JEE Main 2024 Physics Question Paper Feb 1 Shift 1

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

1. The dimensions of angular impulse is equal to

(1) $[M]L^2T^{-1}$
(2) $[M]L^1T^{-1}$
(3) $[M]L^1T^2$
(4) $[M]^1L^1T^{-1}$

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2. A vernier caliper has 10 main scale divisions coinciding with 11 vernier scale divisions. 1 main scale division equals 5 mm. The least count of the device is

(1) $\frac{1}{2}$ mm
(2) $\frac{5}{12}$ mm
(3) $\frac{5}{11}$ mm
(4) 0.3 mm

3. On increasing temperature, the elasticity of a material

(1) Increases
(2) Decreases
(3) Remains constant
(4) May increase or decrease

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4. Determine the lowest energy of photon emitted in Balmer series of hydrogen atom.

(1) 10.02 eV
(2) 1.88 eV
(3) 1.65 eV
(4) 2.02 eV

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5. de Broglie wavelength of proton = λ and that of an α particle is 2λ. The ratio of velocity of proton to that of α particle is:

(1) 8
(2) $\frac{1}{8}$
(3) 4
(4) $\frac{1}{4}$

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6. 2 moles of monoatomic gas and 6 moles of diatomic gas are mixed. Molar specific heat, for constant volume, of mixture shall be (R is universal gas constant)

(1) 1.75R
(2) 2.25R
(3) 2.75R
(4) 2.50R

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7. A gas undergoes a thermodynamic process from state (P_1, V_1, T_1) to state (P_2, V_2, T_2). For the given process if $PV^\gamma =$ constant, find the work done by the gas.

(1) $\frac{(P_2V_2 - P_1V_1)}{2}$
(2) $\frac{(P_1V_1 - P_2V_2)}{2}$
(3) $\frac{3}{2}(P_1V_1 - P_2V_2)$
(4) $2(P_1V_1 - P_2V_2)$

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8. For measuring resistivity, the relation $R = \rho\frac{l}{A} = \frac{\rho l}{\pi r^2}$ is used. Percentage error in resistance R, in length l, and in radius r are given as x, y, and z respectively. Find the percentage error in resistivity ρ.

(1) $x + y + 2z$
(2) $x + 2y + z$
(3) $\frac{x}{2} + y + z$
(4) $x + 2z - y$

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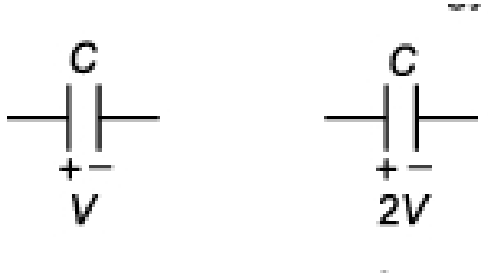
9. Two capacitors are charged as shown. When both the positive terminals and negative terminals of capacitors are connected the energy loss will be



(1) $\frac{1}{2}CV^2$
(2) $\frac{3}{4}CV^2$
(3) $\frac{1}{4}CV^2$
(4) $2CV^2$

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10. A moving coil galvanometer has resistance $50\,\Omega$ and full deflection current is 5 mA. The resistance needed to convert this galvanometer into voltmeter of range 100 volt is

(1) 19550 Ω
(2) 18500 Ω
(3) 19850 Ω
(4) 18760 Ω

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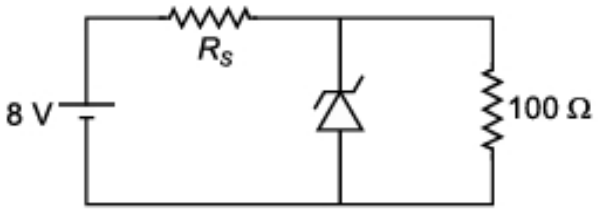
11. In the voltage regulator circuit shown below, the reverse breakdown voltage of the zener diode is 5 V and power dissipated across it is 100 mW. Find R_s.



(1) 120 Ω
(2) 250 Ω
(3) 1000 Ω
(4) 1500 Ω

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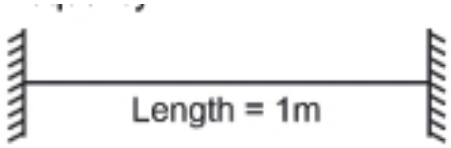
12. Two strings are identical and fixed at both ends with tension 6 N each. If the tension in one string fixed at both ends is changed from 6 N to 52 N, then find beats frequency.



(1) 2.38 Hz
(2) 3.25 Hz
(3) 2.75 Hz
(4) 5.25 Hz

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13. A particle is moving in a circle of radius R in time period of T. This moving particle is projected at angle θ with horizontal & attains a maximum height of $4R$. Angle θ can be given as (g is acceleration due to gravity)

(1) $\sin^{-1}\left(\frac{T}{2\pi\sqrt{R}}\right)$
(2) $\sin^{-1}\left(\frac{T}{\pi\sqrt{R}}\right)$
(3) $\sin^{-1}\left(\frac{T}{\pi\sqrt{2gR}}\right)$
(4) $\sin^{-1}\left(\frac{T}{\sqrt{2gR}}\right)$

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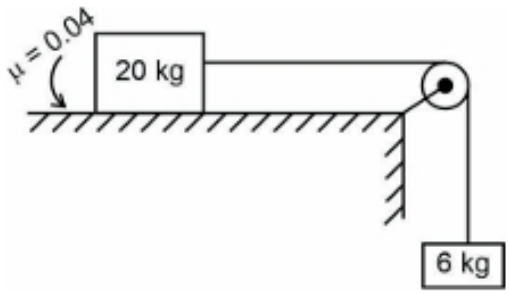
14. A block of mass 20 kg is placed on rough surface having coefficient of friction 0.04 as shown in figure. Find acceleration of system when it is released.



(1) 3 m/s²
(2) 2 m/s²
(3) 1 m/s²
(4) 4 m/s²

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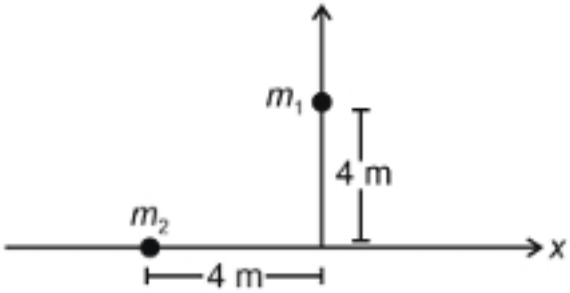
15. In single slit diffraction with slit width 0.1 mm, light of wavelength 6000 A is used. A convex lens of focal length 20 cm is used to focus the diffracted ray. Find width of central maxima.

(1) 24 mm
(2) 2.4 mm
(3) 12 mm
(4) 1.2 mm

SECTION B

21. Two particles each of mass 2 kg are placed as shown in the xy plane. If the distance of the center of mass from origin is $\frac{4}{\sqrt{2}}\hat{i}$, find x.



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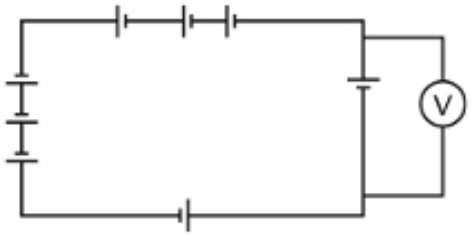
22. Eight identical batteries (5 V, 1 Ω) are connected as shown:



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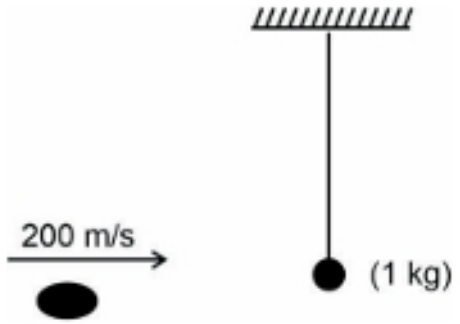
23. A bullet, of mass 10^{-2} kg and velocity 200 m/s, gets embedded inside the bob (mass 1 kg) of a simple pendulum as shown. The maximum height the system rises is ..... cm.



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24. The length of a seconds pendulum if it is placed at height $2R$ (R: radius of earth) is $\frac{10}{x}$ m. Find x.

(1) 9
(2) 3
(3) 6
(4) 5

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25. Nuclear mass and size of nucleus of an element A are 64 and 4.8 femtometer. If size of nucleus of element B is 4 femtometer, then its nuclear mass will be 1000. Find x.

(1) 27
(2) 30
(3) 35
(4) 40

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26. In a series LCR circuit connected to an AC source, the value of the elements are L_0, C_0, and R_0 such that the circuit is in resonance mode. If now the capacitance of the capacitor is made $4C_0$, the new value of inductance for the circuit to still remain in resonance is $\frac{L_0}{n}$. Find n.

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27. The current through a conductor varying with time as $i = 3t^2 + 4t^3$. Find the amount of charge (in C) passing through the cross section of the conductor in the internal time $t = 1$ sec to $t = 2$ sec.

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28. Distance between virtual magnified image, (size three times of object) of an object placed in front of convex lens and object is 20 cm. The focal length of the lens is x cm, then x is ..... cm.
