

JEE Main 2023 31 Jan 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 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 H amount of thermal energy is developed by a resistor in 10 s when a current of 4A is passed through it. If the current is increased to 16A, the thermal energy developed by the resistor in 10 s will be:

- (1) H
- (2) 16H
- (3) $\frac{H}{4}$

(4) $4H$

2. A body is moving with constant speed, in a circle of radius 10 m. The body completes one revolution in 4 s. At the end of the 3rd second, the displacement of the body (in m) from its starting point is:

- (1) 30
 - (2) 15π
 - (3) 5π
 - (4) $10\sqrt{2}$
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3. A microscope is focused on an object at the bottom of a bucket. If liquid with refractive index $\frac{5}{3}$ is poured inside the bucket, then the microscope has to be raised by 30 cm to focus the object again. The height of the liquid in the bucket is:

- (1) 75 cm
 - (2) 50 cm
 - (3) 18 cm
 - (4) 12 cm
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4. A stone of mass 1 kg is tied to the end of a massless string of length 1 m. If the breaking tension of the string is 400 N, then maximum linear velocity the stone can have without breaking the string, while rotating in horizontal plane, is:

- (1) 20 m/s
 - (2) 40 m/s
 - (3) 400 m/s
 - (4) 10 m/s
-

5. For a solid rod, the Young's modulus of elasticity is $3.2 \times 10^{11} \text{ Nm}^{-2}$ and density is $8 \times 10^3 \text{ kg m}^{-3}$. The velocity of longitudinal wave in the rod will be:

- (1) $145.75 \times 10^3 \text{ ms}^{-1}$
- (2) $3.65 \times 10^3 \text{ ms}^{-1}$
- (3) $18.96 \times 10^3 \text{ ms}^{-1}$

(4) $6.32 \times 10^3 \text{ ms}^{-1}$

6. A long conducting wire having a current I flowing through it, is bent into a circular coil of N turns. Then it is bent into a circular coil of n turns. The magnetic field is calculated at the centre of coils in both the cases. The ratio of the magnetic field in first case to that of second case is:

(1) $n : N$

(2) $n^2 : N^2$

(3) $N^2 : n^2$

(4) $n : N$

7. Heat energy of 735 J is given to a diatomic gas allowing the gas to expand at constant pressure. Each gas molecule rotates around an internal axis but does not oscillate. The increase in the internal energy of the gas will be:

(1) 525 J

(2) 441 J

(3) 572 J

(4) 735 J

8. Given below are two statements: Statement I: For transmitting a signal, size of antenna (l) should be comparable to wavelength of signal (at least $l = \frac{\lambda}{4}$ in dimension). Statement II: In amplitude modulation, amplitude of carrier wave remains constant (unchanged). In the light of the above statements, choose the most appropriate answer from the options given below.

(1) Both Statement I and Statement II are correct

(2) Both Statement I and Statement II are incorrect

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

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

9. The number of turns of the coil of a moving coil galvanometer is increased in order to increase current sensitivity by 50%. The percentage change in voltage sensitivity of the galvanometer will be:

- (1) 100%
- (2) 50%
- (3) 75%
- (4) 0%

10. If the two metals A and B are exposed to radiation of wavelength 350 nm. The work functions of metals A and B are 4.8 eV and 2.2 eV. Then choose the correct option:

- (1) Metal B will not emit photo-electrons
- (2) Both metals A and B will emit photo-electrons
- (3) Both metals A and B will not emit photo-electrons
- (4) Metal A will not emit photo-electrons

11. A body weight W , is projected vertically upwards from earth's surface to reach a height above the earth which is equal to nine times the radius of earth. The weight of the body at that height will be:

- (1) $\frac{W}{91}$
- (2) $\frac{W}{100}$
- (3) $\frac{W}{9}$
- (4) $\frac{W}{3}$

12. Match List-I with List-II.

List-I	List-II
A. Angular momentum	I. $[ML^2T^{-2}]$
B. Torque	II. $[ML^2T^{-2}]$
C. Stress	III. $[ML^{-2}T^{-2}]$
D. Pressure gradient	IV. $[ML^{-1}T^{-2}]$

Choose the correct answer from the options given below:

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

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

13. An alternating voltage source $V = 260 \sin(628t)$ is connected across a pure inductor of 5 mH. The inductive reactance in the circuit is:

- (1) 3.14
 - (2) 6.28
 - (3) 0.5
 - (4) 0.318
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14. Match List-I with List-II.

List-I	List-II
A. Microwaves	I. Physiotherapy
B. UV rays	II. Treatment of cancer
C. Infra-red rays	III. Lasik eye surgery
D. X-rays	IV. Aircraft navigation

Choose the correct answer from the option given below:

- (1) A-II, B-IV, C-III, D-I
 - (2) A-IV, B-I, C-II, D-III
 - (3) A-III, B-II, C-I, D-IV
 - (4) A-IV, B-III, C-I, D-II
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15. The radius of electron's second stationary orbit in Bohr's atom is R . The radius of the 3rd orbit will be:

- (1) $\frac{R}{3}$
 - (2) $2.25R$
 - (3) $3R$
 - (4) $9R$
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16. Under the same load, wire A having length 5.0 m and cross section $2.5 \times 10^{-5} \text{ m}^2$ stretches uniformly by the same amount as another wire B of length 6.0 m and a cross

section of $3.0 \times 10^{-5} \text{ m}^2$. The ratio of the Young's modulus of wire A to that of wire B will be:

- (1) 1:4
 - (2) 1:1
 - (3) 1:10
 - (4) 1:2
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17. Considering a group of positive charges, which of the following statements is correct?

- (1) Net potential of the system cannot be zero at a point but net electric field can be zero at that point.
 - (2) Net potential of the system at a point can be zero but net electric field can't be zero at that point.
 - (3) Both the net potential and the net electric field can be zero at a point.
 - (4) Both the net potential and the net electric field cannot be zero at a point.
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18. A body of mass 10 kg is moving with an initial speed of 20 m/s. The body stops after 5 s due to friction between the body and the floor. The value of the coefficient of friction is: (Take acceleration due to gravity $g = 10 \text{ m/s}^2$)

- (1) 0.2
 - (2) 0.3
 - (3) 0.5
 - (4) 0.4
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19. A hypothetical gas expands adiabatically such that its volume changes from 08 litres to 27 litres. If the ratio of final pressure of the gas to initial pressure of the gas is $\frac{16}{81}$, then the ratio of C_P to C_V will be:

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

20. Given below are two statements:

Statement I: In a typical transistor, all three regions emitter, base, and collector have same doping level. **Statement II:** In a transistor, collector is the thickest and base is the thinnest segment. In light of the above statements, choose the most appropriate answer from the options given below.

- (1) Both Statement I and Statement II are correct
 - (2) Both Statement I and Statement II are incorrect
 - (3) Statement I is incorrect but Statement II is correct
 - (4) Statement I is correct but Statement II is incorrect
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SECTION-B

21. A series LCR circuit consists of $R = 80 \Omega$, $X_L = 100 \Omega$, and $X_C = 40 \Omega$. The input voltage is $2500 \cos(100\pi t)$ V. The amplitude of current, in the circuit, is A.

22. Two light waves of wavelengths 800 nm and 600 nm are used in Young's double slit experiment to obtain interference fringes on a screen placed 7 m away from the plane of slits. If the two slits are separated by 0.35 mm, then the shortest distance from the central bright maximum to the point where the bright fringes of the two wavelengths coincide will be mm.

23. A water heater of power 2000 W is used to heat water. The specific heat capacity of water is $4200 \text{ J kg}^{-1} \text{ K}^{-1}$. The efficiency of the heater is 70%. Time required to heat 2 kg of water from 10°C to 60°C is s.

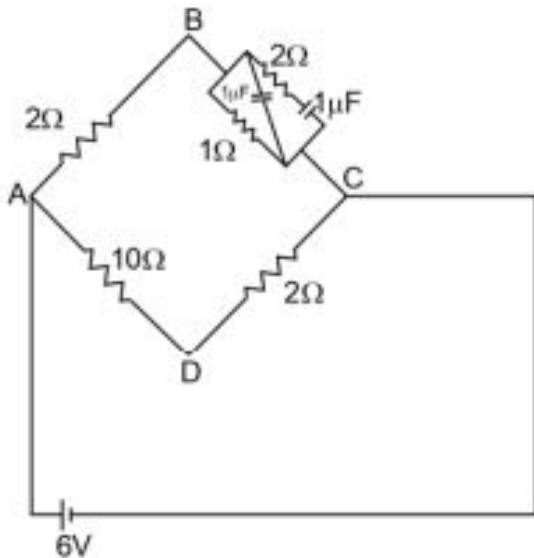
24. A ball is dropped from a height of 20 m. If the coefficient of restitution for the collision between the ball and the floor is 0.5, after hitting the floor, the ball rebounds to a height of m.

25. Two discs of the same mass and different radii are made of different materials such that their thicknesses are 1 cm and 0.5 cm respectively. The densities of materials are in

the ratio 3:5. The moment of inertia of these discs respectively about their diameters will be in the ratio $\frac{x}{6}$. The value of x is

26. If the binding energy of the ground state electron in a hydrogen atom is 13.6 eV, then the energy required to remove the electron from the second excited state of Li^{2+} will be: $x \times 10^1$ eV. The value of x is

27. For the given circuit, in the steady state, $|V_B - V_D| = \dots\dots\dots \text{ V}$.



28. Two parallel plate capacitors C_1 and C_2 , each having capacitance of $10 \mu\text{F}$ are individually charged by a 100 V D.C. source. Capacitor C_1 is kept connected to the source and a dielectric slab is inserted between its plates. Capacitor C_2 is disconnected from the source and then a dielectric slab is inserted in it. Afterwards, the capacitor C_1 is also disconnected from the source and the two capacitors are finally connected in parallel combination. The common potential of the combination will be V. (Assuming Dielectric constant = 10)

29. The displacement equations of two interfering waves are given by

$$y_1 = 10 \sin(\omega t + \frac{\pi}{3}) \text{ cm}, \quad y_2 = 5[\sin(\omega t) + \sqrt{3} \cos(\omega t)] \text{ cm}.$$

The amplitude of the resultant wave is cm.

30. Two bodies are projected from ground with same speeds 40 m/s at two different angles with respect to horizontal. The bodies were found to have same range. If one of the body was projected at an angle of 60° , with horizontal then sum of the maximum heights, attained by the two projectiles is m. (Given $g = 10 \text{ m/s}^2$)
