



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 screw gauge when the circular scale is given five complete rotations it moves linearly by 2.5 mm. If the circular scale has 100 divisions, the least count of screw gauge is _____ mm.

- (A) 1×10^{-2}
- (B) 1×10^{-3}
- (C) 5×10^{-2}
- (D) 5×10^{-3}

2. The increase in the pressure required to decrease the volume (ΔV) of water is $6.3 \times 10^7 \text{ N/m}^2$. The percentage decrease in the volume is _____. (Bulk modulus of water = $2.1 \times 10^9 \text{ N/m}^2$.)

- (A) 2 %
 - (B) 3 %
 - (C) 6 %
 - (D) 4 %
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3. The time taken by a block of mass m to slide down from the highest point to the lowest point on a rough inclined plane is 50 % more compared to the time taken by the same block on identical inclined smooth plane. Both inclined planes are at 45° with the horizontal. The coefficient of kinetic friction between the rough inclined surface and block is _____.

- (A) $3/4$
 - (B) $2/3$
 - (C) $5/9$
 - (D) $4/9$
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4. Two nuclei of mass number 3 combine with another nucleus of mass number 4 to yield a nucleus of mass number 10. If the binding energy per nucleon for the mass numbers 3, 4 and 10 are 5.6 MeV, 7.4 MeV and 6.1 MeV, respectively, then in the process, $\Delta Mc^2 =$ _____ MeV.

- (A) 6.9
 - (B) 7.9
 - (C) 2.2
 - (D) 4.3
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5. A solid sphere of mass M and radius R is divided into two unequal parts. The smaller part having mass $M/8$ is converted into a sphere of radius r and the larger part is converted into a circular disc of thickness t and radius $2R$. If I_1 is moment of inertia of a sphere having radius r about an axis through its centre and I_2 is the moment of inertia of a disc about its diameter,

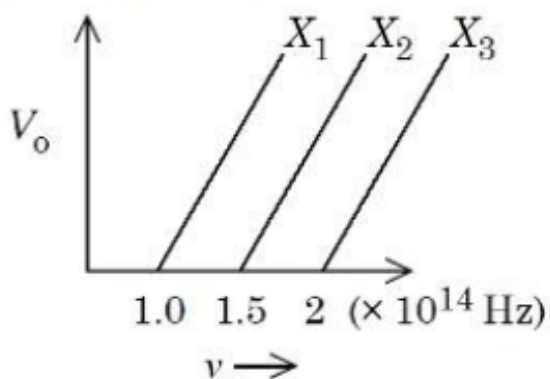
the ratio of their moment of inertia $I_2/I_1 = \underline{\hspace{2cm}}$.

- (A) 35
 - (B) 70
 - (C) 140
 - (D) 210
-

6. The two projectiles are projected with the same initial velocities at the 15° and 30° with respect to the horizontal. The ratio of their ranges is $1 : x$. The value of x is

- (A) $\sqrt{2}$
 - (B) $\sqrt{3}$
 - (C) $2\sqrt{3}$
 - (D) $\frac{1}{\sqrt{2}}$
-

7. The graph shows variation of stopping potential V_0 with the frequency ν of the incident radiation for three photosensitive metals X_1, X_2 and X_3 . Which metal will give out electrons with greater kinetic energy, for the same wavelength of incident radiation?



- (A) X_1
 - (B) X_2
 - (C) X_3
 - (D) All the metals will give out photo electrons with same kinetic energies.
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8. A slit of width a is illuminated by light of wavelength λ . The linear separation between 1^{st} and 3^{rd} minima in the diffraction pattern produced on a screen placed at a distance D from

the slit system is _____.

- (A) $\frac{D\lambda}{a}$
 - (B) $1.5\frac{D\lambda}{a}$
 - (C) $2\frac{D\lambda}{a}$
 - (D) $3\frac{D\lambda}{a}$
-

9. A string A of length 0.314 m and Young's modulus 2×10^{10} N/m² is connected to another string B of length and Young's modulus both twice of those of A. This series combination of strings is then suspended from a rigid support and its free end is fixed to a load of mass 0.8 kg. The net change in length of the combination is _____ mm.

(radius of both the strings is 0.2 mm and acceleration due to gravity = 10 m/s²)

(Mass of both strings is to be neglected as compared to the mass of load)

- (A) 3
 - (B) 2
 - (C) 1.9
 - (D) 1
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10. One gas of n_1 mole of molecules at temperature T_1 , volume V_1 , and pressure P_1 , and another gas of n_2 mole of molecules at temperature T_2 , volume V_2 , and pressure P_2 , are mixed resulting in pressure P and volume V of the mixture. The temperature of the mixture is _____.

- (A) $(T_1 + T_2)/2$
 - (B) $T_1 T_2 P V / (T_2 P_1 V_1 + T_1 P_2 V_2)$
 - (C) $(T_2 P_1 V_1 + T_1 P_2 V_2) / (T_1 T_2 P V)$
 - (D) $|T_1 - T_2|/2$
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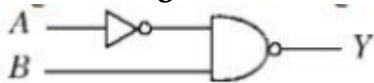
11. An ideal gas undergoes a process maintaining relation between pressure (P) and volume (V) as $P = P_0 \left[1 + \left(\frac{V_0}{V} \right)^2 \right]^{-1}$, where P_0 and V_0 are constants. If two samples A and B (two moles each) with initial volumes V_0 and $3V_0$ respectively undergo above mentioned process and attain same pressure, then the difference at the temperatures of these samples, $T_B - T_A$ is _____.

- (A) $\frac{9P_0V_0}{8R}$
 (B) $\frac{11P_0V_0}{10R}$
 (C) $\frac{7P_0V_0}{6R}$
 (D) $\frac{13P_0V_0}{11R}$

12. A voltmeter with internal resistance of $x \Omega$ can be used to measure upto 20 V. In order to increase its measuring range to 30 V, the required modification is

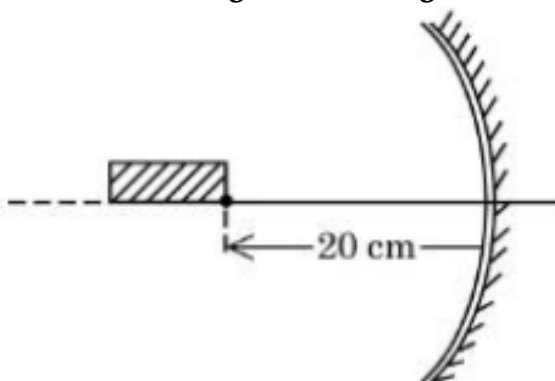
- (A) connect resistor of $\frac{x}{2} \Omega$, in series with voltmeter.
 (B) connect resistor of $\frac{x}{2} \Omega$, in parallel to voltmeter.
 (C) connect a resistor of $x \Omega$ in series with voltmeter.
 (D) connect resistor of $2x \Omega$ in parallel to voltmeter.

13. Two 4 bits binary numbers, $A = 1101$ and $B = 1010$ are given in the inputs of a logic circuit shown in figure below. The output (Y) will be:



- (A) $Y = 1101$
 (B) $Y = 0010$
 (C) $Y = 0111$
 (D) $Y = 1000$

14. A rod of length 10 cm lies along the principle axis of a concave mirror of focal length 10 cm as shown in figure. The length of the image is _____ cm.



- (A) 2.5
 (B) 5

(C) 7.5

(D) 7

15. A parallel plate air capacitor is connected to a battery. The plates are pulled apart at uniform speed v . If x is the separation between the plates at any instant, then the time rate of change of electrostatic energy of the capacitor is proportional to x^α , where α is _____.

(A) -2

(B) 1

(C) -1

(D) 2

16. An insulated wire is wound so that it forms a flat coil with $N = 200$ turns. The radius of the innermost turn is $r_1 = 3$ cm, and of the outermost turn $r_2 = 6$ cm. If 20 mA current flows in it then the magnetic moment will be $\alpha \times 10^{-2}$ A.m². The value of α is _____.

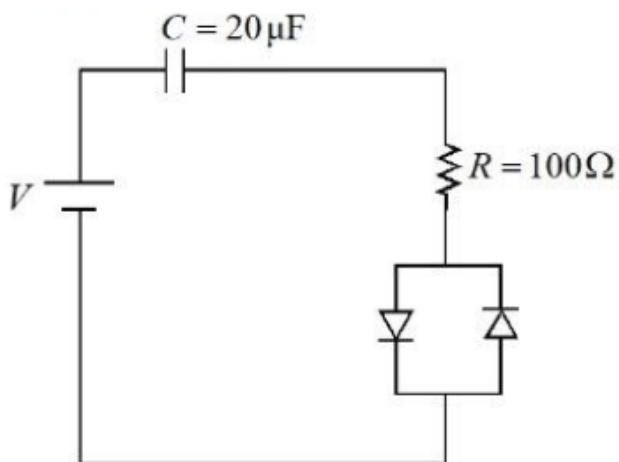
(A) 4.4

(B) 2.64

(C) 3.25

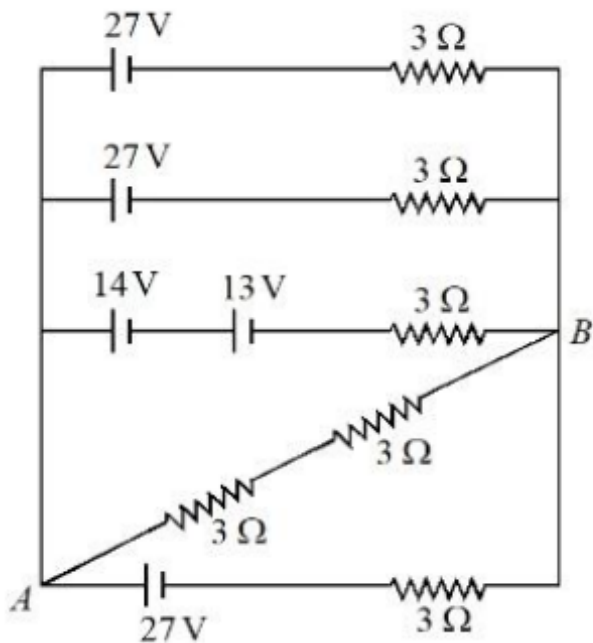
(D) 1.2

17. Consider a circuit consisting of a capacitor ($20\mu\text{F}$), resistor (100Ω) and two identical diodes as shown in the figure. The resistance of each diode under forward biasing condition is 10Ω . The time constant of the circuit is $\alpha \times 10^{-3}$ s. The value of α is _____.



- (A) 2.2
- (B) 2.0
- (C) 2.1
- (D) 2.4

18. The voltage and the current between A and B points shown in the circuit are _____



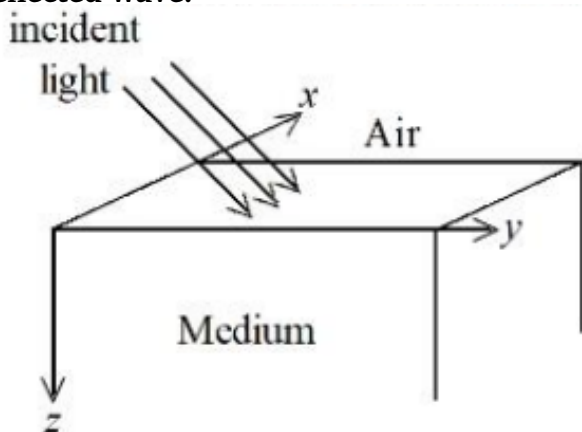
- (A) 24 V, 12 A
- (B) 24 V, 4 A
- (C) 18 V, 12 A
- (D) 27 V, 4 A

19. A telescope with objective diameter R is used to observe a distant star emitting light of wavelength 500 nm, at a resolution of 5×10^{-7} radian. The value of R is _____ cm.

- (A) 61
- (B) 122
- (C) 244
- (D) 305

20. An unpolarized light is incident on the plane interface of air-dielectric medium shown in

figure. If the incident angle is equal to Brewster angle, identify the expression representing reflected wave.



- (A) $(E_x \hat{i} + E_y \hat{j}) \sin(kx - kz - \omega t)$
 (B) $(E_x \hat{i} + E_z \hat{k}) \sin(kx + ky - \omega t)$
 (C) $(E_x \hat{j} + E_y \hat{k}) \sin(ky + kz - \omega t)$
 (D) $(E_x \hat{i} + E_y \hat{j} + E_z \hat{k}) \sin(kx + ky - kz - \omega t)$

Physics Section - B

21. A 1 kg block subjected to two simultaneous forces $(2\hat{i} + 3\hat{j} + 4\hat{k})$ N and $(3\hat{i} - \hat{j} - 2\hat{k})$ N is moved a distance of 25 m along $(3\hat{i} - 4\hat{j})$ direction. The work done in this process is _____ J.

22. The surface tension of a soap solution is 3.5×10^{-2} N/m. The work required to increase the radius of a soap bubble from 1 cm to 2 cm is $\alpha \times 10^{-6}$ J. The value of α is _____. ($\pi = 22/7$)

23. The velocity of a particle executing simple harmonic motion along x-axis is described as $v^2 = 50 - x^2$, where x represents displacement. If the time period of motion is $\frac{x}{7}$ s, the value of x is _____.

24. A body of mass 2 kg begins to move under the influence of time dependent force $\vec{F} = (2t\hat{i} + 6t^2\hat{j})$ N, where $\hat{i}$ and $\hat{j}$ are unit vectors along x and y-axis respectively. The power produced by the force at $t = 2$ s is _____ W.

25. An inductor of 10 mH , capacitor of $0.1\text{ }\mu\text{F}$, and a resistor of $100\text{ }\Omega$ are connected in series across an A.C. power supply of 220 V , 70 Hz . The power factor of the given circuit is 0.5 . The difference between the inductive reactance and capacitive reactance is $\sqrt{3}a\text{ }\Omega$. The value of a is _____.
