Units and Measurements

Questions Bank

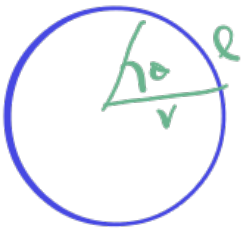
Physics Practice Series

Question 1

Define plane angle.

Plane angle is the ratio of the lenght of an arc to the radius of the circle in which the arc lies.

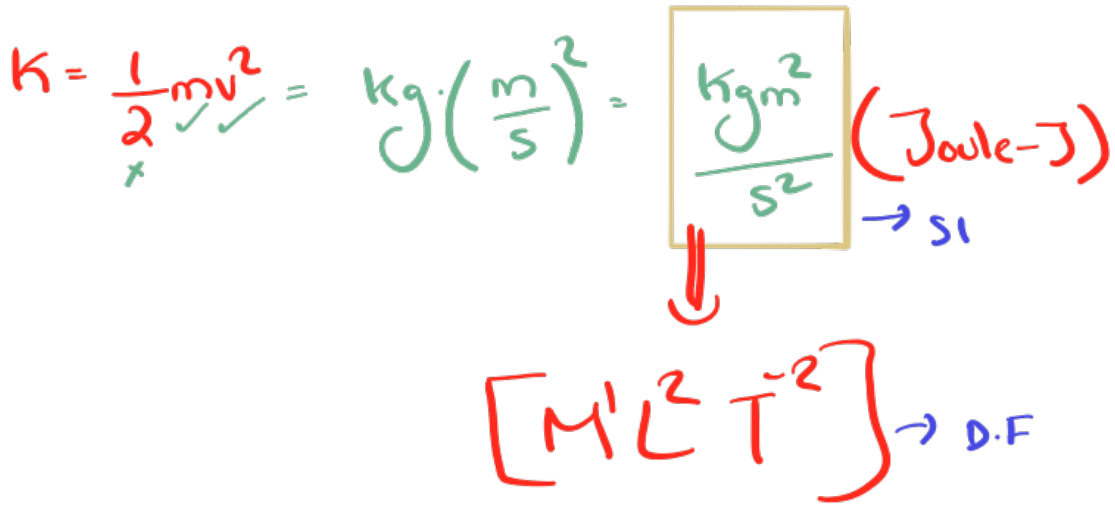
$$\theta = \frac{l}{r} = \frac{\text{Arc l}}{\text{radius}}$$



→ Refractive Index
→ Coefficient of friction (μ)
→ Plane angle
→ Trignometric func (sin, cos)
→ π, e, 2, 3

Question 2

Write the SI unit and dimensional formula of energy.



Question 3

Fill in the blanks:

Name of base quantity	Name of SI unit
Length	metre
Mass	..... kilogram
..... Time	second
Electric current	..... ampere
Thermodynamic temperature	..... kelvin
..... Amt of Subs	mole
..... Luminous Intensity	candela

Question 4

1 () State the principle of homogeneity of dimensions.

2 () A planet moves around the Sun in nearly circular orbits. Its period depends on radius (r) of the orbit, mass of the Sun (M) and gravitational constant (G). Derive the expression for its time period of the planet using the method of dimensions.

1. According to the principle of homogeneity only quantities of the same dimension can be added, subtracted or equated

2. $[T] \propto [r]^a [M]^b [G]^c$

$\propto [L]^a [M]^b [M^{-1} L^3 T^{-2}]^c$

$[G] = [M^{-1} L^3 T^{-2}]$

$[T]^1 \propto [L]^{a+3c} \times [M]^{b-c} \times [T]^{-2c}$

$a + 3c = 0 \Rightarrow a = -3c \Rightarrow a = \frac{3}{2}$

$b - c = 0 \Rightarrow b = c \Rightarrow b = -\frac{1}{2}$

$-2c = 1 \Rightarrow c = -\frac{1}{2} \Rightarrow c = -\frac{1}{2}$

$[T] \propto [r]^a [M]^b [G]^c$

$[T) \propto [r]^{3/2} [M]^{-\frac{1}{2}} [G]^{-\frac{1}{2}}$

$[T] = k[r]^{3/2} [M]^{-\frac{1}{2}} [G]^{-\frac{1}{2}}$

$T = k\sqrt{\frac{r^3}{GM}}$

Question 5

Fill in the blanks in the table below:

Quantity	SI Unit	Symbol of SI unit
Time	second	——————— s
Electric current	~~ampere~~ ——	A
~~——————~~ Solid Angle	steradian	Sr
——————— Amt. subs	mole	mol

Steradian - Solid Angle - Sr

$\theta = \frac{Arc\ l}{r}$ | $\Omega = \frac{Area}{r^2}$ m^2 m^2

Question 6

[2021 IMPROVEMENT]

Centripetal force (F) depends on mass (m) of the object, its velocity (v) and radius (R) of the circle. Using the method of dimensions derive an equation for centripetal force.

$$F \propto m^a v^b R^c$$

$$[MLT^{-2}] \propto [M]^a [LT^{-1}]^b [L]^c$$

$$[M^1L^1T^{-2}] \propto [M]^a [L]^{b+c} [T]^{-b}$$

$$a = 1 \implies a = 1$$

$$b + c = 1 \implies b + c = 1 \implies c = 1 - b = 1 - 2 = -1 \implies c = -1$$

$$-b = -2 \implies b = 2$$

$$F \propto m^1 v^2 R^{-1} \propto \frac{mv^2}{R}$$

$$F = \frac{kmv^2}{R}$$

Question 7

The restoring force developed in a spring extended by a length 'x' is $F = kx$. The dimensional formula of 'k' is:

$$F = kx$$

$$[MLT^{-2}] = [k][L]$$

$$\div [L]$$

$$\frac{[MLT^{-2}]}{[L]} = \frac{[k][L]}{[L]}$$

$$[k] = \frac{[MLT^{-2}]}{[L]} = [MT^{-2}]$$

Question 8

[2022 MARCH]

Check the dimensional correctness of the relation:

$$v = \sqrt{\frac{GM}{R}}$$

Where v is the orbital velocity, G is the gravitational constant and R is the radius of earth.

$G = [M^{-1}L^{3}T^{-2}]$

$M = [M^{1}L^{0}T^{0}]$

$R = [M^{0}L^{1}T^{0}]$

Question 9

Light year is the unit of .....

(a) time

(b) distance

(c) velocity

$1 ly \approx 9.46 \times 10^{12}$ km

$1 AU \approx 150 \times 10^{6}$

$= 1.5 \times 10^{8}$ km

1 Parsec (pc) = 3.26 ly

Question 10

1 Å(angstrom) $=$ .....

(i) 10^{10} m

(ii) 10^{-15} m

(iii) 10^{15} m

(iv) 10^{-10} m

1 Å = 10^{-10} m

1 Fermi (fm) = 10^{-15} m

Question 11

[2023 MARCH]

() What do you mean by principle of homogeneity of dimensions?

() Using this principle, check whether the following equation is dimensionally correct:

$$\frac{1}{2}mv^2 = mgh$$

() State the number of significant figures in the following:

(i*) 0.060607 m^2

(i*) 6.0320 N m^{-2}

Question 12

Which of the following is a fundamental quantity?

() Volume

() Mass

() Density

() Pressure

Question 13

[2023 IMPROVEMENT]

() Using the principle of homogeneity of dimensions check whether the equation $\frac{1}{2}mv^2 = mgh$ is dimensionally correct.

() There is a famous relation in physics which relates moving mass 'm' with rest mass 'm_0' and velocity 'v'. A boy recalls the relation almost correctly as:

$$m = \frac{m_0}{(1 - v^2)^{\frac{1}{2}}}$$

but forgot to put the velocity of light 'c' in the equation. Where is the correct position of 'c' in the above equation?

$$m = \frac{m_0}{\left(1 - \frac{v^2}{c^2}\right)^{1/2}}$$

Question 14

The dimensional formula of gravitational constant is:

() $[MLT^{-2}]$

() $[ML^2T^{-2}]$

() $[M^{-1}L^3T^{-2}]$

() $[M^{-1}L^2T^{-2}]$

Question 15

Write two uses of dimensional analysis.

↳ Checking validity of Equation

↳ Guessing relation between quantities

Question 16 [2024 MARCH]

State number of significant figures in:

(I*) 6.320 J = 4

(I*) 2370 g cm^{-3} = 3

Question 17

Find out the fundamental quantity from among the physical quantities given below:

() Velocity

() Temperature

() Force

() Density

Question 18

[2025 MARCH]

() State the principle of homogeneity of dimensions.

() Consider a simple pendulum, having a bob attached to a string that oscillates under the action of the force of gravity. Suppose that the period of oscillation of the simple pendulum depends on its length (l), mass of the bob (m) and acceleration due to gravity (g). Derive the expression for its time period using method of dimensions.

$$T \propto l^a m^b g^s$$

$$[T] \propto [L][M][LT^{-2}]$$