JEE Main 2023 April 11 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 Duration of test is 3 Hours.
2. This paper consists of 90 Questions.
3. There are three parts in the 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 carries 4 marks for correct answer and –1 mark for wrong answer..
5. (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 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: Eight equal drops of water are falling through air with a steady speed of 10 cm/s. If the drops collapse, the new velocity is :-

(1) $10cm/s$

(2) $40cm/s$

(3) $16cm/s$

(4) $5cm/s$

2: Provided that below are two statements : One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: A bar magnet dropped through a metallic cylindrical pipe takes more time to come down compared to a non-magnetic bar with same geometry and mass.

Reason R: For the magnetic bar, Eddy currents are produced in the metallic pipe which oppose the motion of the magnetic bar.

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

(1) A is true but R is false

(2) Both A and R are true but R is **NOT** the correct explanation of A

(3) A is false but R is true

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

3: A space ship of mass 2×10^4 kg is launched into a circular orbit close to the earth surface. The additional velocity to be imparted to the space ship in the orbit to overcome the gravitational pull will be (if $g = 10$ m/s^2 and radius of earth = 6400 km):

(1) $7.9(\sqrt{2}-1)$ km/s

(2) $7.4(\sqrt{2}-1)$ km/s

(3) $11.2(\sqrt{2}-1)$ km/s

(4) $8(\sqrt{2}-1)$ km/s

4: A projectile is projected at 30° from horizontal with initial velocity 40 ms^{-1}. The velocity of the projectile at $t = 2$ s from the start will be :

(Provided that $g = 10$ m/s^2)

(1) Zero

(2) $20\sqrt{3}$ ms^{-1}

(3) $40\sqrt{3}$ ms^{-1}

(4) 20 ms^{-1}

5: A plane electromagnetic wave of frequency 20 MHz propagates in free space along x-direction. At a particular space and time, $\vec{E} = 6.6\hat{j}$ v/m. What is $\vec{B}$ at this point?

(1) $-2.2 \times 10^{-8}\hat{k}$ T

(2) $-2.2 \times 10^{-8}\hat{i}$ T

(3) $2.2 \times 10^{-8}\hat{k}$ T

(4) $2.2 \times 10^{-8}\hat{i}$ T

6: A car P travelling at 20 ms^{-1} sounds its horn at a frequency of 400 Hz. Another car Q is travelling behind the first car in the same direction with a velocity 40 ms^{-1}. The frequency heard by the passenger of the car Q is approximately [Take, velocity of sound $= 360$ ms^{-1}]

(1) $471Hz$

(2) $514Hz$

(3) $421Hz$

(4) $485Hz$

7: A body of mass 500 g moves along x-axis such that its velocity varies with displacement x according to the calculation $v = 10\sqrt{x}$ m/s the force acting on the body is :-

(1) $25N$

(2) $5N$

(3) $166N$

(4) $125N$

8: The ratio of the de-Broglie wavelengths of proton and electron having same Kinetic energy:

(Assume $m_p = m_e \times 1840$)

(1) $1 : 62$

(2) $1 : 30$

(3) $1 : 43$

(4) $2 : 43$

9: If force (F), velocity (V) and time (T) are considered as fundamental physical quantity, then dimensional formula of density will be :-

(1) $FV^{-2}T^2$

(2) FV^4T^{-6}

(3) $FV^{-4}T^{-2}$

(4) $F^2V^{-2}T^6$

10: An electron is allowed to move with constant velocity along the axis of current carrying straight solenoid.

A. The electron will experience magnetic force along the axis of the solenoid.

B. The electron will not experience magnetic force.

C. The electron will continue to move along the axis of the solenoid.

D. The electron will be accelerated along the axis of the solenoid.

E. The electron will follow parabolic path inside the solenoid.

Choose the correct answer from the options Provided that below:

(1) A and D only

(2) B, C and D only

(3) B and E only

(4) B and C only

11: The Thermodynamic process, in which internal energy of the system remains constant is

(1) Isobaric

(2) Isochoric

(3) Adiabatic

(4) Isothermal

12: In satellite communication, the uplink frequency band used is:

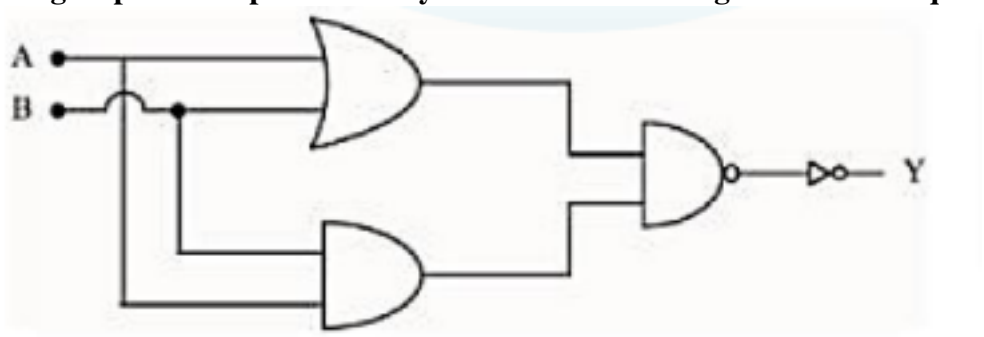
(1) $76 - 88$ MHz

(2) $420 - 890$ MHz

(3) $3.7 - 4.2$ GHz

(4) $5.925 - 6.425$ GHz

13: The logic operations performed by the Provided that digital circuit is equivalent to:



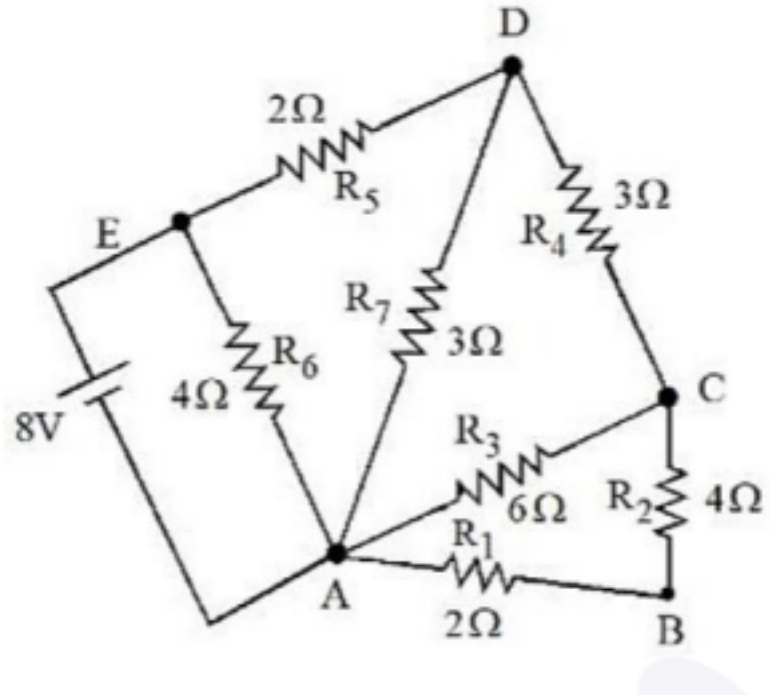
(1) OR

(2) $NAND$

(3) NOR

(4) AND

14: The current flowing through R_2 is:



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

(2) $\frac{1}{4}$ A

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

(4) $\frac{1}{2}$ A

15: When vector $\vec{A} = 2\hat{i} + 3\hat{j} + 2\hat{k}$ is subtracted from vector $\vec{B}$, it gives a vector equal to $2\hat{j}$. Then the magnitude of vector $\hat{B}$ will be:

(1) 3

(2) $\sqrt{5}$

(3) $\sqrt{33}$

(4) $\sqrt{6}$

16: If V is the gravitational potential due to sphere of uniform density on it's surface, then it's value at the center of sphere will be:-

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

(2) V

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

(4) $\frac{V}{2}$

17: The root mean square speed of molecules of nitrogen gas at 27°C is approximately : (Provided that mass of a nitrogen molecule $= 4.6 \times 10^{-26}$ kg and take Boltzmann constant $k_B = 1.4 \times 10^{-23}$ JK^{-1})

(1) 1260 m/s

(2) 91 m/s

(3) 523 m/s

(4) 27.4 m/s

18: The energy of He^{+} ion in its first excited state is, (The ground state energy for the Hydrogen atom is -13.6 eV):

(1) -13.6 eV

(2) -54.4 eV

(3) -27.2 eV

(4) -3.4 eV

19: When one light ray is reflected from a plane mirror with 30° angle of reflection, the angle of deviation of the ray after reflection is:

(1) 140°

(2) 130°

(3) 120°

(4) 110°

20: A capacitor of capacitance C is charge to a potential V. The flux of the electric field through a closed surface enclosing the positive plate of the capacitor is :

(1) Zero

(2) $\frac{CV}{\varepsilon_0}$

(3) $\frac{2CV}{\varepsilon_0}$

(4) $\frac{CV}{2\varepsilon_0}$

Section B

21: A coil has an inductance of 2H and resistance of 4Ω. A 10 V is applied across the coil. The energy stored in the magnetic field after the current has built up to its equilibrium value will be ____ $\times 10^{-2}$ J.

22: A metallic cube of side 15 cm moving along y-axis at a uniform velocity of 2 ms^{-1}. In a region of uniform magnetic field of magnitude 0.5T directed along z-axis. In equilibrium the potential difference between the faces of higher and lower potential developed because of the motion through the field will be _____ mV.

(0,0,0) – (2,0,0) – (2,2,0) – (0,2,0) – cycle; (0,0,2) – (2,0,2) – (2,2,2) – (0,2,2) – cycle; (0,0,0) – (0,0,2); (2,0,0) – (2,0,2); (2,2,0) – (2,2,2); (0,2,0) – (0,2,2); [-¿] (2,2,0) – (3,2,0) node[anchor=west] x; [-¿] (0,2,0) – (0,3,0) node[anchor=south] y; [-¿] (0,0,0) – (0,0,3) node[anchor=east] z; [-¿] (0.5,2.5,0) – (0.5,3,0) node[anchor=south west] $\vec{v}$; [-¿] (0,0,1.5) – (0.5,0,1.5) node[anchor=north east] $\vec{B}$;

23: In the Provided that circuit, $C_1 = 2$ μF, $C_2 = 0.2$ μF, $C_3 = 2$ μF, $C_4 = 4$ μF, $C_5 = 2$ μF, $C_6 = 2$ μF. The charge stored on capacitor C_4 is ____ μC.

(0,0) to[battery1, l=10V] (0,2) to[C, l=C_1] (2,2) to[C, l=C_3] (4,2) to[C, l=C_4] (4,0) to[C, l=C_5] (2,0) to[C, l=C_6] (0,0) (2,0) to[C, l=C_2] (2,2) ;

24: A nucleus disintegrates into two nuclear parts, in such a way that ratio of their nuclear sizes is $1 : 2^{1/3}$. Their respective speed have a ratio of n : 1. The value of n is ____.

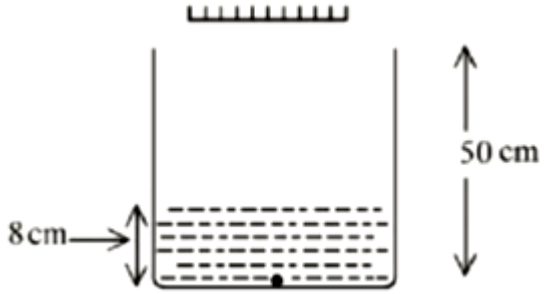
25: The surface tension of soap solution is 3.5×10^{-2} Nm^{-1}. The amount of work done required to increase the radius of soap bubble from 10 cm to 20 cm is ____ $\times 10^{-4}$ J. (take $\pi = 22/7$)

26: A circular plate is rotating horizontal plane, about an axis passing through its center perpendicular to the plate, with an angular velocity ω. A person sits at the center having two

dumbbells in his hands. When he stretches out his hands, the moment of inertia of the system becomes triple. If E be the initial Kinetic energy of the system, then final Kinetic energy will be $\frac{E}{x}$. The value of x is _____.

27: A block of mass 5 kg starting from rest pulled up on a smooth incline plane making an angle of 30° with horizontal with an affective acceleration of 1 ms^{-2}. The power delivered by the pulling force at $t = 10$ s from the starts is _____ W. [use $g = 10$ ms^{-2}] (Evaluate the nearest integer value)

28: As shown in the figure, a plane mirror is fixed at a height of 50 cm from the bottom of tank containing water $\left(\mu = \frac{4}{3}\right)$. The height of water in the tank is 8 cm. A small bulb is placed at the bottom of the water tank. The distance of image of the bulb formed by mirror from the bottom of the tank is _____ cm.



29: Two identical cells each of emf 1.5 V are connected in series across a $10\ \Omega$ resistance. An ideal voltmeter connected across $10\ \Omega$ resistance reads 1.5 V. The internal resistance of each cell is ____ Ω.

30: A wire of density 8×10^3 kg/m^3 is stretched between two clamps 0.5 m apart. The extension developed in the wire is 3.2×10^{-4} m. If $Y = 8 \times 10^{10}$ N/m^2, the fundamental frequency of vibration in the wire will be _____ Hz.
