APPLIED PHYSICS-I

Unit – 1

(Physical world, Units and Measurements)

2 MARKS QUESTION

Q. No.	Question	Taxonomy Level	Marking Scheme
Q 1.	**Show that momentum and impulse have same dimension.**	L2	
Ans.	Dimensional formula of momentum= Mass x Velocity =$[M^1L^1T^{-1}]$ Dimensional formula of impulse = Force x Time = $[M^1L^1T^{-1}]$ Momentum and impulse have same dimensions 1,1,-1		1 1
Q2.	**Write the SI unit of following Physical quantities.** **(a) Power, (b)Pressure.**	L1	
Ans.	SI unit of Power is Watt or Joule/Sec SI unit of Pressure is Pascal or N/m^2		1 1
Q3.	**Convert the one unit of Force from SI to CGS system.**	L2	
Ans.	SI unit of Force is Newton CGS unit of Force is Dyne Force= ma = $Kg\ m/s^2$ 1 Newton =1 $Kg\ m/s^2$ **= 1000g X 100cm/s^2** **= 10^5 g cm/s^2** **= 10^5 Dyne**		1 1
Q 4.	**The energy expressed as E =K v, where v is the velocity. Find the dimensional formula of K?**	L3	
Ans.	E = K v => $[M^1L^2T^{-2}]$ = K $[M^0L^1T^{-1}]$ => K = $[M^1L^2T^{-2}]/[M^0L^1T^{-1}] = [M^1L^1T^{-1}]$ Dimensional formula of K is $[M^1L^1T^{-1}]$		1 1
Q5.	**A force F is given by F= at +bt^2, where t is time period, what is the dimensional formula of a?**	L3	
Ans.	According to principle of homogeneity, Dimensional formula of at = Dimensional formula of F Dimensional formula of a = $[M^1L^1T^{-2}]/[M^0L^0T^1]$ = $[M^1L^1T^{-3}]$		1 1
Q6.	**If radius of a circle is (2.0±0.5), then calculate percentage error in its measurement.**	L3	
Ans.	Percentage of error = $\frac{\Delta r}{r} \times 100$ = $\frac{0.5}{2.0} \times 100$ = 25%		1 1
Q7.	**Error in measurement of radius of a sphere is 2%. Find the percentage of error in measurement of its volume.**	L3	
Ans.	Volume of sphere= $\frac{4}{3}\pi r^3$ Percentage error in volume = 3 X Percentage error in radius = 3 X($\frac{\Delta r}{r} \times 100$) = 3 X 2% =6%		1 1
Q8.	**Define Absolute Error.**	L1	

Ans.	Let $X_1, X_2, X_3, \ldots\ldots\ldots\ldots. X_n$ are various observations. $\overline{X}$= mean of observation = $\frac{X_1+X_2+X_3+\ldots\ldots\ldots+X_n}{n}$ Absolute error in individual observations are $\overline{X}-X_1, \overline{X}-X_2, \overline{X}-X_3, \ldots\ldots\ldots\ldots \overline{X}-X_n$		1 1
Q9.	**Define relative error and percentage Error.**	**L1**	
Ans.	**Relative error:** It is the ratio of mean absolute error to the mean value of the observation being measured. Relative error =$\frac{\Delta A_{mean}}{A_{mean}}$ Percentage error: Relative error expressed in percentage Percentage error =$\frac{\Delta A_{mean}}{A_{mean}} \times 100$		**1** **1**
Q 10.	**When final results involve the quotient of two measured value $X = \frac{A}{B}$, what will be the expression for maximum relative error in X.**	**L2**	
Ans.	$\frac{\Delta X}{X} = \frac{\Delta A}{A} + \frac{\Delta B}{B}$ Max. Relative error in X = Max. Relative error in A + Max. Relative error in B.		1 1
Q 11.	**If the percentage of error in momentum is 2% and percentage of measuring the mass of a body is 3%. Find the percentage error in Kinetic Energy?**	**L3**	
Ans.	Kinetic Energy (K) =$\frac{1}{2} m v^2 = \frac{P^2}{2m}$ $\frac{\Delta K}{K} = \frac{2\Delta P}{P} + \frac{\Delta m}{m}$ Percentage error of K = $\frac{\Delta K}{K} \times 100 = 2 \times \frac{\Delta P}{P} \times 100 + \frac{\Delta m}{m} \times 100$ =2 X 2% + 3% =4% + 3% =7%		1 1
Q 12.	**Write the number of significant figures of the following** **(a) 0.007 m^2** **(b) 2.64 X 10^{24} Kg** **(c) 0.2370 cm^{-3}** **(d) 0.0006032 m^2**	**L2**	
Ans.	(a) 1 , (b) 3, (c) 4, (d) 4		0.5 each
Q 13.	**Convert 10 Calories into Joules.**	**L2**	
Ans.	1 calorie = 4.2 Joules 10 calorie = 42 Joules		1 1
Q 14.	**Name the fundamental quantities and their units in SI.**	**L1**	
Ans.	Mass - Kilogram Length – meter Time – Second Temperature- Kelvin Current- Ampere Luminous Intensity- Candela Amount of Substance- Mole		1 1

Q15.	**Two resistances $(5.1 \pm 0.03)\Omega$ and $(2.6 \pm 0.02)\Omega$ are connected in series in a circuit. Calculate total resistance with error limit.**	**L3**	
Ans.	Given $R_1 = (5.1 \pm 0.03)\Omega$ and $R_2 = (2.6 \pm 0.02)\Omega$ Total resistance in series $= R_1 + R_2 = 5.1 + 2.6 = 7.7\ \Omega$ $\Delta R = \pm (\Delta R_1 + \Delta R_2) = \pm (0.03 + 0.02)\Omega = \pm 0.05\ \Omega$ $R = (7.7 \pm 0.05)\ \Omega$		1 1
Q16.	**Write the SI unit and dimensional formula of Kinetic energy**	L1	
Ans.	SI unit of Kinetic energy is Joule Dimensional Formula of $KE = \frac{1}{2}mv^2 = [M^1][L^1T^{-1}]^2 = [M^1L^2T^{-2}]$		1 1
Q17.	**The errors in the measurement of length and breadth of a rectangular table are 3 % and 2 % respectively. What will be the % error in its area?**	L3	
Ans.	Given, error in length, $\frac{\Delta L}{L} = 3\%$, error in breadth, $\frac{\Delta B}{B} = 2\%$ Since, Area of the rectangle A= LB Error in area, $\frac{\Delta A}{A} \times 100 = \frac{\Delta L}{L} + \frac{\Delta B}{B} = 3\ \% + 2\% = 5\ \%$		1 1
Q18.	**Write the dimensional formula of Force and Work.**	L1	
Ans.	Force = mass ×acceleration = $[M^1L^1T^{-2}]$ Work = Force ×displacement= $[M^1L^1T^{-2}] \times [L^1] = [M^1L^2T^{-2}]$		1 1

5 MARKS QUESTION

Q 1.	**State the principle of homogeneityand check the correctness of following equation** $$E = mgh + \frac{1}{2}mv^2$$ **Where E=Energy, m=Mass, g= Acceleration due to gravity, v= Velocity**	**L3**	
Ans.	The principal of homogeneity states that the dimension of every term in both sides of a correct relation must be same. Given $E = mgh + \frac{1}{2}mv^2$ Dimensional formula of E = $[M^1L^2T^{-2}]$ Dimensional formula of mgh = $[M^1L^0T^0]\ [M^0L^1T^{-2}]\ [M^0L^1T^0]$ = $[M^1L^2T^{-2}]$ Dimensional formula of $\frac{1}{2}mv^2$= $[M^1L^0T^0]\ [M^0L^1T^{-1}]^2$ = $[M^1L^2T^{-2}]$ As the dimensional formulas of each term present in the equation are same, hence the relation is dimensionally correct.		1 1 1 1 1
Q2.	**Convert one Joule of work into Erg(CGS).**	**L3**	
Ans.	The dimensional formula of Work W = F.s = Force X displacement $=> W = [M^1L^1T^{-2}][L^1] = [M^1L^2T^{-2}]$ So, we can write, a=1, b=2, c= -2 We know that $n_1u_1 = n_2u_2$		1

	Here $n_1 = 1, u_1 = joule\ (MKS), M_1 = 1kg, L_1 = 1m, T_1 = 1s$, $u_2 = Erg\ (CGS)$, $M_2 = 1g, L_2 = 1cm, T_2 = 1s n_2 = ?$ Therefore $n_1[M_1^a L_1^b T_1^c] = n_2[M_2^a L_2^b T_2^c]$ $=> n_2 = n_1\left[\frac{M_1}{M_2}\right]^a\left[\frac{L_1}{L_2}\right]^b\left[\frac{T_1}{T_2}\right]^c$ Substituting the value as given in the problem we get, $n_2 = 1\left[\frac{1kg}{1g}\right]^1\left[\frac{1m}{1cm}\right]^2\left[\frac{1s}{1s}\right]^{-2} = 1\left[\frac{1000g}{1g}\right]^1\left[\frac{100cm}{1cm}\right]^2\left[\frac{1s}{1s}\right]^{-2}$ = 1 X 1000 X 10000 X 1 = 10^7 Therefore 1 Joule = 10^7Erg		1 1 1 1
Q3.	**Using dimensional Analysis Obtain an expression for centripetal force of a particle revolving in a horizontal circle, that depends on mass (m) of the particle, radius of the circle (r) and velocity (v).**	L3	
Ans.	$F \propto m^a v^b r^c$ $=> F = km^a v^b r^c$ Where k is the dimensionless constant. Writing Dimensional formula on both sides, we get $[M^1L^1T^{-2}] = [M^1L^0T^0]^a[M^0L^1T^{-1}]^b[M^0L^1T^0]^c$ $=> [M^1L^1T^{-2}] = [M^aL^0T^0][M^0L^bT^{-b}][M^0L^cT^0]$ $=> [M^1L^1T^{-2}] = [M^aL^{b+c}T^{-b}]$ Comparing the powers of M , a=1 Comparing the powers of T , -b = -2 => b=2 Comparing the powers of L , b+c = 1 => c = -1 Putting these values of a, b, c in equation, we get $F = k\, m^1 v^2\, r^{-1}$ $=> F = k\frac{mv^2}{r}$		1 1 1 1 1
Q4.	**A Physical quantity A is given by $A = \frac{a^2b^3}{c\sqrt{d}}$. The percentage error in a,b,c,d are 1%,3%,2% and 2% respectively. What is the percentage error on A?**	L3	
Ans.	**Percentage error in A** $= \frac{\Delta A}{A} \times 100 = \left(2 \times \frac{\Delta a}{a} \times 100\right) + \left(3 \times \frac{\Delta b}{b} \times 100\right) + \left(1 \times \frac{\Delta c}{c} \times 100\right) + \left(\frac{1}{2} \times \frac{\Delta d}{d} \times 100\right)$ $= 2 \times (\%\ error\ in\ a) + 3 \times (\%\ error\ in\ b) + 1 \times (\%\ error\ in\ c) + \frac{1}{2} \times (\%\ error\ in\ d)$ **Where** $\%\ error\ in\ a = 1\%$, $\%\ error\ in\ b = 3\%$, $\%\ error\ in\ c = 2\%$, $\%\ error\ in\ d = 2\%$		1 1 1 1

	$= (2 \times 1\%) + (3 \times 3\%) + (1 \times 2\%) + (\frac{1}{2} \times 2\%)$ = 14 %		1
Q5.	**Time period of oscillation of a simple pendulum in an experiment is recorded as 2.56s, 2.62s, 2.70s, 2.58s, 2.45s. Find mean time period and mean absolute error?**	**L3**	
Ans.	Given time periods are $T_1 = 2.56s, T_2 = 2.62s, T_3 = 2.70s,$ $T_4 = 2.58s, T_5 = 2.45s$ Mean time period of simple pendulum is $T_{mean} = \frac{(2.56 + 2.62 + 2.70 + 2.58 + 2.45)}{5} s$ $=> T_m = 2.58\ s$ Absolute Error in each observation $\Delta T_1 = T_m - T_1 = 2.58 - 2.56 = 0.02s$ $\Delta T_2 = T_m - T_2 = 2.58 - 2.62 = 0.04s$ $\Delta T_3 = T_m - T_3 = 2.58 - 2.70 =- 0.12s$ $\Delta T_4 = T_m - T_4 = 2.58 - 2.58 = 0\ s$ $\Delta T_5 = T_m - T_5 = 2.58 - 2.45 = 0.13s$ Mean Absolute Error $\Delta T_m = \frac{\lvert\Delta T_1\rvert+\lvert\Delta T_2\rvert+\lvert\Delta T_3\rvert+\lvert\Delta T_4\rvert+\lvert\Delta T_5\rvert}{5} s$ $= \frac{0.02+0.04+0.12+0+0.13}{5} s = \frac{0.31}{5} s$ = 0.062 s		1 1 1 1 1
Q6.	**State the principle of homogeneity. Using dimensional formula check the correctness of the equation v = u +at**	L3	
Ans.	The principal of homogeneity states that the dimension of every term in both sides of a correct relation must be same. Given v = u +at Dimensional formula of v = $[L^1T^{-1}]$ Dimensional formula of u = $[L^1T^{-1}]$ Dimensional formula of at = $[L^1T^{-2}] [T^1] = [L^1T^{-1}]$ Since, the dimensional formula of all the three terms are same, the equation is dimensionally correct.		1 1 1 1 1
Q7.	**State the principle of homogeneity. Using dimensional formula check the correctness of the equation $v^2 - u^2 = 2as$**	L3	
Ans	The principal of homogeneity states that the dimension of every term in both sides of a correct relation must be same. Given $v^2 - u^2 = 2as$ Dimensional formula of $v^2 = [L^1T^{-1}]^2 = [L^2 T^{-2}]$ Dimensional formula of $u^2 = [L^1T^{-1}]^2 = [L^2 T^{-2}]$ Dimensional formula of 2aS = $[L^1T^{-2}] [L^1] = [L^2 T^{-2}]$		1 1 1 1

	Since, the dimensional formula of all the terms in the above equation are same, the equation is dimensionally correct.		1