JEE Main 2025 April 4 Shift 1
Question Paper

Time Allowed :3 Hours	Maximum Marks :300	Total Questions :75

General Instructions

Read the following instructions very carefully and strictly follow them:

1. Multiple choice questions (MCQs)
2. Questions with numerical values as answers.
3. There are three sections: **Mathematics, Physics, Chemistry**.
4. **Mathematics:** 25 (20+5) 10 Questions with answers as a numerical value. Out of 10 questions, 5 questions are compulsory.
5. **Physics:** 25 (20+5) 10 Questions with answers as a numerical value. Out of 10 questions, 5 questions are compulsory..
6. **Chemistry:** 25 (20+5) 10 Questions with answers as a numerical value. Out of 10 questions, 5 questions are compulsory.
7. Total: 75 Questions (25 questions each).
8. 300 Marks (100 marks for each section).
9. **MCQs:** Four marks will be awarded for each correct answer and there will be a negative marking of one mark on each wrong answer.
10. **Questions with numerical value answers:** Candidates will be given four marks for each correct answer and there will be a negative marking of 1 mark for each wrong answer.

Physics

Section - A

26. The mean free path and the average speed of oxygen molecules at 300 K and 1 atm are 3×10^{-7} m and 600 m/s, respectively. Find the frequency of its collisions.
(1) 2×10^{10}/s
(2) 9×10^{9}/s
(3) 2×10^{9}/s
(4) 5×10^{8}/s

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27. A small mirror of mass m is suspended by a massless thread of length l. Then the small angle through which the thread will be deflected when a short pulse of

laser of energy E falls normal on the mirror (c = speed of light in vacuum and g = acceleration due to gravity).
(1) $\theta = \frac{3E}{4mc\sqrt{gl}}$
(2) $\theta = \frac{E}{mc\sqrt{gl}}$
(3) $\theta = \frac{E}{2mc\sqrt{gl}}$
(4) $\theta = \frac{2E}{mc\sqrt{gl}}$

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28. Two liquids A and B have θ_A and θ_B as contact angles in a capillary tube. If $K = \cos\theta_A / \cos\theta_B$, then identify the correct statement:
(1) K is negative, then liquid A and liquid B have convex meniscus.
(2) K is negative, then liquid A and liquid B have concave meniscus.
(3) K is negative, then liquid A has concave meniscus and liquid B has convex meniscus.
(4) K is zero, then liquid A has convex meniscus and liquid B has concave meniscus.

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29. Which of the following are correct expression for torque acting on a body?
A. $\ddot{\tau} = \ddot{r} \times \ddot{L}$
B. $\ddot{\tau} = \frac{d}{dt}(\ddot{r} \times \ddot{p})$
C. $\ddot{\tau} = \ddot{r} \times \frac{d\dot{p}}{dt}$
D. $\ddot{\tau} = I\dot{\alpha}$
E. $\ddot{\tau} = \ddot{r} \times \ddot{F}$
($\ddot{r}$ = position vector; $\dot{p}$ = linear momentum; $\ddot{L}$ = angular momentum; $\ddot{\alpha}$ = angular acceleration; I = moment of inertia; $\ddot{F}$ = force; t = time)
Choose the correct answer from the options given below:
(1) B, D and E Only
(2) C and D Only
(3) B, C, D and E Only
(4) A, B, D and E Only

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30. In a Young's double slit experiment, the slits are separated by 0.2 mm. If the slits separation is increased to 0.4 mm, the percentage change of the fringe width is:
(1) 0%
(2) 100%
(3) 50%
(4) 25%

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31. An alternating current is represented by the equation, $i = 100\sqrt{2}\sin(100\pi t)$ ampere. The RMS value of current and the frequency of the given alternating current are
(1) $100\sqrt{2}$ A, 100 Hz

(2) $\frac{100}{\sqrt{2}}$ A, 100 Hz
(3) 100 A, 50 Hz
(4) $50\sqrt{2}$ A, 50 Hz

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32. Consider the sound wave travelling in ideal gases of He, CH_4, and CO_2. All the gases have the same ratio $\frac{P}{\rho}$, where P is the pressure and ρ is the density. The ratio of the speed of sound through the gases $v_{He} : v_{CH_4} : v_{CO_2}$ is given by
(1) $\sqrt{\frac{7}{5}} : \sqrt{\frac{5}{3}} : \sqrt{\frac{4}{3}}$
(2) $\sqrt{\frac{5}{3}} : \sqrt{\frac{4}{3}} : \sqrt{\frac{7}{5}}$
(3) $\sqrt{\frac{5}{3}} : \sqrt{\frac{4}{3}} : \sqrt{\frac{4}{3}}$
(4) $\sqrt{\frac{4}{3}} : \sqrt{\frac{5}{3}} : \sqrt{\frac{7}{5}}$

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33. In an electromagnetic system, the quantity representing the ratio of electric flux and magnetic flux has dimension of $M^B L^O T^B A^S$, where value of 'Q' and 'R' are
(1) $(3, -5)$
(2) $(-2, 2)$
(3) $(-2, 1)$
(4) $(1, -1)$

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34. When an object is placed 40 cm away from a spherical mirror an image of magnification $\frac{1}{2}$ is produced. To obtain an image with magnification of $\frac{1}{3}$, the object is to be moved:
(1) 40 cm away from the mirror.
(2) 80 cm away from the mirror.
(3) 20 cm towards the mirror.
(4) 20 cm away from the mirror.

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35. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R. Assertion A: In photoelectric effect, on increasing the intensity of incident light the stopping potential increases. Reason R: Increase in intensity of light increases the rate of photoelectrons emitted, provided the frequency of incident light is greater than threshold frequency.
(1) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**
(2) **A** is false but **R** is true
(3) **A** is true but **R** is false
(4) Both **A** and **R** are true and **R** is the correct explanation of **A**

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36. If $\overrightarrow{\mathrm{L}}$ and $\overrightarrow{\mathrm{P}}$ represent the angular momentum and linear momentum respectively of a particle of mass ' m ' having position vector $\overrightarrow{\mathrm{r}} = \mathrm{a}(\hat{\mathrm{i}}\cos\omega\mathrm{t} + \hat{\mathrm{j}}\sin\omega\mathrm{t})$. The direction of force is
(1) Opposite to the direction of $\overrightarrow{\mathrm{r}}$
(2) Opposite to the direction of $\overrightarrow{\mathrm{L}}$
(3) Opposite to the direction of $\overrightarrow{\mathrm{P}}$
(4) Opposite to the direction of $\overrightarrow{\mathrm{L}} \times \overrightarrow{\mathrm{P}}$

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37. A body of mass m is suspended by two strings making angles θ_1 and θ_2 with the horizontal ceiling with tensions T_1 and T_2 simultaneously. T_1 and T_2 are related by $\mathrm{T}_1 = \sqrt{3}\ \mathrm{T}_2$. the angles θ_1 and θ_2 are
(1) $\theta_1 = 30°\theta_2 = 60°$ with $\mathrm{T}_2 = \frac{3\mathrm{mg}}{4}$
(2) $\theta_1 = 60°\theta_2 = 30°$ with $\mathrm{T}_2 = \frac{\mathrm{mg}}{2}$
(3) $\theta_1 = 45°\theta_2 = 45°$ with $\mathrm{T}_2 = \frac{3\mathrm{mg}}{4}$
(4) $\theta_1 = 30°\theta_2 = 60°$ with $\mathrm{T}_2 = \frac{4\mathrm{mg}}{5}$

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38. Current passing through a wire as function of time is given as $I(t) = 0.02\mathrm{t} + 0.01$ A. The charge that will flow through the wire from $t = 1$ s to $\mathrm{t} = 2$ s is:
(1) 0.06 C
(2) 0.02 C
(3) 0.07 C
(4) 0.04 C

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39. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R. Assertion A: The kinetic energy needed to project a body of mass m from earth surface to infinity is $\frac{1}{2}\mathrm{mgR}$, where R is the radius of earth. Reason R: The maximum potential energy of a body is zero when it is projected to infinity from earth surface.
(1) A False but **R** is true
(2) Both **A** and **R** are true and **R** is the correct explanation of **A**
(3) **A** is true but **R** is false
(4) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**

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40. The Boolean expression $\mathrm{Y} = \mathrm{A}\overline{\mathrm{B}}\mathrm{C} + \overline{\mathrm{AC}}$ can be realised with which of the following gate configurations.
A. One 3-input AND gate, 3 NOT gates and one 2-input OR gate, One 2-input AND gate
B. One 3-input AND gate, 1 NOT gate, One 2-input NOR gate and one 2-input OR gate
C. 3-input OR gate, 3 NOT gates and one 2-input AND gate
Choose the correct answer from the options given below:

(1) B, C Only
(2) A,B Only
(3) A, B, C Only
(4) A, C Only

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41. In an experiment with a closed organ pipe, it is filled with water by $\left(\frac{1}{5}\right)$ th of its volume. The frequency of the fundamental note will change by
(1) 25%
(2) 20%
(3) -20%
(4) -25%

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42. Two simple pendulums having lengths l_1 and l_2 with negligible string mass undergo angular displacements θ_1 and θ_2, from their mean positions, respectively. If the angular accelerations of both pendulums are same, then which expression is correct?
(1) $\theta_1 l_2^2 = \theta_2 l_1^2$
(2) $\theta_1 l_1 = \theta_2 l_2$
(3) $\theta_1 l_1^2 = \theta_2 l_2^2$
(4) $\theta_1 l_2 = \theta_2 l_1$

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43. Two infinite identical charged sheets and a charged spherical body of charge density ' ρ ' are arranged as shown in figure. Then the correct relation between the electrical fields at $\mathrm{A}, \mathrm{B}, \mathrm{C}$ and D points is:
(1) $\vec{E}_A = \vec{E}_B; \vec{E}_C = \vec{E}_D$
(2) $\vec{E}_A > \vec{E}_B; \vec{E}_C = \vec{E}_D$
(3) $\vec{E}_C \neq \vec{E}_D; \vec{E}_A > \vec{E}_B$
(4) $\left|\vec{E}_A\right| = \left|\vec{E}_B\right|; \vec{E}_C > \vec{E}_D$

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44. Two small spherical balls of mass 10 g each with charges $-2\mu\mathrm{C}$ and $2\mu\mathrm{C}$, are attached to two ends of very light rigid rod of length 20 cm. The arrangement is now placed near an infinite nonconducting charge sheet with uniform charge density of $100\mu\mathrm{C/m}^2$ such that length of rod makes an angle of 30° with electric field generated by charge sheet. Net torque acting on the rod is:
(1) 112 Nm
(2) 1.12 Nm
(3) 2.24 Nm
(4) 11.2 Nm

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45. Considering the Bohr model of hydrogen like atoms, the ratio of the radius 5^{th} orbit of the electron in Li^{2+} and $He^{+}$is

(1) $\frac{3}{2}$
(2) $\frac{4}{9}$
(3) $\frac{9}{4}$
(4) $\frac{2}{3}$

SECTION-B

46. A circular ring and a solid sphere having same radius roll down on an inclined plane from rest without slipping. The ratio of their velocities when reached at the bottom of the plane is $\sqrt{\frac{x}{5}}$ where $x =$ _____.

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47. Two slabs with square cross section of different materials $(1, 2)$ with equal sides (l) and thickness d_1 and d_2 such that $d_2 = 2\ d_1$ and $l > d_2$. Considering lower edges of these slabs are fixed to the floor, we apply equal shearing force on the narrow faces. The angle of deformation is $\theta_2 = 2\theta_1$. If the shear moduli of material 1 is $4 \times 10^9\ N/m^2$, then shear moduli of material 2 is $x \times 10^9\ N/m^2$, where value of x is _____ .

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48. Distance between object and its image (magnified by $-\frac{1}{3}$) is 30 cm. The focal length of the mirror used is $\left(\frac{x}{4}\right)$ cm, where magnitude of value of x is _____ .

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49. Four capacitors each of capacitance $16\,\mu F$ are connected as shown in the figure. The capacitance between points A and B is: _____ (in μF).

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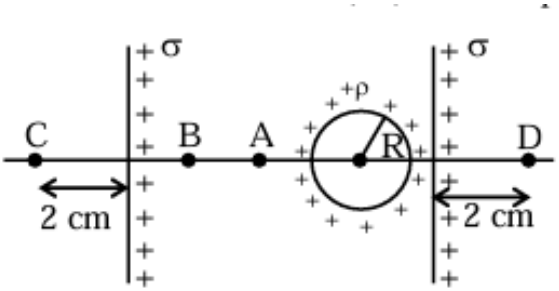
50. Conductor wire ABCDE with each arm 10 cm in length is placed in magnetic field of $\frac{1}{\sqrt{2}}$ Tesla, perpendicular to its plane. When conductor is pulled towards right with constant velocity of 10 cm/s, induced emf between points A and E is _____ mV.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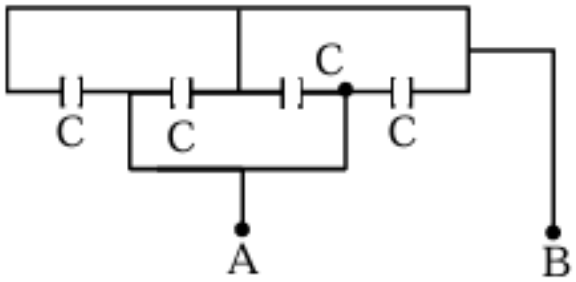
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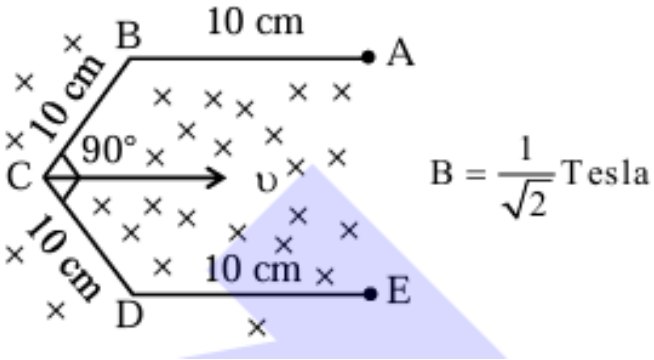
B
10 cm
A
10 cm
90°
C
υ
10 cm
10 cm
D
E
B = 1/√2 Tesla