



General Instructions

- (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. In a Vernier calipers, when both jaws touch each other, zero of the Vernier scale is shifted to the right of zero of the main scale and 7^{th} Vernier division coincides with a main scale reading. If the value of 1 main scale division is 1 mm and there are 10 Vernier scale divisions, then the Vernier caliper has:

- (A) 0.07 cm negative zero error
- (B) 0.7 cm negative zero error

- (C) 0.07 cm positive zero error
(D) 0.7 cm positive zero error
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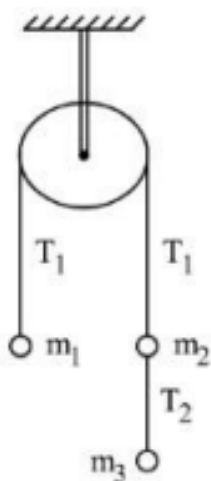
2. L , C and R represents physical quantities inductance, capacitance and resistance respectively. The dimensional formula $ML^2T^{-4}A^{-2}$ corresponds to _____.

- (A) $\frac{R}{\sqrt{LC}}$
(B) $\frac{R}{LC}$
(C) $\frac{C}{\sqrt{LR}}$
(D) $\frac{1}{R}\sqrt{\frac{L}{C}}$
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3. When one moves from a point 16 km below the earth's surface to a point 16 km above the earth's surface. The change in g is approximately $\alpha\%$. The value of α is _____. (Take radius of the earth = 6400 km.)

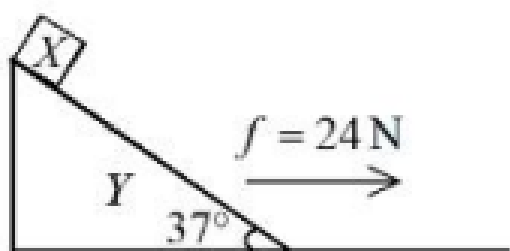
- (A) 0.12
(B) 0.25
(C) 0.50
(D) 0.75
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4. Three masses $m_1 = 4$ kg, $m_2 = 4$ kg and $m_3 = 6$ kg are suspended from a fixed smooth frictionless pulley as shown in the figure below. The value of T_1/T_2 is: (take $g = 10$ m/s²)



- (A) $5/3$
- (B) $2/3$
- (C) $3/5$
- (D) $3/5$

5. A wedge Y with mass of 10 kg and all frictionless surfaces and the inclined surface making 37° with horizontal. A block X with mass 2 kg is placed at the highest point of the wedge as shown in figure is at rest. At $t = 0$ wedge (Y) is pulled toward right with constant force (f) of 24 N . Taking the block X at rest at $t = 0$, the time taken by it to slide down 8.8 m on the slope, while Y is on the move, is _____ s.



(take $\tan(37^\circ) = 3/4$ and $g = 10\text{ m/s}^2$)

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

6. The Young's modulus of steel wire of radius r and length L is Y . If the radius r and length L of the wire are doubled then the value of Y :

- (A) increases by two times
- (B) reduces by half
- (C) remains unchanged
- (D) becomes one fourth

7. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R

Statement I: Change in internal energy of a system containing n mole of ideal gas can be written as $\Delta U = nC_v(T_f - T_i) = \frac{nR}{\gamma-1}(T_f - T_i)$, where $\gamma = \frac{C_p}{C_v}$, T_i = initial temperature, T_f = final temperature.

Statement II: Relation between degree of freedom f and $\gamma (= C_p/C_v)$ is $\gamma = 1 + \frac{2}{f}$

Choose the correct answer from the options given below

- (A) Both A and R are true and R is the correct explanation of A
- (B) Both A and R are true but R is NOT the correct explanation of A
- (C) A is true but R is false
- (D) A is false but R is true

8. Consider the following statements:

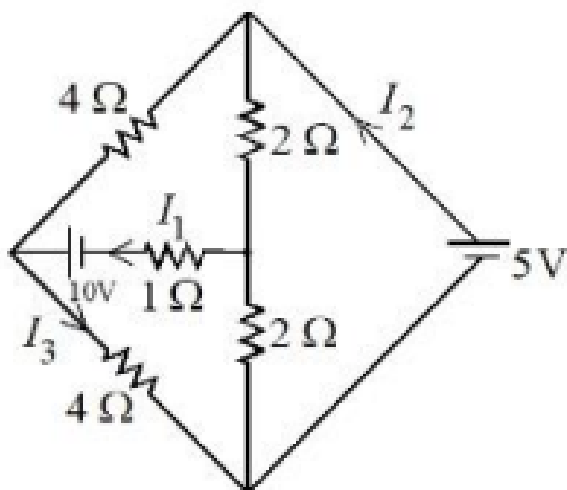
- A. Zeroth law of thermodynamics gives concept of temperature
- B. First law of thermodynamics gives concept of internal energy
- C. In isothermal expansion of ideal gas, $\Delta Q \neq \Delta W$
- D. Product of intensive and extensive variables is extensive
- E. The ratio of any extensive variable to mass will be an extensive variable

Choose the correct combination of statements from the options given below:

- (A) C, D and E Only

- (B) A, B and C Only
 (C) A, B and D Only
 (D) B, C and D Only

9. Refer to the figure given below. The values of I_1, I_2 and I_3 are _____



- (A) $I_1 = 2.5 \text{ A}, I_2 = 1.875 \text{ A}, I_3 = 1.875 \text{ A}$
 (B) $I_1 = 1.875 \text{ A}, I_2 = 2.5 \text{ A}, I_3 = 1.875 \text{ A}$
 (C) $I_1 = 1.875 \text{ A}, I_2 = 1.875 \text{ A}, I_3 = 2.5 \text{ A}$
 (D) $I_1 = 2.5 \text{ A}, I_2 = 2.5 \text{ A}, I_3 = 1.875 \text{ A}$

10. An electron of mass m is moving in an electric field $\vec{E} = -2E_0\hat{i}$ ($E_0 = \text{constant} > 0$), with an initial velocity $\vec{v} = v_0\hat{i}$ ($v_0 = \text{constant} > 0$). If $\lambda_0 = \frac{h}{4mv_0}$, its de Broglie wavelength at time t is:

- (A) $\frac{4\lambda_0}{\left[1 - \frac{E_0 e t}{2mv_0}\right]}$
 (B) $\frac{4\lambda_0}{\left[1 + \frac{E_0 e t}{2mv_0}\right]}$
 (C) $\frac{4\lambda_0}{\left[1 + \frac{2E_0 e t}{mv_0}\right]}$
 (D) $\frac{4\lambda_0}{\left[1 - \frac{2E_0 e t}{mv_0}\right]}$

11. In the hydrogen atom, the electron makes a transition from the higher orbit (i) to a lower

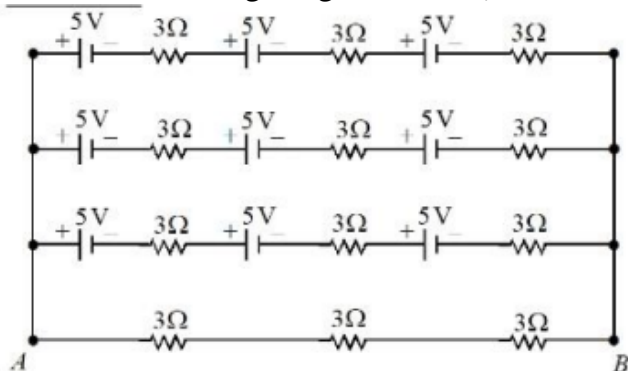
orbit (f). The ratio of the radius of the orbits is given by $r_i : r_f = 16 : 4$. The wavelength of photon emitted due to this transition is _____ nm. (Given Rydberg constant = $1.097 \times 10^7 / \text{m}$)

- (A) 121
- (B) 242
- (C) 486
- (D) 974

12. A displacement current of 4.0 A can be set up in the space between two parallel plates of $6\mu\text{F}$ capacitor. The rate of change of potential difference across the plates of the capacitor is nearly $\alpha \times 10^6$ V/s. The value of α is _____.

- (A) 0.58
- (B) 0.67
- (C) 0.82
- (D) 0.75

13. Refer to the figure given below, current between terminals A and B is _____



- (A) 12.5
- (B) 1.25
- (C) 7.5
- (D) 5

14. In Young's double slit experiment, the fringe width of the interference pattern produced on the screen is $2.4\mu\text{m}$. If the experiment is carried out in another medium having refractive index 1.2, the fringe width will be _____ μm .

- (A) 1.2
- (B) 2
- (C) 2.4
- (D) 2.88

15. A ray of light passing through an equilateral prism is having velocity $2.12 \times 10^8 \text{ m/s}$ in the prism material, then the minimum angle of deviation is _____ degrees.

- (A) 45
- (B) 30
- (C) 28
- (D) 58

16. Light source having wavelength 331 nm is used to generate photo-electrons whose stopping potential is 0.2 V. The work function of the used metal in the experiment is $\alpha \times 10^{-19} \text{ J}$. The value of α is _____. ($h = 6.62 \times 10^{-34} \text{ Js}$, $e = 1.6 \times 10^{-19} \text{ C}$ and $c = 3 \times 10^8 \text{ m/s}$)

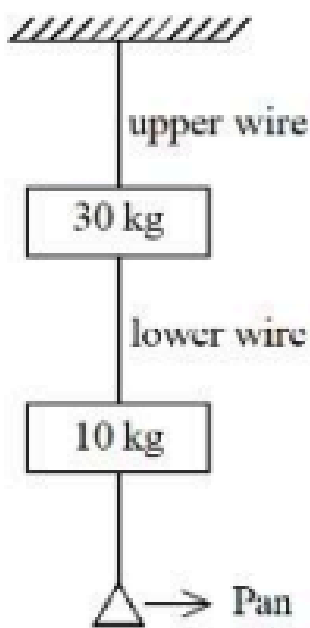
- (A) 3.68
- (B) 4.68
- (C) 5.68
- (D) 2.68

17. A compound microscope is designed with two symmetric biconvex lenses. The objective lens is cut vertically, creating two identical plano-convex lenses. One of them is used in place of original objective lens. To retain same magnification keeping the object distance unchanged,

the tube length has to be:

- (A) increased two times
- (B) increased $3/2$ times
- (C) decreased two times
- (D) decreased $3/2$ times

18. Two wires as shown in the figure below, made of steel and have breaking stress of $12 \times 10^8 \text{ N/m}^2$. Area of cross-section of upper wire is 0.008 cm^2 and of lower wire is 0.004 cm^2 . The maximum mass that can be added to pan without breaking any wire is _____ kg. (take $g = 10 \text{ m/s}^2$)



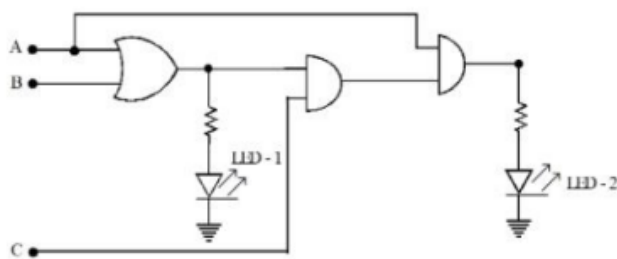
- (A) 56
- (B) 38
- (C) 96
- (D) 5.6

19. An a.c. source of angular frequency ω is connected across a resistor R and a capacitor C in series. The current is observed as I . Now the frequency of the source is changed to $\omega/4$,

(keeping the voltage unchanged) the current is found to be $I/3$. The ratio of resistance to reactance at frequency ω is:

- (A) $\sqrt{6/7}$
- (B) $\sqrt{3/5}$
- (C) $\sqrt{7/8}$
- (D) $\sqrt{3/4}$

20. For the given logic circuit, which of the following inputs combination will make both LED-1 and LED-2 to glow?



- (A) $A = 0, B = 1, C = 1$
- (B) $A = 1, B = 0, C = 0$
- (C) $A = 1, B = 0, C = 1$
- (D) $A = 1, B = 1, C = 0$

Physics Section - B

21. A cube has side length 5 cm and modulus of rigidity 10^5 N/m^2 . The displacement produced by a force of 10 N in the upper face of the cube is ____ mm.

22. From 18 m height above the ground a ball is dropped from rest. The height above the ground at which the magnitude of velocity equal to the magnitude of acceleration (in the same

set of units) due to gravity is ____ m. (Take $g = 10 \text{ m/s}^2$ and neglect air resistance)

23. A transverse wave on a string is described by $y = 3 \sin(36t + 0.018x + \pi/4)$, where x, y are in cm and t in seconds. The least distance between the two successive crests in the wave is ____ cm. (Nearest integer) ($\pi = 3.14$)

24. The charged particle moving in a uniform magnetic field of $(3\hat{i} + 2\hat{j}) \text{ T}$ has an acceleration $(4\hat{i} - \frac{x}{2}\hat{j}) \text{ m/s}^2$. The value of x is ____.

25. In the given circuit below inductance values of L_1, L_2 and L_3 are same. The magnetic energy stored in the entire circuit is (U_t) and that stored in the L_2 inductor is (U_j) . U_t/U_j is _____. (Ignore the mutual inductance if any).

