

JEE Main 2023 1 Feb Shift 1 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 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. Match the List I with List II:

List I	List II
A. Intrinsic Semiconductor	I. Fermi-level near conduction band
B. n-type Semiconductor	II. Fermi-level at middle
C. p-type Semiconductor	III. Fermi-level near valence band
D. Metals	IV. Fermi-level inside conduction band

Choose the correct answer from the options given below:

- (1) (A) $\rightarrow$ I, (B) $\rightarrow$ II, (C) $\rightarrow$ III, (D) $\rightarrow$ IV
 - (2) (A) $\rightarrow$ II, (B) $\rightarrow$ I, (C) $\rightarrow$ III, (D) $\rightarrow$ IV
 - (3) (A) $\rightarrow$ II, (B) $\rightarrow$ III, (C) $\rightarrow$ I, (D) $\rightarrow$ IV
 - (4) (A) $\rightarrow$ III, (B) $\rightarrow$ I, (C) $\rightarrow$ II, (D) $\rightarrow$ IV
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2. An object moves with speed v_1, v_2, v_3 along a line segment AB, BC, and CD respectively as shown in the figure. Where $AB = BC$ and $AD = 3AB$, then the average speed of the object will be:

- (1) $\frac{(v_1+v_2+v_3)}{3}$
 - (2) $\frac{v_1 v_2 v_3}{3(v_1 v_2 + v_2 v_3 + v_3 v_1)}$
 - (3) $\frac{3v_1 v_2 v_3}{v_1 v_2 + v_2 v_3 + v_3 v_1}$
 - (4) $\frac{(v_1+v_2+v_3)}{3v_1 v_2 v_3}$
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3. Given below are two statements:

Statement-I: Acceleration due to gravity is different at different places on the surface of Earth.

Statement-II: Acceleration due to gravity increases as we go down below the Earth's surface.

Choose the correct answer from the options given below:

- (1) Both Statement I and Statement II are true

- (2) Both Statement I and Statement II are false
 (3) Statement I is true but Statement II is false
 (4) Statement I is false but Statement II is true

4. Match the List I with List II:

List I	List II
A. AC generator	I. Presence of both L and C
B. Transformer	II. Electromagnetic Induction
C. Resonance Phenomenon	III. Quality Factor
D. Sharpness of Resonance	IV. Mutual Inductance

Choose the correct answer from the options given below:

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

5. Match the List-I with List-II:

List I	List II
A. Microwaves	I. Radioactive decay of the nucleus
B. Gamma rays	II. Rapid acceleration and deceleration of electrons in aerials
C. Radio waves	III. Inner shell electrons
D. X-rays	IV. Klystron valve

Choose the correct answer from the options given below:

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

6. If Earth has a mass nine times and radius twice that of a planet P, then

$$\frac{V_e}{3} \sqrt{x} \text{ ms}^{-1}$$

will be the minimum velocity required by a rocket to pull out of the gravitational force of P, where V_e is escape velocity on Earth. The value of x is:

- (1) 2
- (2) 3
- (3) 18
- (4) 1

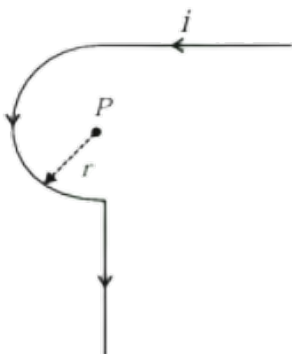
7. 'n' polarizing sheets are arranged such that each makes an angle 45° with the preceding sheet. An unpolarized light of intensity I is incident into this arrangement. The output intensity is found to be

$$\frac{I}{64}.$$

The value of n will be:

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

8. Find the magnetic field at the point P in the figure. The curved portion is a semicircle connected to two long straight wires.



- (1) $\frac{\mu_0 I}{2r} \left(1 + \frac{2}{\pi}\right)$
- (2) $\frac{\mu_0 I}{2r} \left(1 + \frac{1}{\pi}\right)$
- (3) $\frac{\mu_0 I}{2r} \left(\frac{1}{2} + \frac{1}{2\pi}\right)$
- (4) $\frac{\mu_0 I}{2r} \left(1 + \frac{1}{\pi}\right)$

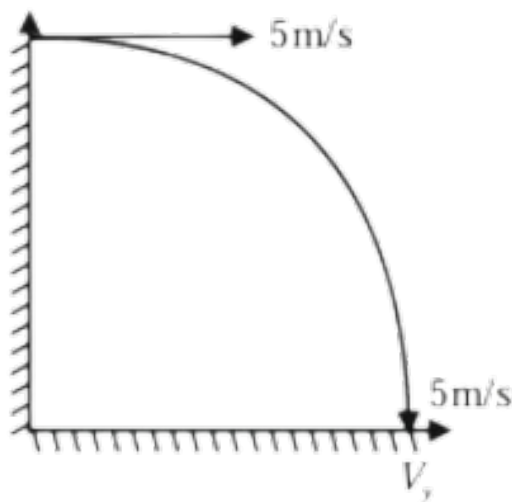
9. Which of the following frequencies does not belong to FM broadcast?

- (1) 106 MHz
 - (2) 64 MHz
 - (3) 99 MHz
 - (4) 89 MHz
-

10. A steel wire with mass per unit length $7.0 \times 10^{-3} \text{ kgm}^{-1}$ is under tension of 70 N. The speed of transverse waves in the wire will be:

- (1) $200\pi \text{ m/s}$
 - (2) 100 m/s
 - (3) 10 m/s
 - (4) 50 m/s
-

11. A child stands on the edge of the cliff 10 m above the ground and throws a stone horizontally with an initial speed of 5 m/s. Neglecting air resistance, the speed with which the stone hits the ground will be ___ m/s (given, $g = 10 \text{ m/s}^2$).



- (1) 20
 - (2) 15
 - (3) 30
 - (4) 25
-

12. A proton moving with one-tenth of velocity of light has a certain de-Broglie

wavelength λ . An alpha particle having certain kinetic energy has the same de-Broglie wavelength λ . The ratio of kinetic energy of proton and that of alpha particle is:

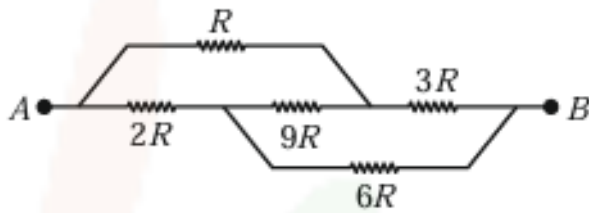
- (1) 2 : 1
- (2) 4 : 1
- (3) 1 : 2
- (4) 1 : 4

13. A sample of gas at temperature T is adiabatically expanded to double its volume.

The work done by the gas in the process is (given, $\gamma = \frac{3}{2}$):

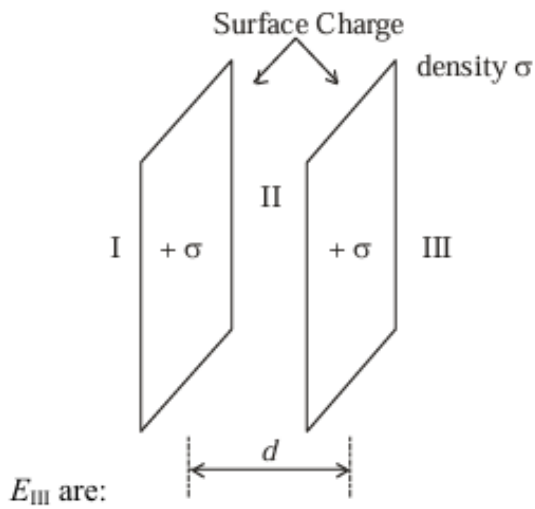
- (1) $W = TR[\sqrt{2} - 2]$
- (2) $W = \frac{T}{R}[\sqrt{2} - 2]$
- (3) $W = RT[2 - \sqrt{2}]$
- (4) $W = RT[2 - \sqrt{2}]$

14. The equivalent resistance between A and B of the network shown in figure:



- (1) $\frac{11R}{3}$
- (2) $14R$
- (3) $21R$
- (4) $\frac{8R}{3}$

15. Let σ be the uniform surface charge density of two infinite thin plane sheets shown in the figure. Then the electric fields in three different regions E_I , E_{II} and E_{III} are:



- (1) $\vec{E}_I = \frac{2\sigma}{\epsilon_0} \hat{n}$, $\vec{E}_{II} = 0$, $\vec{E}_{III} = \frac{2\sigma}{\epsilon_0} \hat{n}$
 (2) $\vec{E}_I = 0$, $\vec{E}_{II} = \frac{\sigma}{\epsilon_0} \hat{n}$, $\vec{E}_{III} = 0$
 (3) $\vec{E}_I = \frac{\sigma}{2\epsilon_0} \hat{n}$, $\vec{E}_{II} = 0$, $\vec{E}_{III} = \frac{\sigma}{2\epsilon_0} \hat{n}$
 (4) $\vec{E}_I = -\frac{\sigma}{\epsilon_0} \hat{n}$, $\vec{E}_{II} = 0$, $\vec{E}_{III} = \frac{\sigma}{\epsilon_0} \hat{n}$

16. A mercury drop of radius 10^{-3} m is broken into 125 equal size droplets. Surface tension of mercury is 0.45 Nm^{-1} . The gain in surface energy is:

- (1) $2.26 \times 10^{-5} \text{ J}$
 (2) $28 \times 10^{-5} \text{ J}$
 (3) $17.5 \times 10^{-5} \text{ J}$
 (4) $5 \times 10^{-5} \text{ J}$

17. The mass of proton, neutron and helium nucleus are respectively 1.0073 u, 1.0087 u and 4.0015 u. The binding energy of helium nucleus is:

- (1) 14.2 MeV
 (2) 28.4 MeV
 (3) 56.8 MeV
 (4) 7.1 MeV

18. The equation of state for some gases is given by:

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$

The physical quantity, which has the same dimensional formula as $\frac{b^2}{a}$, will be:

- (1) Bulk modulus
 - (2) Modulus of rigidity
 - (3) Compressibility
 - (4) Energy density
-

19. The average kinetic energy of a molecule of the gas is:

- (1) Proportional to absolute temperature
 - (2) Proportional to volume
 - (3) Proportional to pressure
 - (4) Dependent on the nature of the gas
-

20. A block of mass 5 kg is placed at rest on a rough surface. If a force of 30N is applied parallel to the surface and the block slides through a distance of 50 m in 10s, then the coefficient of kinetic friction is (given, $g = 10 \text{ ms}^{-2}$):

- (1) 0.60
 - (2) 0.75
 - (3) 0.50
 - (4) 0.25
-

21. A charge particle of 2 C accelerated by a potential difference of 100V enters a region of uniform magnetic field of magnitude 4 mT at right angle to the direction of field. The charge particle completes semicircle of radius 3 cm inside magnetic field. The mass of the charge particle is $___ \times 10^{-18} \text{ kg}$.

22. In an experiment to find emf of a cell using potentiometer, the length of null point for a cell of emf 1.5 V is found to be 60 cm. If this cell is replaced by another cell of emf

E, the length-of null point increases by 40 cm. The value of E is $\frac{x}{10}$ V. The value of x is -----.

23. A small particle moves to position $5\hat{i} - 2\hat{j} + \hat{k}$ from its initial position $2\hat{i} + 3\hat{j} - 4\hat{k}$ under the action of force $5\hat{i} + 2\hat{j} + 7\hat{k}$ N. The value of work done will be ---- J.

24. A light of energy 12.75 eV is incident on a hydrogen atom in its ground state. The atom absorbs the radiation and reaches to one of its excited states. The angular momentum of the atom in the excited state is $\frac{x}{\pi} \times 10^{-17}$ eVs. The value of x is -----.

25. A certain pressure P is applied to 1 litre of water and 2 litre of a liquid separately. Water gets compressed to 0.01% whereas the liquid gets compressed to 0.03%. The ratio of Bulk modulus of water to that of the liquid is $\frac{3}{x}$. The value of x is -----.

(1) 1

(2) 2

(3) 3

(4) 4

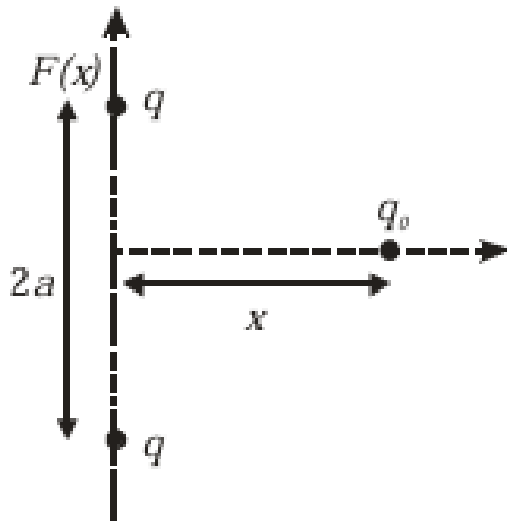
26. Two equal positive point charges are separated by a distance $2a$. The distance of a point from the centre of the line joining two charges on the equatorial line (perpendicular bisector) at which force experienced by a test charge q_0 becomes maximum is $\frac{a}{\sqrt{x}}$. The value of x is -----.

(1) 1

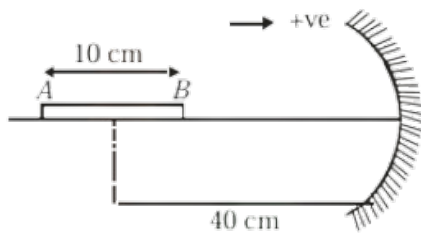
(2) 2

(3) 3

(4) 4

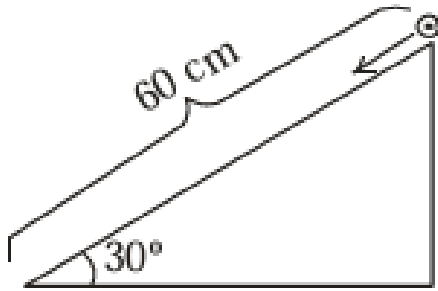


27. A thin cylindrical rod of length 10 cm is placed horizontally on the principle axis of a concave mirror of focal length 20 cm. The rod is placed in a such a way that mid point of the rod is at 40 cm from the pole of mirror. The length of the image formed by the mirror will be $\frac{x}{3}$ cm. The value of x is



- (1) 30
- (2) 32
- (3) 34
- (4) 36

28. A solid cylinder is released from rest from the top of an inclined plane of inclination 30° and length 60 cm. If the cylinder rolls without slipping, its speed upon reaching the bottom of the inclined plane is ms^{-1} . (Given $g = 10 \text{ ms}^{-2}$)



- (1) 1
 - (2) 2
 - (3) 3
 - (4) 4
-

29. The amplitude of a particle executing SHM is 3 cm. The displacement at which its kinetic energy will be 25% more than the potential energy is _____ cm.

- (1) 3 cm
 - (2) 2 cm
 - (3) 4 cm
 - (4) 5 cm
-

30. A series LCR circuit is connected to an ac source of 220V, 50Hz. The circuit contains a resistance $R = 100\Omega$ and an inductor of inductive reactance $X_L = 79.6\Omega$. The capacitance of the capacitor needed to maximize the average rate at which energy is supplied will be _____ μF .

- (1) 30 μF
 - (2) 40 μF
 - (3) 50 μF
 - (4) 60 μF
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