PHYSICS

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer:

1. For a given single electron atom, ratio of shortest wavelengths in Balmer and Lyman series is

(1) 4 : 1 (2) 1 : 4

(3) 1 : 2 (4) 2 : 1

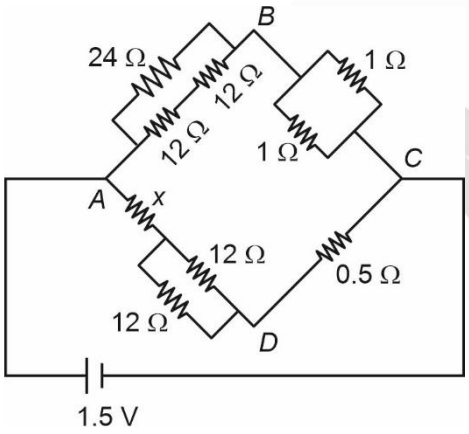
Answer (1)

Sol. $\frac{1}{\lambda_L} = RZ^2\left\{1-\frac{1}{\infty}\right\}$

$\frac{1}{\lambda_B} = RZ^2\left[\frac{1}{4}-\frac{1}{\infty}\right]$

$\frac{\lambda_B}{\lambda_L} = 4$

2. The value of unknown resistance x for which potential difference between point B and D is zero is



(1) 12 Ω (2) 6 Ω

(3) 3 Ω (4) 2 Ω

Answer (2)

Sol. $V_D - V_B = 0$, *i.e.*, it is condition of Wheatstone bridge.

$\frac{12}{6+x} = \frac{0.5}{0.5}$

$x = 6\ \Omega$

3. Which of the following does not depend on the wave nature of light?

A. Reflection

B. Diffraction

C. Photoelectric effect

D. Polarization

E. Interference

(1) C only (2) A, B

(3) A, B, C (4) D, E

Answer (1)

Sol. Theoretical

4. Four particles A, B, C, D have masses $\frac{m}{2}$, m, $2m$ and $4m$. They have equal momentum. The particle that has highest kinetic energy is

(1) A

(2) B

(3) C

(4) D

Answer (1)

Sol. $KE = \frac{p^2}{2m}$

$\Rightarrow KE \propto \frac{1}{m}$

5. Which of the following is not a semiconductor?

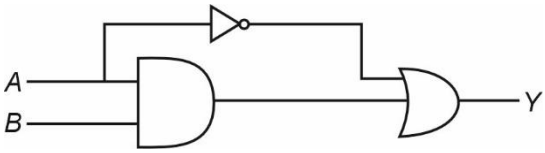
(1) Silicon (2) Germanium

(3) Copper oxide (4) Graphite

Answer (4)

Sol. Theoretical.

6. Find the truth table for the following circuit.



(1)

A	B	Y
0	0	1
0	1	1
1	0	0
1	1	0

(2)

A	B	Y
0	0	1
0	1	1
1	0	0
1	1	1

(3)

A	B	Y
0	0	0
0	1	1
1	0	0
1	1	1

(4)

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

Answer (2)

Sol. $Y = AB + A'$

$= A' + B$

7. A bullet of mass 50 gm enters a metal sheet with speed of 100 m/s and emerges with speed of 40 m/s. The loss in kinetic energy of bullet is

(1) 105 J

(2) 42 J

(3) 210 J

(4) 140 J

Answer (3)

Sol. $|\Delta K| = \frac{1}{2} \times \frac{50}{100}\{100^2 - 40^2\} = \frac{50}{2000} \times 140 \times 60$

= 210 J

8. A ball of mass m and density ρ made to free fall into viscous liquid of density ρ_0. The viscous force on ball is

(1) $mg\left(1 - \frac{\rho}{\rho_0}\right)$ (2) $mg\left(1 - \frac{\rho_0}{\rho}\right)$

(3) $\frac{mg}{1 - \frac{\rho}{\rho_0}}$ (4) $\frac{mg}{1 - \frac{\rho_0}{\rho}}$

Answer (2)

Sol. $\vec{W} + \vec{B} + \vec{F}_{\text{viscous}} = \vec{O}$

$\vec{F}_v = W + B$

$= mg - \rho_0 vg$

$= mg - \rho_0 \frac{m}{\rho} g$

$= mg\left(1 - \frac{\rho_0}{\rho}\right)$

9. For a spring block system, the error in time period calculation is 2% and the error in mass calculation is 1%. Find the percentage error in spring constant k.

(1) 2%

(2) 4%

(3) 5%

(4) 10%

Answer (3)

Sol. $k = 4\pi^2 \cdot \frac{m}{T^2}$

$\frac{dk}{k} \times 100 = \pm\left(\frac{dm}{m} \times 100 + 2 \cdot \frac{dT}{T} \times 100\right)$

$\boxed{\frac{dk}{k} \times 100 = 1 + 2 \times 2 = 5}$

10. Match the dimensions:

a.	Torque	i.	M^0L^2AT
b.	Magnetic moment	ii.	$ML^2T^{-2}A^0$
c.	Magnetic field	iii.	$MLT^{-3}A^{-2}$
d.	Permeability	iv.	$ML^0T^{-2}A^{-1}$

(1) a-i, b-ii, c-iii, d-iv (2) a-ii, b-iv, c-i, d-iii

(3) a-ii, b-i, c-iv, d-iii (4) a-ii, b-iii, c-i, d-iv

Answer (3)

Sol. $\tau = F\ell \equiv ML^2T^{-2}$

$\mu = iA \equiv M^0L^2AT$

$$B \equiv \frac{F}{qV} \equiv \frac{MLT^{-2}}{ATLT^{-1}} \equiv MT^{-2}A^{-1}$$

$$\mu_0 \equiv \frac{Br}{i} \equiv \frac{MT^{-2}A^{-1}\cdot L}{AT} \equiv MLT^{-3}A^{-2}$$

11. Kinetic energy to move a body of mass m from surface of earth to infinite distance form the earth is (g is acceleration due to gravity on surface of earth & R is radius of earth)

(1) $2mgR$ (2) $\frac{1}{2}mgR$

(3) mgR (4) $\frac{1}{4}mgR$

Answer (3)

Sol. $K + U = 0$

$$\Rightarrow K = \frac{GMm}{R} = mgR$$

12. Find the ratio of root mean square speed of oxygen and helium molecules at same temperature.

(1) $\frac{2\sqrt{2}}{1}$ (2) $\frac{1}{2\sqrt{2}}$

(3) $\frac{1}{4}$ (4) $\frac{1}{32}$

Answer (2)

Sol. $V_{rms} = \sqrt{\frac{3RT}{M}}$

$$\frac{(V_{rms})_{O_2}}{(V_{rms})_{He}} = \frac{M\mu_e}{M_{O_2}} = \sqrt{\frac{4}{32}}$$

$$= \frac{1}{2\sqrt{2}}$$

13. The specific heat capacity for a gas following the relation $PV^2 = RT$ is (C_V is heat capacity at constant volume and R is gas constant)

(1) C_V (2) $C_V + R$

(3) $\frac{R}{3} + C_V$ (4) R

Answer (1)

Sol. $\frac{PV^2}{PV} = C \Rightarrow V = \text{constant}$

$\Rightarrow$ C_V

14. A screw gauge has circular scale 100 divisions with pitch 1 mm. Upon keeping a wire between studs, main scale reading is 1 mm and circular scale divisions 42th coincide with reference line.

Find the diameter of circular cross-section wire in mm.

(1) 1.42 (2) 1.40

(3) 1.38 (4) 0.39

Answer (1)

Sol. Diameter = Main scale reeding + circular scale reading × least count

d = 1 mm + (42 × 0.01) mm

d = 1.42 mm

15.

16.

17.

18.

19.

20.

SECTION - B

Numerical Value Type Questions: This section contains 10 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. Ratio of angle of prism and minimum deviation is one for a prism whose refractive index is $\sqrt{3}$ then angle of prism (in degrees) is _____.

Answer (60)

Sol. $A = \delta$

$$\frac{\sin\left(\frac{A+\delta}{2}\right)}{\sin\frac{A}{2}} = \frac{\sin A}{\sin\frac{A}{2}} = \sqrt{3}$$

$$2\cos\frac{A}{2} = \sqrt{3}$$

$\Rightarrow$ $A = 60°$

22. Time period of a simple harmonic motion is 3.14 seconds, with amplitude 0.06 m. The maximum velocity of particle is $k \times 10^{-2}$ m/s. Find the value of k.

Answer (12)

Sol. $V_{max} = A\omega = A.\frac{2\pi}{T}$

$$V_{max} = 0.06 \times \frac{2\pi}{3.14}$$

$$\boxed{V_{max} = 0.12 \text{ m/s}}$$

23. A body uniformly accelerates [starting from rest] to speed of 80 km/hr in time t and then maintains this speed for time interval of $3t$. Average speed for whole motion is _____ km/hr.

Answer (70)

Sol. $< v >= \frac{40 \times t + 80 \times 3t}{4t} = \frac{40 + 240}{4} = 70$

24. Radiation of energy 3.5 eV is incident on a metal. The stopping potential required is 0.5 V. The work function of the metal is _____ eV.

Answer (3)

Sol. $nf - \phi = eV$

$\Rightarrow$ $\phi = 3.5 - 0.5 = 3$ eV

25. If the radius of earth is reduced to $\frac{3}{4}$th of its original radius, then the time period of earth's rotation becomes K hours 30 minutes. Find the value of K.

Answer (13)

Sol. $\vec{\tau}_{ext} = 0 \Rightarrow$ Angular momentum is conserved

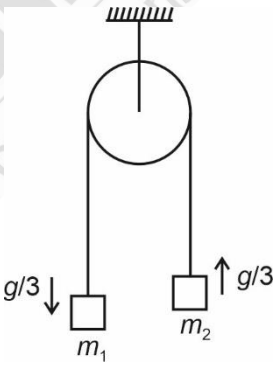
$$\frac{2}{5}mR^2 \cdot \omega = \frac{2}{5}m\left(\frac{3R}{4}\right)^2 .\omega_1$$

$$\omega_1 = \frac{16\omega}{9}$$

$$T_1 = \frac{2\pi}{\omega_1} = \frac{2\pi}{\omega} \cdot \frac{9}{16} = 24 \times \frac{9}{16} \text{ hours}$$

T_1 = 13 hours 30 minutes

26. Two masses m_1 and m_2 are attached through a thin string passing over frictionless and massless pulley. The acceleration of masses is as shown. Then $\frac{m_1}{m_2}$ is _____



Answer (2)

Sol. $a = \frac{m_1 - m_2}{m_1 + m_2}g = \frac{g}{3}$

$\Rightarrow$ $\frac{m_1}{m_2} = 2$

27.

28.

29.

30.