

JEE Main 2023 Physics Question Paper Apr 8 Shift 1

Time Allowed :3 Hour	Maximum Marks :120	Total Questions :30
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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 30 questions. The maximum marks are 120.
3. The question paper consists of topics from Physics, having 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. 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.

1. The engine of a train moving with speed 10 ms^{-1} towards a platform sounds a whistle at frequency 400 Hz . The frequency heard by a passenger inside the train is: (neglect air speed. Speed of sound in air $= 330 \text{ ms}^{-1}$)

- (A) 200 Hz
(B) 388 Hz
(C) 412 Hz
(D) 400 Hz

2. An air bubble of volume 1 cm^3 rises from the bottom of a lake 40 m deep to the surface at a temperature of 12°C . The atmospheric pressure is $1 \times 10^5 \text{ Pa}$, the density of water is 1000 kg/m^3 and $g = 10 \text{ m/s}^2$. There is no difference of the temperature of water at the depth of 40 m and on the surface. The volume of air bubble when it reaches the surface will be:

- (A) 2 cm^3
(B) 3 cm^3
(C) 4 cm^3
(D) 5 cm^3

3. Given below are two statements:

Statement I: If heat is added to a system, its temperature must increase.

Statement II: If positive work is done by a system in a thermodynamic process, its volume must increase.

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

- (A) Both Statement I and Statement II are true.
 - (B) Both Statement I and Statement II are false.
 - (C) Statement I is true but Statement II is false.
 - (D) Statement I is false but Statement II is true.
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4. An aluminium rod with Young's modulus $Y = 7.0 \times 10^{10} \text{ N/m}^2$ undergoes elastic strain of 0.04%. The energy per unit volume stored in the rod in SI unit is:

- (A) 2800
 - (B) 5600
 - (C) 8400
 - (D) 11200
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5. Given below are two statements:

Statement I: If E be the total energy of a satellite moving around the earth, then its potential energy will be $\frac{E}{2}$.

Statement II: The kinetic energy of a satellite revolving in an orbit is equal to the half the magnitude of total energy E .

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

- (A) Both Statement I and Statement II are correct.
 - (B) Both Statement I and Statement II are incorrect.
 - (C) Statement I is correct but Statement II is incorrect.
 - (D) Statement I is incorrect but Statement II is correct.
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6. At any instant the velocity of a particle of mass 500 g is $(2t\hat{i} + 3t^2\hat{j}) \text{ ms}^{-1}$. If the force acting on the particle at $t = 1 \text{ s}$ is $(\hat{i} + x\hat{j}) \text{ N}$. Then the value of x will be:

- (A) 6
 - (B) 4
 - (C) 3
 - (D) 2
-

7. Two forces having magnitude A and $\frac{A}{2}$ are perpendicular to each other. The magnitude of their resultant is:

- (A) $\frac{5A}{2}$
 - (B) $\frac{\sqrt{5}A}{2}$
 - (C) $\frac{\sqrt{5}A}{4}$
 - (D) $\frac{\sqrt{5}A^2}{2}$
-

8. The weight of a body on the earth is 400 N. Then weight of the body when taken to a depth half of the radius of the earth will be:

- (A) Zero
 - (B) 100 N
 - (C) 200 N
 - (D) 300 N
-

9. Two projectiles A and B are thrown with initial velocities of 40 m/s and 60 m/s at angles 30° and 60° with the horizontal respectively. The ratio of their ranges respectively is ($g = 10 \text{ m/s}^2$)

- (A) 1 : 1
 - (B) $2 : \sqrt{3}$
 - (C) 4 : 9
 - (D) $\sqrt{3} : 2$
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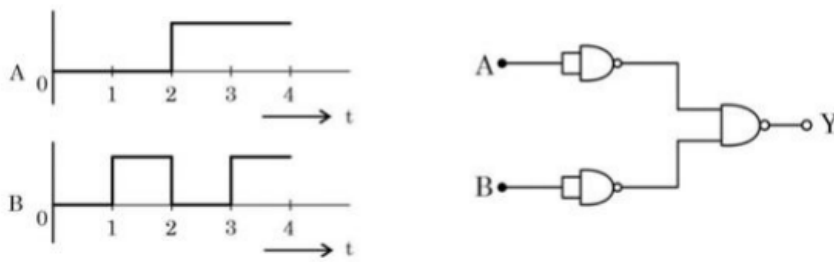
10. A cylindrical wire of mass $(0.4 \pm 0.01) \text{ g}$ has length $(8 \pm 0.04) \text{ cm}$ and radius $(6 \pm 0.03) \text{ mm}$. The maximum error in its density will be:

- (A) 1%
 - (B) 3.5%
 - (C) 4%
 - (D) 5%
-

11. A TV transmitting antenna is 98 m high and the receiving antenna is at the ground level. If the radius of the earth is 6400 km, the surface area covered by the transmitting antenna is approximately:

- (A) 4868 km^2
 - (B) 1549 km^2
 - (C) 3942 km^2
 - (D) 1240 km^2
-

12. For the logic circuit shown, the output waveform at Y is:



- (A)
- (B)
- (C)
- (D)

13. For a nucleus A_ZX having mass number A and atomic number Z

A. The surface energy per nucleon $(b_s) = -a_s A^{2/3}$.

B. The Coulomb contribution to the binding energy $b_c = -a_c \frac{Z(Z-1)}{A^{1/3}}$.

C. The volume energy $b_v = a_v A$.

D. Decrease in the binding energy is proportional to surface area.

E. While estimating the surface energy, it is assumed that each nucleon interacts with 12 nucleons. (a_1, a_2 and a_3 are constants)

Choose the most appropriate answer from the options given below:

- (A) A, B, C, D only
 (B) B, C only
 (C) C, D only
 (D) B, C, D only

14. Proton (P) and electron (e) will have same de-Broglie wavelength when the ratio of their momentum is (assume, $m_p = 1849m_e$):

- (A) 1 : 1849
 (B) 1 : 43

- (C) 43 : 1
 - (D) 1 : 1
-

15. In a reflecting telescope, a secondary mirror is used to:

- (A) remove spherical aberration
 - (B) move the eyepiece outside the telescopic tube
 - (C) make chromatic aberration zero
 - (D) reduce the problem of mechanical support
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16. Dimension of $\frac{1}{\mu_0\epsilon_0}$ should be equal to:

- (A) L/T
 - (B) T/L
 - (C) L^2/T^2
 - (D) T^2/L^2
-

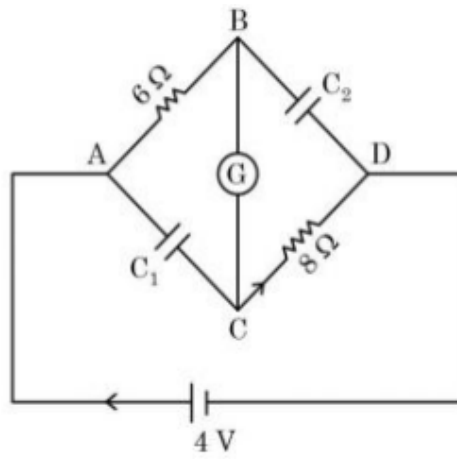
17. Certain galvanometers have a fixed core made of non magnetic metallic material. The function of this metallic material is:

- (A) to oscillate the coil in magnetic field for longer period of time
 - (B) to produce large deflecting torque on the coil
 - (C) to make the magnetic field radial
 - (D) to bring the coil to rest quickly
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18. A charge particle moving in magnetic field B, has the components of velocity along B as well as perpendicular to B. The path of the charge particle will be:

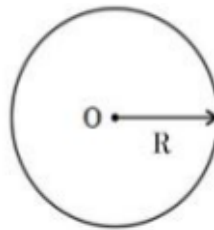
- (A) straight along the direction of magnetic field B
 - (B) circular path
 - (C) helical path with the axis along magnetic field B
 - (D) helical path with the axis perpendicular to the direction of magnetic field B
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19. In this figure the resistance of the coil of galvanometer G is 2Ω . The emf of the cell is 4 V. The ratio of potential difference across C_1 and C_2 is:

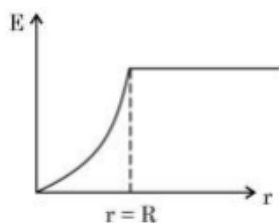


- (A) $4/5$
- (B) 1
- (C) $5/4$
- (D) $3/4$

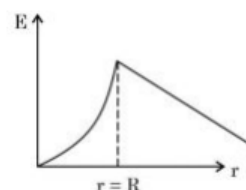
20. Graphical variation of electric field due to a uniformly charged insulating solid sphere of radius R , with distance r from the centre O is represented by:



- (A)
- (B)



(C)



(D)

21. An organ pipe 40 cm long is open at both ends. The speed of sound in air is 360 ms^{-1} . The frequency of the second harmonic is _____ Hz.

22. An air bubble of diameter 6 mm rises steadily through a solution of density 1750 kg/m^3 at the rate of 0.35 cm/s . The co-efficient of viscosity of the solution (neglect density of air) is _____ Pas (given, $g = 10 \text{ ms}^{-2}$).

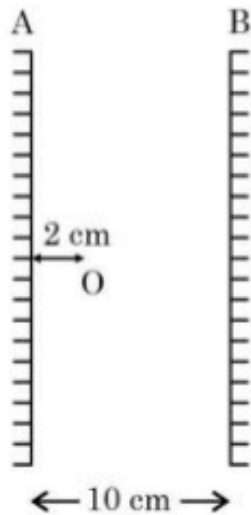
23. The moment of inertia of a semicircular ring about an axis, passing through the center and perpendicular to the plane of ring, is $\frac{1}{x}MR^2$, where R is the radius and M is the mass of the semicircular ring. The value of x will be _____.

24. The momentum of a body is increased by 50%. The percentage increase in the kinetic energy of the body is _____%.

25. A nucleus with mass number 242 and binding energy per nucleon as 7.6 MeV breaks into two fragment each with mass number 121. If each fragment nucleus has binding energy per nucleon as 8.1 MeV, the total gain in binding energy is _____ MeV.

26. Two vertical parallel mirrors A and B are separated by 10 cm. A point object O is placed at a distance of 2 cm from mirror A. The distance of the second nearest

image behind mirror A is _____ cm.



27. An oscillating LC circuit consists of a 75 mH inductor and a $1.2 \mu\text{F}$ capacitor. If the maximum charge to the capacitor is $2.7 \mu\text{C}$. The maximum current in the circuit will be _____ mA.

28. The magnetic intensity at the center of a long current carrying solenoid is found to be $1.6 \times 10^3 \text{ Am}^{-1}$. If the number of turns is 8 per cm, then the current flowing through the solenoid is _____ A.

29. A current of 2 A flows through a wire of cross-sectional area 25.0 mm^2 . The number of free electrons in a cubic meter are 2.0×10^{28} . The drift velocity of the electrons is _____ $\times 10^{-6} \text{ ms}^{-1}$ (given, charge on electron = $1.6 \times 10^{-19} \text{ C}$).

30. An electric dipole of dipole moment is $6.0 \times 10^{-6} \text{ Cm}$ placed in a uniform electric field of $1.5 \times 10^3 \text{ NC}^{-1}$ in such a way that dipole moment is along electric field. The work done in rotating dipole by 180° in this field will be _____ mJ.
