JEE Main 2023 April 12 Shift 1 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. An ice cube has a bubble inside. When viewed from one side the apparent distance of the bubble is 12 cm. When viewed from the opposite side, the apparent distance of the bubble is observed as 4 cm. If the side of the ice cube is 24 cm, the refractive index of the ice cube is:

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

(2) $\frac{3}{2}$

(3) $\frac{2}{3}$

(4) $\frac{6}{5}$

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32. Two satellites A and B move round the earth in the same orbit. The mass of A is twice the mass of B. The quantity which is same for the two satellites will be:

(1) Potential energy

(2) Total energy

(3) Kinetic energy

(4) Speed

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33. The amplitude of 15 sin (1000 πt) is modulated by 10 sin (4πt) signal. The amplitude modulated signal contains frequencies of:

(1) 500 Hz.

(2) 2 Hz.

(3) 250 Hz.

(4) 498 Hz.

(5) 502 Hz.

(1) and (3) only (1) and (4) only (1) and (2) only (1), (4) and (5) only

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34. In an n-p-n common emitter (CE) transistor, the collector current changes from 5 mA to 16 mA for the change in base current from 100 A and 200 A, respectively. The current gain of the transistor is:

(1) 110

(2) 0.9

(3) 210

(4) 9

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35. If the r.m.s. speed of chlorine molecules is 490 m/s at 27°C, the r.m.s. speed of argon molecules at the same temperature will be (Atomic mass of argon = 39.9u, molecular mass of chlorine = 70.9u):

(1) 751.7 m/s

(2) 451.7 m/s

(3) 651.7 m/s

(4) 551.7 m/s

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36. A proton and an α-particle are accelerated from rest by 2V and 4V potentials, respectively. The ratio of their de-Broglie wavelength is:

(1) 4:1.

(2) 2:1.

(3) 8:1.

(4) 16:1.

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37. Given below are two statements:

Statement I: The diamagnetic property depends on temperature.

Statement II: The included magnetic dipole moment in a diamagnetic sample is always opposite to the magnetizing field.

In light of the given statement, choose the correct answer from the options below:

(1) Statement I is incorrect but Statement II is true.

(2) Both Statement I and Statement II are true.

(3) Both Statement I and Statement II are false.

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

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38. A wire of resistance 160 Ω is melted and drawn into a wire of one-fourth of its length. The new resistance of the wire will be:

(1) 10 Ω

(2) 640 Ω

(3) 40 Ω

(4) 16 Ω

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39. Match List I with List II:

List I		List II	
A.	Spring constant	I.	(T^{-1})
B.	Angular speed	II.	(MT^{-2})
C.	Angular momentum	III.	(ML^2)
D.	Moment of Inertia	IV.	(ML^2T^{-1})

Choose the correct answer from the options given below:

(1) A-II, B-I, C-IV, D-III

(2) A-IV, B-I, C-III, D-II

(3) A-II, B-III, C-I, D-IV

(4) A-I, B-III, C-II, D-IV

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40. Three forces $F_1 = 10\,\mathbf{N}, F_2 = 8\,\mathbf{N}, F_3 = 6\,\mathbf{N}$ are acting on a particle of mass 5 kg. The forces F_2 and F_3 are applied perpendicular so that particle remains at rest. If the force F_1 is removed, then the acceleration of the particle is:

(1) 2 ms^{-2}.

(2) 0.5 ms^{-2}.

(3) 4.8 ms^{-2}.

(4) 7 ms^{-2}.

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41. A body cools from 80°C to 60°C in 5 minutes. The temperature of the surrounding is 20°C. The time it takes to cool from 60°C to 40°C is:

(1) 500 s.

(2) $\frac{25}{3}$ s.

(3) 450 s.

(4) 420 s.

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42. An engine operating between the boiling and freezing points of water will have:

(1) efficiency more than 27%.

(2) efficiency less than the efficiency a Carnot engine operating between the same two temperatures.

(3) efficiency equal to 27%.

(4) efficiency less than 27%.

(1) $2, 3$ and 4 only

(2) 2 and 3 only

(3) 2 and 4 only

(4) 1 and 2 only

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43. Given below are two statements:

Statement I: A truck and a car moving with the same kinetic energy are brought to rest by applying brakes which provide equal retarding forces. Both come to rest in equal distance.

Statement II: A car moving towards east takes a turn and moves towards north, the speed remains unchanged. The acceleration of the car is zero.

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

(1) Statement I is correct but Statement II is incorrect

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

(3) Both Statement I is correct but Statement II are incorrect

(4) Both Statement I is correct but Statement II are correct

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44. A particle is executing Simple Harmonic Motion (SHM). The ratio of potential energy and kinetic energy of the particle when its displacement is half of its amplitude will be:

(1) 1 : 1

(2) 2 : 1

(3) 1 : 4

(4) 1 : 3

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45. A ball is thrown vertically upward with an initial velocity of 150 m/s. The ratio of velocity after 3 s and 5 s is $\frac{x+1}{x}$. The value of x is:

Take $g = 10\,\text{m/s}^2$.

(1) 6

(2) 5

(3) -5

(4) 10

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

Assertion A: If an electric dipole of dipole moment 30×10^{-5} Cm is enclosed by a closed surface, the net flux coming out of the surface will be zero.

Reason R: Electric dipole consists of two equal and opposite charges.

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

(1) Both A and R are true and R is the correct explanation of A

(2) A is true but R is false

(3) Both A and R true but R is NOT the correct explanation of A

(4) A is false but R is true

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

Assertion A: EM waves used for optical communication have longer wavelengths than that of microwave, employed in Radar technology.

Reason R: Infrared EM waves are more energetic than microwaves.

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

(1) A is false but R is true

(2) A is true but R is false

(3) Both A and R true but R is NOT the correct explanation of A

(4) Both A and R true and R is the correct explanation of A

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48. A 12.5 eV electron beam is used to bombard gaseous hydrogen at room temperature. The number of spectral lines emitted will be:

(1) 2.

(2) 1.

(3) 3.

(4) 4.

49. The ratio of escape velocity of a planet to the escape velocity of Earth will be:
Given: Mass of the planet is 16 times the mass of Earth and radius of the planet is 4 times the radius of Earth.

(1) 4:1.

(2) 2:1.

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

(4) 1 : 4.

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50. Given below are two statements:
Statement I: When the frequency of an a.c. source in a series LCR circuit increases, the current in the circuit first increases, attains a maximum value and then decreases.
Statement II: In a series LCR circuit, the value of the power factor at resonance is one.
In light of the given statements, choose the most appropriate answer from the options given below:

(1) Statement I is incorrect but Statement II is true.

(2) Both Statement I and Statement II are false.

(3) Statement I is correct but Statement II is false.

(4) Both Statement I and Statement II are true.

SECTION-B

51. For a certain organ pipe, the first three resonance frequencies are in the ratio of 1:3:5 respectively. If the frequency of the fifth harmonic is 405 Hz and the speed of sound in air is 324 m/s^{-1}, the length of the organ pipe is _____ m.

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52. For a rolling spherical shell, the ratio of rotational kinetic energy and total kinetic energy is $\frac{x}{5}$. The value of x is:

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53. A compass needle oscillates 20 times per minute at a place where the dip is 30° and 30 times per minute where the dip is 60°. The ratio of total magnetic field due to the earth at two places respectively is $\frac{4}{\sqrt{x}}$. The value of x is:

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54. A conducting circular loop is placed in a uniform magnetic field of 0.4 T with its plane perpendicular to the field. Somehow, the radius of the loop starts expanding at a constant rate of 1 mm/s. The magnitude of induced emf in the loop at an instant when the radius of the loop is 2 cm will be _____ μV.

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55. To maintain a speed of 80 km/h by a bus of mass 500 kg on a plane rough road for 4 km distance, the work done by the engine of the bus will be _____ KJ. [The coefficient of friction between tyre of bus and road is 0.04].

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56. A common example of alpha decay is

$$^{238}_{92}U \rightarrow ^{234}_{90}Th + ^{4}_{2}He + Q.$$

Given:

$$^{238}_{92}U = 238.05060\,u, \quad ^{234}_{90}Th = 234.04360\,u, \quad ^{4}_{2}He = 4.00260\,u, \quad 1u = 931.5\,\textbf{MeV/c}^2.$$

The energy released Q during the alpha decay of $^{238}_{92}U$ is $_{MeV.}$

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57. The current flowing through a conductor connected across a source is 2A and 1.2 A at 0°C and 100°C respectively. The current flowing through the conductor at 50°C will be _____ $\times 10^2$ mA.

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58. Two convex lenses of focal length 20 cm each are placed coaxially with a separation of 60 cm between them. The image of the distant object formed by the combination is at _____ cm from the first lens.

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59. Glycerine of density 1.25×10^3 kg/m^{-3} is flowing through the conical section of pipe. The area of cross-section of the pipe at its ends is 10 cm^2 and 5 cm^2 and pressure drop across its length is 3 Nm^{-2}. The rate of flow of glycerine through the pipe is $x \times 10^{-5}$ m^3 s^{-1}. The value of x is _____ .

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60. 64 identical drops each charged up to a potential of 10 mV are combined to form a bigger drop. The potential of the bigger drop will be _____ mV.
