



### General Instructions

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- (i) **Duration:** The total duration of the examination is 1 hours (60 minutes).
- (ii) **Total Marks:** The complete Physics paper carries a maximum of 100 marks.
- (iii) **Structure:** The paper consists of two sections:
  - **Section A:** 20 Multiple Choice Questions (MCQs).
  - **Section B:** 5 Numerical Value Type Questions.
- (iv) **Compulsory Questions:** All 25 questions are compulsory.
- (v) Each question has four options. Only **one** option is correct.
- (vi) **Correct Answer:** +4 marks.
- (vii) **Incorrect Answer:** –1 mark (Negative marking).
- (viii) **Unanswered/Marked for Review:** 0 marks.

### Physics Section - A

1. The percentage error in the calculated volume of a sphere, if there is 2% error in its diameter measurement, is \_\_\_\_\_.

- (A) 1
- (B) 2
- (C) 6
- (D) 8

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2. Match List - I with List - II.

| List - I                  | List - II                 |
|---------------------------|---------------------------|
| A. Boltzmann constant     | I. $[M^{-1}L^3T^{-2}]$    |
| B. Stefan's constant      | II. $[ML^2T^{-1}]$        |
| C. Planck's constant      | III. $[ML^2T^{-2}K^{-1}]$ |
| D. Gravitational constant | IV. $[ML^0T^{-3}K^{-4}]$  |

Choose the correct answer from the options given below :

- (A) A-I, B-II, C-III, D-IV  
(B) A-IV, B-III, C-II, D-I  
(C) A-III, B-IV, C-II, D-I  
(D) A-II, B-I, C-IV, D-III
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3. A solid sphere (A) of mass  $5m$  and a spherical shell (B) of mass  $m$ , both having same radius, are placed on a rough surface. When a force of same magnitude is applied tangentially at the highest points of A and B, they start rolling without slipping with an acceleration of  $a_A$  and  $a_B$ , respectively. The ratio of  $a_A$  and  $a_B$  is \_\_\_\_\_.

- (A) 5 : 21  
(B) 6 : 10  
(C) 21 : 25  
(D) 1 : 5
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4. A body of mass  $1\text{ kg}$  moves along a straight line with a velocity  $v = 2x^2$ . The work done by the body during displacement from  $x = 0$  to  $5\text{ m}$  is \_\_\_\_\_ J.

- (A) 0  
(B) 250  
(C) 1250  
(D) 1000
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5. A cylinder with adiabatic walls is closed at both ends and is divided into two compartments

by a frictionless adiabatic piston. Ideal gas is filled in both (left and right) the compartments at same P, V, T. Heating is started from left side until pressure changes to  $\frac{27P}{8}$ . If initial volume of each compartment was 9 litres then the final volume in right-hand side compartment is \_\_\_\_\_ litres. (for this ideal gas  $C_p/C_v = 1.5$ )

- (A) 3
  - (B) 4
  - (C) 14
  - (D) 9
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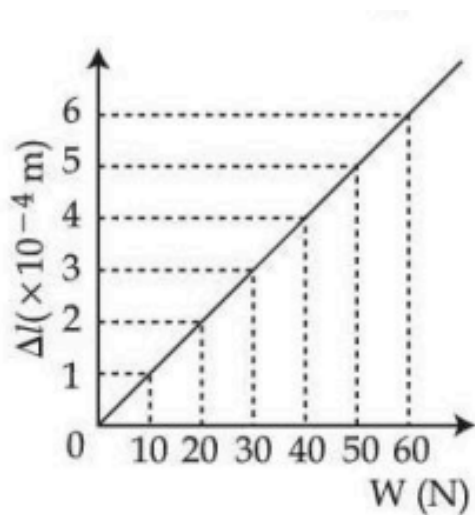
6. For an electromagnetic wave propagating through vacuum,  $\vec{k}$ ,  $\vec{E}$  and  $\omega$  represent propagation vector, electric field and angular frequency, respectively. The magnetic field associated with this wave is represented by :

- (A)  $\frac{\vec{E} \times \vec{k}}{\omega}$
  - (B)  $\frac{\vec{k} \times \vec{E}}{\omega}$
  - (C)  $\omega(\vec{E} \times \vec{k})$
  - (D)  $\omega(\vec{k} \times \vec{E})$
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7. Two identical bodies A and B of equal masses have initial velocities  $\vec{v}_1 = 4\hat{i}$  m/s and  $\vec{v}_2 = 4\hat{j}$  m/s respectively. The body A has acceleration  $\vec{a}_1 = 6\hat{i} + 6\hat{j}$  m/s<sup>2</sup> while the acceleration of the other body B is zero. The centre of mass of the two bodies moves in \_\_\_\_\_ path.

- (A) circular
  - (B) parabolic
  - (C) straight line
  - (D) elliptical
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8. Figure represents the extension ( $\Delta l$ ) of a wire of length 1 meter, suspended from the ceiling of the room at one end with a load W connected to the other end. If the cross-sectional area of the wire is  $10^{-5}$  m<sup>2</sup> then the Young's modulus of the wire is \_\_\_\_\_ N/m<sup>2</sup>.



- (A)  $1.0 \times 10^{11}$   
 (B)  $2.0 \times 10^{10}$   
 (C)  $1.0 \times 10^{10}$   
 (D)  $2.0 \times 10^{11}$

9. A cylindrical vessel of 40 cm radius is completely filled with water and its capacity is  $528 \text{ dm}^3$  ( $\text{dm}$  : decimeter). The vessel is placed on a solid block of exactly same height as vessel. If a small hole is made at 70 cm below the top of water level, then horizontal range of water falling on the ground in the beginning is \_\_\_\_\_ cm.

- (A)  $120\sqrt{2}$   
 (B)  $140\sqrt{2}$   
 (C)  $140\sqrt{3}$   
 (D)  $120\sqrt{3}$

10. If 2 mole of an ideal monoatomic gas at temperature  $T$ , is mixed with 6 mole of another ideal monoatomic gas at temperature  $2T$  then the temperature of mixture is :

- (A)  $\frac{5}{2}T$   
 (B)  $\frac{5}{4}T$   
 (C)  $\frac{7}{2}T$

(D)  $\frac{7}{4}T$

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11. A spring stretches by 2 mm when it is loaded with a mass of 200 g. From equilibrium position the mass is further pulled down by 2 mm and released. The frequency associated with the system and maximum energy in the spring are \_\_\_\_\_ Hz and \_\_\_\_\_ J, respectively. (Take  $g = 10 \text{ m/s}^2$ )

(A)  $\frac{5\sqrt{50}}{\pi}$  and  $8 \times 10^{-3}$

(B)  $\frac{5\sqrt{50}}{\pi}$  and 8

(C)  $\frac{10\sqrt{50}}{\pi}$  and  $2 \times 10^{-3}$

(D)  $\frac{5\sqrt{50}}{\pi}$  and  $16 \times 10^{-3}$

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12. The electric potential as a function of  $x, y$  is given by  $V = 5(x^2 - y^2) \text{ V}$ . The electric field at a point (2, 3) m is \_\_\_\_\_ V/m.

(A)  $(-20\hat{i} + 30\hat{j})$

(B)  $(20\hat{i} - 30\hat{j})$

(C)  $(20\hat{i} + 45\hat{j})$

(D)  $(-4\hat{i} + 6\hat{j})$

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13. A current of 30 A each flows in opposite directions in two conducting wires, placed parallel to each other at a distance of 8 cm. The magnetic field at the mid point between the two wires is \_\_\_\_\_  $\mu\text{T}$ . ( $\frac{\mu_0}{4\pi} = 10^{-7} \text{ N/A}^2$ )

(A) 30

(B) 300

(C) 150

(D) 0.0

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14. A square loop of side 2 cm is placed in a time varying magnetic field with magnitude as  $B = 0.4 \sin(300t)$  Tesla. The normal to the plane of loop makes an angle of  $60^\circ$  with the field. The maximum induced emf produced in the loop is \_\_\_\_\_ mV.

- (A) 12
  - (B) 18
  - (C) 21
  - (D) 24
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15. A sphere of capacitance 100 pF is charged to a potential of 100 V. Another identical uncharged metal sphere is brought in contact with the charged sphere, then the change in the total energy stored on these spheres, when they touch is  $\alpha \times 10^{-7}$  J. The value of  $\alpha$  is \_\_\_\_\_ (combined capacitance of spheres is 200 pF)

- (A) 5
  - (B)  $\frac{5}{2}$
  - (C)  $\frac{7}{2}$
  - (D)  $\frac{9}{2}$
- 

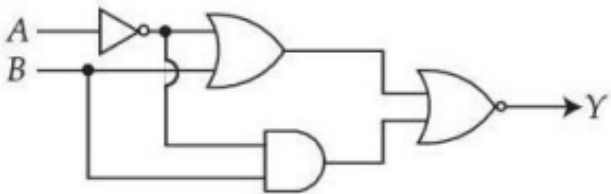
16. The energy released if hydrogen atoms are combined to form  ${}^4_2\text{He}$  is \_\_\_\_\_ MeV. (Take binding energies per nucleon of  ${}^2_1\text{H}$  and  ${}^4_2\text{He}$  as 1.1 MeV and 7.2 MeV, respectively)

- (A) 6.1
  - (B) 24.4
  - (C) 26.6
  - (D) 5
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17. Angle of minimum deviation is equal to the half of the angle of prism in an equilateral prism. The refractive index of the prism is \_\_\_\_\_ .

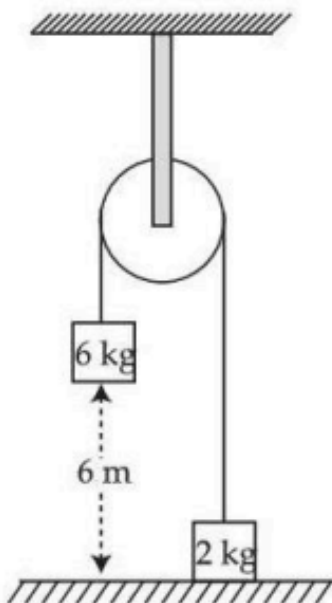
- (A) 1.5
- (B)  $\sqrt{3}$
- (C)  $\sqrt{2}$
- (D) 1.65

18. Refer to the logic circuit given below. For two inputs ( $A = 1, B = 1$ ) and ( $A = 0, B = 1$ ), output (Y) will be \_\_\_\_\_ .



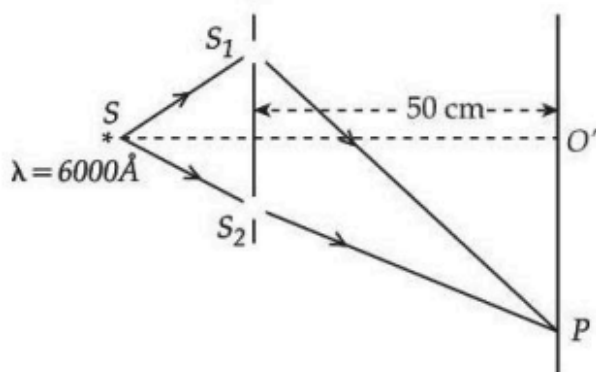
- (A) 1, 0 respectively
- (B) 0, 1 respectively
- (C) 0, 0 respectively
- (D) 1, 1 respectively

19. The velocity at which 6 kg mass (shown in figure) strikes the ground when it is released from a height of 6 m above the ground is \_\_\_\_\_ m/s. Assume pulley is massless and string is light and inextensible. (Take  $g = 10 \text{ m/s}^2$ )



- (A) 7.74
- (B) 7.20
- (C) 6.55
- (D) 4.50

20. In a Young double slit experiment, the wavelength of incident light is  $6000 \text{ \AA}$ , the separation between slits  $S_1$  and  $S_2$  is 5 cm and the distance between slits plane and screen is 50 cm, as shown in the figure below. If the resultant intensity at P is equal to the intensity due to individual slits, the path difference between interfering waves is \_\_\_\_\_  $\text{\AA}$ .



- (A) 4000
- (B) 3000
- (C) 2000
- (D) 1000

### Physics Section - B

21. A block takes  $t$  time to slide down a plane inclined at  $45^\circ$  to the horizontal. If the surface is made smooth (frictionless), the block takes time  $t/2$  to slide down the plane. The coefficient of friction between the block and the inclined plane is  $\left(\frac{\alpha}{100}\right)$ . The value of  $\alpha$  is \_\_\_\_\_.

22. The de Broglie wavelength for an electron accelerated through the potential difference of  $V_1$  volt is  $\lambda_1$ . When the potential difference is changed to  $V_2$  volt, the associated de Broglie wavelength is increased by 50%. If  $(V_1/V_2) = (9/\alpha)$ , then the value of  $\alpha$  is \_\_\_\_\_ .

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23. A moving coil of galvanometer when shunted with  $2\ \Omega$  resistance gives a full scale deflection for a current of 500 mA. When a resistance of  $470\ \Omega$  is connected in series it gives a full scale deflection for 10 V potential applied on it. The value of resistance of galvanometer coil is \_\_\_\_\_  $\Omega$ .

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24. Two cells of emfs 1 V and 2 V and internal resistance  $2\ \Omega$  and  $1\ \Omega$ , respectively connected in parallel, gave a current of 1 A through an external resistance. If the polarity of one cell is reversed, then value of current through the external resistance will be  $\frac{\alpha}{5}$  A. The value of  $\alpha$  is \_\_\_\_\_ .

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25. A concave mirror of focal length 10 cm forms an image which is double the size of object when the object is placed at two different positions. The distance between the two positions of the object is \_\_\_\_\_ cm.

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