

JEE Main 2024 April 6 Shift 2 Physics Question Paper

Time Allowed :1 Hour	Maximum Marks :100	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 90 questions. 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.

1. The longest wavelength associated with the Paschen series is: (Given $R_H = 1.097 \times 10^7 \text{ SI unit}$)

- (1) $1.094 \times 10^{-6} \text{ m}$
- (2) $2.973 \times 10^{-6} \text{ m}$
- (3) $3.646 \times 10^{-6} \text{ m}$
- (4) $1.876 \times 10^{-6} \text{ m}$

2. A total of 48 J of heat is given to one mole of helium kept in a cylinder. The temperature of helium increases by 2°C . The work done by the gas is: (Given, $R = 8.3 \text{ J K}^{-1}\text{mol}^{-1}$)

- (1) 72.9 J
- (2) 24.9 J
- (3) 48 J
- (4) 23.1 J

3. In finding out the refractive index of a glass slab, the following observations were made through a travelling microscope: 50 vernier scale division = 49 MSD; 20 divisions on the main scale in each cm.

For mark on paper:

$$\text{MSR} = 8.45 \text{ cm}, \text{VC} = 26$$

For mark on paper seen through slab:

MSR = 7.12 cm, VC = 41

For powder particle on the top surface of the glass slab:

MSR = 4.05 cm, VC = 1

(MSR = Main Scale Reading, VC = Vernier Coincidence)

The refractive index of the glass slab is:

- (1) 1.42
 - (2) 1.52
 - (3) 1.24
 - (4) 1.35
-

4. In the given electromagnetic wave

$$E_y = 600 \sin(\omega t - kx) \text{ Vm}^{-1},$$

the intensity of the associated light beam is (in W/m^2); (Given $\epsilon_0 = 9 \times 10^{-12} \text{ C}^2\text{N}^{-1}\text{m}^{-2}$)

- (1) 486
 - (2) 243
 - (3) 729
 - (4) 972
-

5. Assuming the earth to be a sphere of uniform mass density, a body weighed 300 N on the surface of the earth. How much would it weigh at $R/4$ depth under the surface of the earth?

- (1) 75 N
 - (2) 375 N
 - (3) 300 N
 - (4) 225 N
-

6. The acceptor level of a p-type semiconductor is 6 eV. The maximum wavelength of light which can create a hole would be: (Given $hc = 1240 \text{ eV nm}$)

- (1) 407 nm
 - (2) 414 nm
 - (3) 207 nm
 - (4) 103.5 nm
-

7. A car of 800 kg is taking a turn on a banked road of radius 300 m and angle of banking 30° . If the coefficient of static friction is 0.2, then the maximum speed with which the car can negotiate the turn safely is: ($g = 10 \text{ m/s}^2$, $\sqrt{3} = 1.73$)

- (1) 70.4 m/s
 - (2) 51.4 m/s
 - (3) 264 m/s
 - (4) 102.8 m/s
-

8. Two identical conducting spheres P and S with charge Q on each, repel each other with a force of 16 N. A third identical uncharged conducting sphere R is

successively brought in contact with the two spheres. The new force of repulsion between P and S is:

- (1) 4 N
 - (2) 6 N
 - (3) 1 N
 - (4) 12 N
-

9. In a coil, the current changes from -2 A to $+2\text{ A}$ in 0.2 s and induces an emf of 0.1 V . The self-inductance of the coil is:

- (1) 5 mH
 - (2) 1 mH
 - (3) 2.5 mH
 - (4) 4 mH
-

10. For the thin convex lens, the radii of curvature are at 15 cm and 30 cm respectively. The focal length of the lens is 20 cm. The refractive index of the material is:

- (1) 1.2
 - (2) 1.4
 - (3) 1.5
 - (4) 1.8
-

11. Energy of 10 non-rigid diatomic molecules at temperature T is:

- (1) $\frac{7}{2}RT$
 - (2) $70 k_B T$
 - (3) $35 RT$
 - (4) $35 k_B T$
-

12. A body of weight 200 N is suspended from a tree branch through a chain of mass 10 kg. The branch pulls the chain by a force equal to (if $g = 10\text{ m/s}^2$):

- (1) 150 N
 - (2) 300 N
 - (3) 200 N
 - (4) 100 N
-

13. When UV light of wavelength 300 nm is incident on the metal surface having work function 2.13 eV, electron emission takes place. The stopping potential is: (Given $hc = 1240\text{ eV nm}$)

- (1) 4 V
 - (2) 4.1 V
 - (3) 2 V
 - (4) 1.5 V
-

14. The number of electrons flowing per second in the filament of a 110 W bulb

operating at 220 V is: (Given $e = 1.6 \times 10^{-19} \text{ C}$)

- (1) 31.25×10^{17}
 - (2) 6.25×10^{18}
 - (3) 6.25×10^{17}
 - (4) 1.25×10^{19}
-

15. When the kinetic energy of a body becomes 36 times its original value, the percentage increase in the momentum of the body will be:

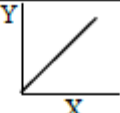
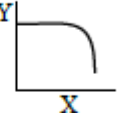
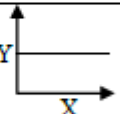
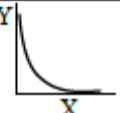
- (1) 500%
 - (2) 600%
 - (3) 6%
 - (4) 60%
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16. Pressure inside a soap bubble is greater than the pressure outside by an amount:

(Given: R = Radius of bubble, S = Surface tension of bubble)

- (1) $\frac{4S}{R}$
 - (2) $\frac{4R}{S}$
 - (3) $\frac{S}{R}$
 - (4) $\frac{2S}{R}$
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17. Match List-I with List-II

List-I (Y vs X)		List-II (Shape of Graph)	
(A)	Y = magnetic susceptibility X = magnetising field	(I)	
(B)	Y = magnetic field X = distance from centre of a current carrying wire for $x < a$ (where a = radius of wire)	(II)	
(C)	Y = magnetic field X = distance from centre of a current carrying wire for $x > a$ (where a = radius of wire)	(III)	
(D)	Y = magnetic field inside solenoid X = distance from center	(IV)	

Choose the correct answer from the options below:

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

18. In a vernier caliper, when both jaws touch each other, zero of the vernier scale shifts towards the left, and its 4th division coincides exactly with a certain division on the main scale. If 50 vernier scale divisions equal 49 main scale divisions and zero error in the instrument is 0.04 mm, then how many main scale divisions are there in 1 cm?

- (1) 40
- (2) 5
- (3) 20
- (4) 10

19. Given below are two statements:

Statement (I): Dimensions of specific heat are $[L^2T^{-2}K^{-1}]$

Statement (II): Dimensions of gas constant are $[ML^2T^{-2}K^{-1}]$

- (1) Statement (I) is incorrect but statement (II) is correct

- (2) Both statement (I) and statement (II) are incorrect
(3) Statement (I) is correct but statement (II) is incorrect
(4) Both statement (I) and statement (II) are correct
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20. A body projected vertically upwards with a certain speed from the top of a tower reaches the ground in t_1 . If it is projected vertically downwards from the same point with the same speed, it reaches the ground in t_2 . Time required to reach the ground, if it is dropped from the top of the tower, is:

- (1) $\sqrt{t_1 t_2}$
(2) $\sqrt{t_1 - t_2}$
(3) $\sqrt{\frac{t_1}{t_2}}$
(4) $\sqrt{t_1 + t_2}$
-

21. In the Franck-Hertz experiment, the first dip in the current-voltage graph for hydrogen is observed at 10.2 V. The wavelength of light emitted by the hydrogen atom when excited to the first excitation level is ____ nm.

(Given $hc = 1245 \text{ eV nm}$, $e = 1.6 \times 10^{-19} \text{ C}$)

22. For a given series LCR circuit, it is found that maximum current is drawn when the value of variable capacitance is 2.5 nF. If resistance of 200Ω and 100 mH inductor is being used in the circuit, the frequency of the AC source is ____ $\times 10^3 \text{ Hz}$. (Given $\pi^2 = 10$)

23. A particle moves in a straight line such that its displacement x at any time t is given by:

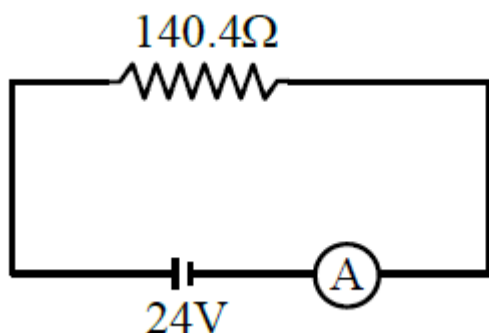
$$x^2 = 1 + t^2.$$

Its acceleration at any time t is x^{-n} , where $n = \text{____}$.

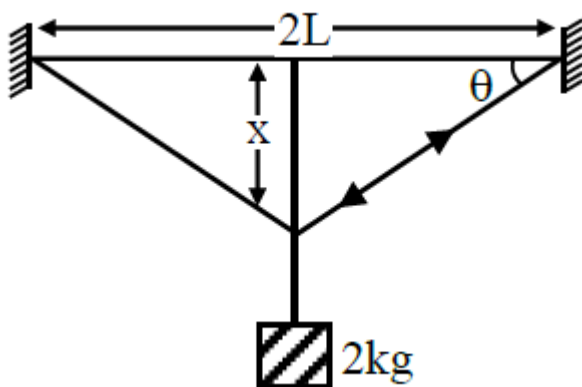
24. Three balls of masses 2 kg, 4 kg, and 6 kg respectively are arranged at the center of the edges of an equilateral triangle of side 2 m. The moment of inertia of the system about an axis through the centroid and perpendicular to the plane of the triangle will be ____ kg m^2 .

25. A coil having 100 turns, area of $5 \times 10^{-3} \text{ m}^2$, carrying a current of 1 mA is placed in a uniform magnetic field of 0.20 T such that the plane of the coil is perpendicular to the magnetic field. The work done in turning the coil through 90° is ____ μJ .

26. In the given figure, an ammeter A consists of a 240Ω coil connected in parallel with a 10Ω shunt. The reading of the ammeter is ____ mA.



27. A wire of cross-sectional area A , modulus of elasticity $2 \times 10^{11} \text{ Nm}^{-2}$, and length 2 m is stretched between two rigid vertical supports. When a 2 kg mass is suspended at the middle, it sags, making an angle $\theta = \frac{1}{100}$ radian at the points of support. The value of A is $\text{---} \times 10^{-4} \text{ m}^2$.
(Given: $g = 10 \text{ m/s}^2$)



28. Two coherent monochromatic light beams of intensities I and $4I$ are superimposed. The difference between maximum and minimum intensities in the resulting beam is x . The value of x is --- .

29. Two open organ pipes of lengths 60 cm and 90 cm resonate at the 6th and 5th harmonics respectively. The difference in frequencies for these modes is --- Hz.
(Velocity of sound in air $v = 333 \text{ m/s}$)

30. A capacitor with a capacitance of $10 \mu\text{F}$ has plates separated by 10 mm and each plate has an area of 4 cm^2 . It is now filled with two dielectric media with dielectric constants $K_1 = 2$ and $K_2 = 3$. If the new force between the plates is 8 N, the supply voltage is --- V.

