	INDIAN SCHOOL AL WADI AL KABIR	
Class: XI	**Department: SCIENCE 2023 – 24** **SUBJECT: PHYSICS**	**Date of submission:** **04.09.2023**
Worksheet No: 03 **WITH ANSWERS**	**CHAPTER / UNIT: UNITS AND MEASUREMENT**	**Note:** **A4 FILE FORMAT**
NAME OF THE STUDENT:	**CLASS & SEC:**	**ROLL NO.:**

<u>OBJECTIVE TYPE OF QUESTIONS (1 MARK):</u>

1) rad / sec is the unit of
   a. Angular displacement
   b. Angular velocity
   c. Angular acceleration
   d. Angular momentum

2) The displacement of particle moving along x-axis with respect to time is $x=at + bt^2 - ct^3$. The dimension of c is
   a. LT^{-2}
   b. T^{-3}
   c. LT^{-3}
   d. T^{-3}

3) Dimensional formula for linear momentum is
   a. $[ML^2T^{-2}]$
   b. $[ML^0T^{-2}]$
   c. $[ML^{-1}T^{-2}]$
   d. $[MLT^{-1}]$

4) Dimensions of stress are [NEET (Sep.) 2020]
   a. $[ML^0T^{-1}]$
   b. $[M^0LT^{-1}]$
   c. $[MLT^{-1}]$
   d. $[ML^{-1}T^{-2}]$

5) If the dimensions of a physical quantity are given by $[M^a L^bT^c]$, then the physical quantity will be [CBSE AIPMT 2009]
   a) Pressure if a=1, b=-1, c=-2
   b) Velocity if a =1, b=0, c=-1
   c) Acceleration if a=0, b=1, c=-2
   d) Force if a=0, b=-1, c=-2

6) If force (F), velocity (v) and time (T) are taken as fundamental units, then the dimensions of mass are
   a) $[FvT^{-1}]$
   b) $[FvT^{-2}]$
   c) $[Fv^{-1}T^{-1}]$
   d) $[Fv^{-1}T]$

7) Two quantities A and B have different dimensions. Which mathematical operation may be physically meaningful.
   a) A/B
   b) A+B
   c) A–B
   d) A = B

8) Which one of the following pair of quantities has the same dimension?
   a) force and work done
   b) momentum and impulse
   c) pressure and force
   d) surface tension and force

9) A physical quantity is measured and the result is expressed as ‘nu’ where u is the unit used and n is the numerical value. If the result is expressed in various units then
   a) $n \propto u$
   b) $n \propto u^2$
   c) $n \propto \sqrt{u}$
   d) $n \propto 1/u$

10) N kg^{-1} is the unit of
   a) velocity
   b) force
   c) acceleration
   d) none of these

11) In the relation $F = a \sin K_1x + b \sin K_2t$, the units (SI) of K_1/K_2 is
   a) s/m
   b) m/s
   c) s m
   d) m s

12) On the basis of dimensions, decide which of the following relations for the displacement of a particle undergoing simple harmonic motion is not correct:
   (a) $y = a \sin (2\pi t/T)$
   (b) $y = a \sin vt$.
   (c) $y = (a/T) \sin (t/a)$
   (d) $y = a\sqrt{2} [\sin(2\pi t/T) – \cos(2\pi t/T)]$

13) Which of the following is not a unit of time?
   (a) second
   (b) minute
   (c) hour
   (d) light year

14) The units of three physical quantities x, y and z are $gcm^2\ s^{-5}$, gs^{-1} and cms^{-2} respectively. The relation between x, y and z is
   a) $z = x^2y$
   b) $y^2 = xy$
   c) $x = yz^2$
   d) $x = y^2z$

15) A certain physical quantity is calculated by the formula $\pi/3\ (a^2 - b^2)\ h$, where a, h and b are all lengths. the quantity being calculated is
   a) Velocity
   b) Length
   c) Area
   d) Volume

<u>ASSERTION AND REASONING TYPE OF QUESTIONS (1 MARK):</u>

DIRECTION: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.
b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
c) If Assertion is true but Reason is false.
d) If both Assertion and Reason are false.

16) **Assertion:** When we change the unit of measurement of a quantity, its numerical value changes.
   Reason: Smaller the unit of measurement smaller is its numerical value.

17) **Assertion:** Number of significant figures in 0.005 is one and that in 0.500 is three.
   Reason: This is because zeros are not significant.

18) **Assertion:** Formula for kinetic energy is $K = 1/\ 2\ mv^2$ and K = ma. (m= mass, u = initial velocity, a= acceleration)
   Reason: Both the equations $K = 1/\ 2\ mv^2$ and K = ma is dimensionally incorrect.

19) **Assertion:** Force cannot be added to pressure.
   Reason: The dimensions of force and pressure are different.

20) **Assertion:** Angle and strain are dimensionless.
   Reason: Angle and strain have no unit.

VERY SHORT ANSWER TYPE OF QUESTIONS: (2 MARK)

21) What is the basis of the principle of homogeneity of dimensions?
22) Name two physical quantities having the dimensions $[ML^2T^{-2}]$
23) The velocity 'v' of a particle depends on time 't' as: $v = At^2 + Bt + C$. Where 'v' is in m/s and 't' in second. What are the units of A, B and C?
24) Can a quantity have dimensions but still no units?
25) Can a quantity have different dimensions in different system of units?
26) Can there be a physical quantity that has no unit and no dimension?
27) Magnitude of force F experienced by a certain object moving with speed 'v' is given by $F = Kv^2$, where K is a constant. Find the dimensions of K.

SHORT ANSWER TYPE OF QUESTIONS (3 MARK):

28) What are the limitations of Dimensional analysis?
29) Convert an acceleration of 100 m/s^2 into km/h^2.
30) Explain different types of system of units.
31) If electric force $F = K\, q_1q_2 / r^2$, where q_1, q_2 are charges and r is distance between them. Then find the dimensional formula for K.
32) State the uses of dimensional analysis.
33) Check the authenticity of the equation $t = k\sqrt{\frac{h}{g}}$ using dimensional analysis. Here t = time period, h = height of liquid column, g = acceleration due to gravity, k is a dimensionless constant.

LONG ANSWER TYPE OF QUESTIONS (5 MARK):

34) A small steel ball of radius 'r' is allowed to fall under gravity through a column of a viscous liquid of coefficient of viscosity 'η'. After some time, the velocity of the body attains a constant value v_T. the terminal velocity depends upon (i) the weight of the ball 'mg' (ii) the coefficient of viscosity 'η' having dimensional formula $[ML^{-1}T^{-1}]$and (iii) the radius of the ball 'r'. by the method of dimensions, determine the relation expressing terminal velocity.
35) A gas bubble from an explosion under water, oscillates with a period T proportional to P^a, d^b and E^c where P is the static pressure, d is the density of water and E is the total energy of the explosion. Find the values of a, b and c.
36) Using the principle of homogeneity of dimensions, find which of the following is correct:
    i. $T^2 = 4\pi^2r^2$

ii. $T^2 = \frac{4\pi^2 r^3}{G}$

iii. $T^2 = \frac{4\pi^2 r^3}{GM}$

37) Using the method of dimensions, derive an expression for the energy of a body executing SHM, assuming this energy depends upon its mass ‘m’, frequency ‘υ’ and amplitude of vibration ‘r’.

38) If force [F], acceleration [A] and time [T] are chosen as the fundamental physical quantities. Find the dimensions of energy.

39) The heat produced in a wire carrying an electric current depends on the current, the resistance and the time. Derive an equation relating the quantities using dimensional analysis. The dimensional formula of resistance is $[ML^2 I^{-2} T^{-3}]$ and heat is a form of energy.

CASE STUDY TYPE OF QUESTIONS (4 MARK):

40) **System of units:** A system of units is a collection of units in which certain units are chosen as fundamental and all others are derived from them. This system is also called an absolute system of units. Some common systems in use are:

- **c.g.s system:** The unit of length is centimetre, mass is gram, time is secong.
- **m.k.s system:** The unit of length is metre, mass is kilogram, time is second.
- **f.p.s system:** The unit of length is foot, mass is pound, time is second.
- **S.I. system:** In 1960, 11th General Conference of Weights and Measures introduced SI system. It has 7 fundamental units (Unit of length is metre, mass is kilogram, Time is second, Temperature is Kelvin, Electric current is Ampere, Luminous intensity is Candela, Amount of substance is mole) and two supplementary units (Unit of plane angle is radian, solid angle is steradian).

i. Which of the following is not the name of physical quantity?

a) kilogram

b) Density

c) Impulse

d) Energy

ii. The weight of a body is 12g. This statement is not correct because

a) The correct symbol for the unit of weight has not been used.

b) The correct symbol for gram is gm.

c) The weight should be expressed in kg.

d) Of some reason other than those given above.

iii. If the unit of force and length are doubled, the unit of energy will be

a) 1/2 times

b) 2 times

c) 4 times

d) 1/4 times

iv. The density of a liquid is 13.6 g cm^{-3}. Its value in S.I. is

a) 13.6 kgm^{-3}

b) 136 kgm^{-3}

c) 13600 kgm^{-3}

d) 1360 kgm^{-3}

ANSWER KEY	
1	b)Angular velocity
2	c)LT^{-3}
3	d)$[MLT^{-1}]$
4	d)$[ML^{-1}T^{-2}]$
5	c)Acceleration if a=0, b=1, c=-2
6	d)$[Fv^{-1}T]$
7	a)A/B
8	b)momentum and impulse
9	d)$n \propto 1/u$
10	c)acceleration
11	a)s/m
12	b)y = a sin vt. c)y = (a/T) sin (t/a)
13	d)light year
14	c)$x = yz^2$
15	d)Volume
16	c) If Assertion is true but Reason is false.
17	c) If Assertion is true but Reason is false.
18	d) If both Assertion and Reason are false.
19	a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.

20	c) If Assertion is true but Reason is false.
21	The principle of homogeneity of dimensions is based on the fact that only the physical quantities of the same kind be added, subtracted or compared.
22	Work, energy, torque
23	$\text{Unit of } A = \frac{\text{Unit of } v}{\text{Unit of } t^2} = \frac{ms^{-1}}{s^2} = ms^{-3}$ $\text{Unit of } B = \frac{\text{Unit of } v}{\text{Unit of } t} = \frac{ms^{-1}}{s} = ms^{-2}.$ $\text{Unit of } C = \text{Unit of } v = ms^{-1}.$
24	No, a quantity having dimensions must have some units of its measurement.
25	No, a quantity has same dimensions in all system of units.
26	Yes, strain is a physical quantity that has no unit and no dimension.
27	$F = Kv^2$ Taking dimensions of each term, we get $[MLT^{-2}] = [K][LT^{-1}]^2$ $\Rightarrow [K] = [MLT^{-2}][L^2T^{-2}]$ $[K] = [ML^{-1}]$
28	• It doesn't give information about the dimensional constant. • The formula containing trigonometric function, exponential functions, logarithmic function, etc. cannot be derived. • It gives no information about whether a physical quantity is a scalar or vector.
29	$100 \text{ m/s}^2 = \frac{100}{1000} \times \frac{1}{\left(\frac{1}{3600}\right)^2} = 12.96 \times 10^5 \, km/h^2$
30	SI System of Units FPS System of Units CGS System of Units MKS System of Units Explain all the systems
31	$F = \frac{kq_1q_2}{r^2}$ $kgms^{-2} = K\frac{(As)(As)}{m^2}$ $K = kgms^{-2} \times \frac{m^2}{(As)(As)} = kgm^3A^{-2}s^{-4}$ $[K] = [ML^3A^{-2}T^{-4}]$

32	To check the correctness of a physical relation To convert the value of a physical quantity from one system to another. To derive relation between various physical quantities. To find the dimensions of dimensional constants
33	Dimensions of t = [T] Dimensions of $\sqrt{\frac{h}{g}}$= $[L]^{1/2} / [LT^{-2}]^{1/2} = [T]$ Hence the given equation is dimensionally correct.
34	$V_T \propto m^{\alpha}\eta^{\beta}r^{\gamma}g^{k}$ $M^0L^1T^{-1} = (M^1)^{\alpha}(M^1L^{-1}T^{-1})^{\beta}(L^1)^{\gamma}(LT^{-2})^{k}$ $0 = \alpha + \beta \Rightarrow \alpha = 1 = k$ $1 = -\beta + \gamma + k\beta = \gamma = -1$ $-1 = -\beta - 2k$ $\Rightarrow V_T \propto \frac{mg}{\eta r}$
35	Given time period T $T \propto P^a d^b E^c$ $T = kP^a d^b E^c$ .....eq(1) where K is a constant of proportionality and dimensionless quantity. Inserting the dimensions of Time, pressure, density and Energy in equation (1) we get $[T] = [ML^{-1}T^{-2}]^a\,[ML^{-3}]^b\,[ML^2T^{-2}]^c$ Equating powers of M ,L,T on both sides we get $0 = a + b + c$ ...(2) $0 = -a - 3b + 2c$ ..(3) $1 = -2a - 2c$ ..(4) By solving (2),(3),(4) $a = \frac{-5}{6}$ $b = \frac{1}{2}$ and $c = \frac{1}{3}$
36	Now, $T^2 = 4\pi^2 r^2$ Taking dimensions on both sides $[T]^2 = [L]^2$ $\therefore$ LHS $\equiv$ RHS

	Now, $T^2 = \frac{4\pi^2 r^3}{G}$ Taking dimensions on both sides $[T]^2 = \frac{[L]^3}{[M^{-1}L^3T^2]} = [M^1L^0T^{-2}]$ $\therefore$ LHS $\equiv$ RHS $T^2 = \frac{4\pi^2 r^3}{GM}$ Taking dimensions on both sides, we get $[T]^2 = \frac{[L]^3}{[M^{-1}L^3T^{-2}M]} = [M^0L^0T^2]$ $\therefore$ LHS = RHS
37	$E \propto m^a \vartheta^b r^c$ $E = Km^a \vartheta^b r^c$ $[ML^2T^{-2}] = [M^a][T^{-1}]^b[L]^c$ Comparing the powers of M L T on either sides: M: 1=a L: 2 = c T: -2 = -b b = 2 $E = Km^1\vartheta^2 r^2$
38	$E = KF^aA^bT^c$ $[ML^2T^{-2}] = [MLT^{-2}]^a[LT^{-2}]^b[T]^c$ $[ML^2T^{-2}] = [M^aL^{a+b}T^{-2a-2b+c}]$ $a = 1, a + b = 2 \Rightarrow b = 1$ and $-2a - 2b + c = -2 \Rightarrow c = 2$ $E = KFAT^2$
39	$H = kI^aR^bt^c$, Where k is a dimensionless constant Writing dimensions of both sides, $ML^2T^{-2} = I^a(ML^2I^{-2}T^{-3})^bT^c$ $= M^bL^{2b}T^{-3b+c}I^{a-2b}$ Equating the exponents, b = 1 2b = 2 -3b + c = -2 a - 2b = 0 Solving these, we get, a = 2, b = 1 and c = 1. Thus, the required equation is $H = kI^2Rt$

40	i)	kilogram
	ii)	The correct symbol for the unit of weight has not been used.
	iii)	4 times
	iv)	13600 kgm^{-3}

Prepared by : **Ms Vivette Shirly Lasrado**	**Checked by:** **HOD – SCIENCE & FRENCH**