 10^{-4}$ **V. The value of** x **is:**

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53. A rectangular parallelepiped is measured as 1 cm × 1 cm × 100 cm. If its specific resistance is $3 \times 10^{-7}\,\Omega$**-cm, then the resistance between its two opposite rectangular faces will be:** _____ $\times 10^{-7}\,\Omega$**.**

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54. A force of $-P\hat{k}$ acts on the origin of the coordinate system. The torque about the point $(2, -3)$ is $P(a\hat{i} + b\hat{j})$. The ratio of $\frac{a}{b}$ is $\frac{x}{2}$. The value of x is:

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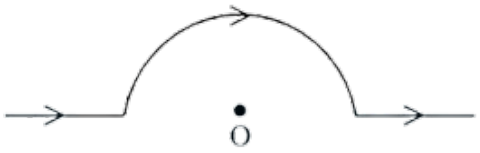
55. A straight wire carrying a current of 14 A is bent into a semicircular arc of radius 2.2 cm as shown in the figure. The magnetic field produced by the current at the centre O of the arc is _____ $\times 10^{-4}$ T.



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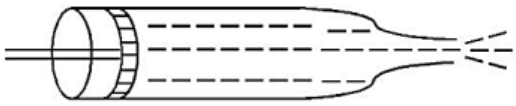
56. Figure below shows a liquid being pushed out of the tube by a piston having area of cross section 2.0 cm^2. The area of cross section at the outlet is 10 mm^2. If the piston is pushed at a speed of 4 cm/s$^-1$, the speed of the outgoing fluid is _____ cm/s$^-1$.



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57. A rectangular block of mass 5 kg attached to a horizontal spiral spring executes simple harmonic motion of amplitude 1 m and time period 3.14 s. The maximum force exerted by the spring on the block is _____ N.

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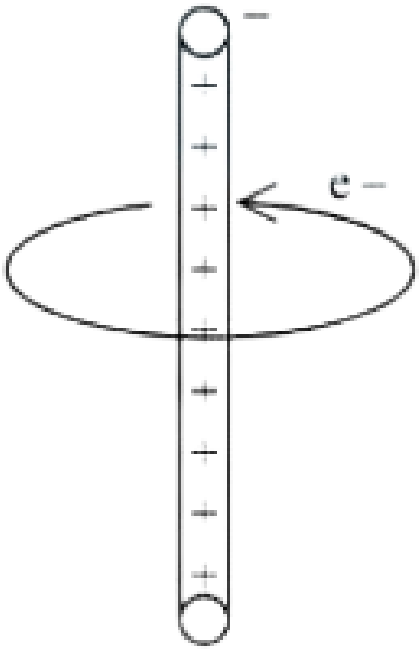
58. An electron revolves around an infinite cylindrical wire having uniform linear charge density 2×10^{-8} C/m^{-1} in a circular path under the influence of an attractive electrostatic field as shown in the figure. The velocity of the electron with which it is revolving is _____ $\times 10^6$ m/s^{-1}. Given mass of the electron $= 9 \times 10^{-31}$ kg



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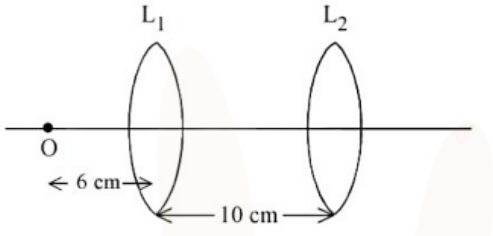
59. A point object, 'O' is placed in front of two thin symmetrical coaxial convex lenses L_1 and L_2 with focal lengths of 24 cm and 9 cm respectively. The distance between the two lenses is 10 cm, and the object is placed 6 cm away from lens L_1 as shown in the figure. The distance between the object and the image formed by the system of two lenses is _____ cm.



(1) 8 cm

(2) 18 cm

(3) 12 cm

(4) 34 cm

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60. If the maximum load carried by an elevator is 1400 kg (600 kg - Passengers + 800

kg - elevator), which is moving up with a uniform speed of 3 m s^{-1} and the frictional force acting on it is 2000 N, then the maximum power used by the motor is ____ kW (g = 10 m/s^2).
