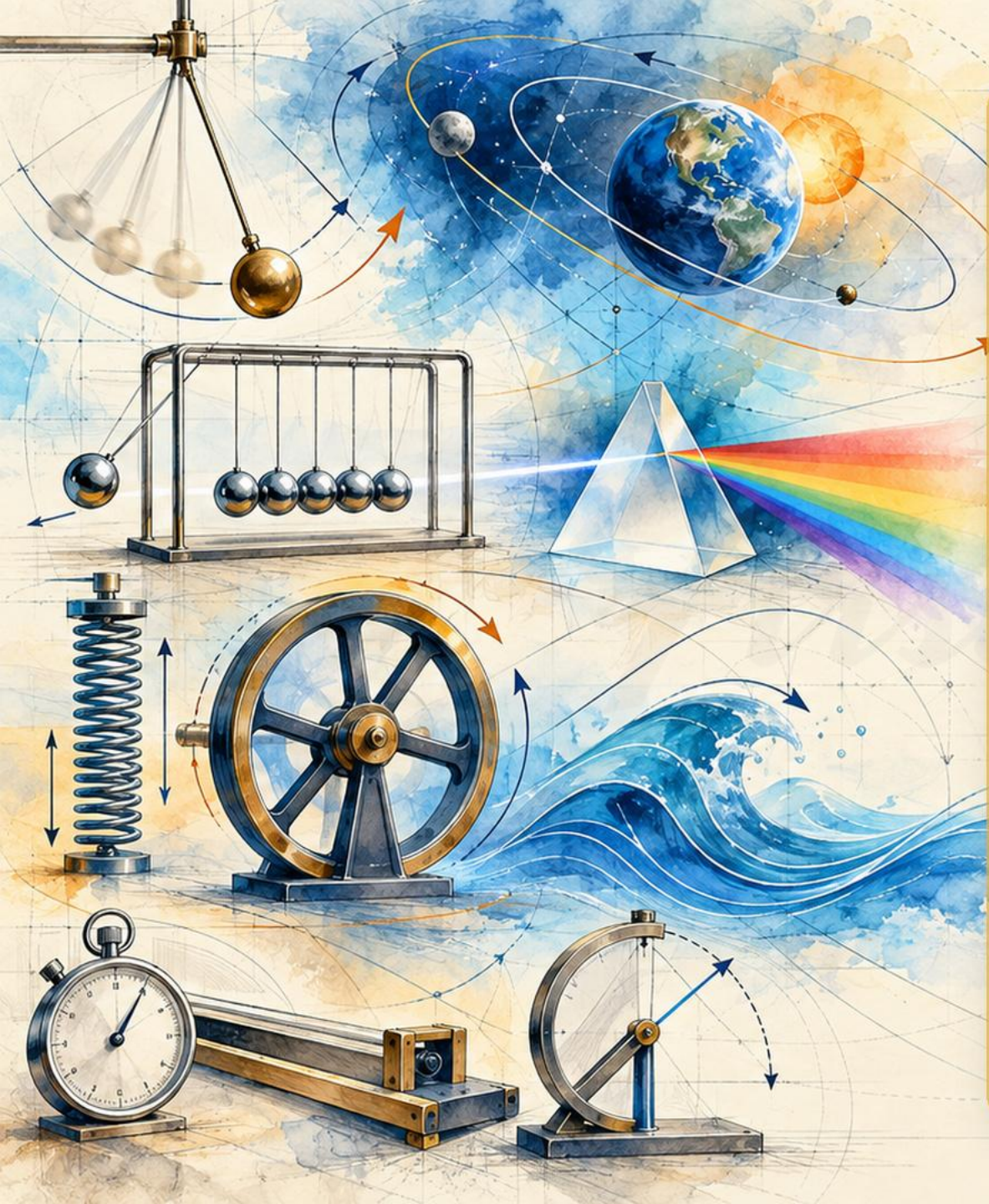




**PHYSICS • CLASS 11**

**1**

**CHAPTER**

# **Units and Measurement**

**NCERT SOLUTIONS**

## EXERCISE SOLUTION: QUESTION 1.1

(a) Find the volume in  $\text{m}^3$  of a cube of side 1 cm.

Solution:

Side of the cube,  $a = 1 \text{ cm} = 10^{-2} \text{ m}$ .

$$\begin{aligned}\text{Volume of a cube, } V &= a^3 \\ &= (10^{-2})^3 \text{ m}^3 \\ &= 10^{-6} \text{ m}^3.\end{aligned}$$

(b) Find the total surface area in  $\text{mm}^2$  of a solid cylinder:  $r = 2.0 \text{ cm}$ ,  $h = 10.0 \text{ cm}$ .

Solution:

Total surface area of a solid cylinder,

$$\begin{aligned}A &= 2\pi r(r + h) \\ &= 2\pi \times 2.0 \times (2.0 + 10.0) \\ &= 2\pi \times 2.0 \times 12.0 \\ &= 150.8 \text{ cm}^2.\end{aligned}$$

$$A = 150.8 \times 100 \text{ mm}^2 \approx 1.5 \times 10^4 \text{ mm}^2.$$

Both circular ends are included; round to two significant figures.

(c) How far does a vehicle at  $18 \text{ km h}^{-1}$  travel in 1 s?

Solution:

$$\begin{aligned}\text{Speed of the vehicle, } v &= 18 \times \frac{1000}{3600} \text{ m s}^{-1} \\ &= 5 \text{ m s}^{-1}.\end{aligned}$$

$$\begin{aligned}\text{Distance travelled in 1 s, } s &= vt \\ &= 5 \times 1 \\ &= 5 \text{ m}.\end{aligned}$$

(d) Lead has relative density 11.3. Find its density in  $\text{g cm}^{-3}$  and  $\text{kg m}^{-3}$ .

Solution:

$$\text{Relative density, } RD = \frac{\rho}{\rho_{\text{water}}} = 11.3.$$

$$\text{Hence, } \rho = 11.3 \times \rho_{\text{water}}.$$

$$\begin{aligned}\text{Taking } \rho_{\text{water}} &= 1.0 \text{ g cm}^{-3}, \\ \rho &= 11.3 \text{ g cm}^{-3}.\end{aligned}$$

$$\begin{aligned}\text{Since } 1 \text{ g cm}^{-3} &= 10^3 \text{ kg m}^{-3}, \\ \rho &= 11.3 \times 10^3 = 1.13 \times 10^4 \text{ kg m}^{-3}.\end{aligned}$$

## EXERCISE SOLUTION: QUESTION 1.2

(a) Convert  $1 \text{ kg m}^2 \text{ s}^{-2}$  to  $\text{g cm}^2 \text{ s}^{-2}$ .

Solution:

We know that  $1 \text{ kg} = 10^3 \text{ g}$  and  $1 \text{ m}^2 = 10^4 \text{ cm}^2$ .

Therefore,

$$\begin{aligned} 1 \text{ kg m}^2 \text{ s}^{-2} &= (10^3 \text{ g})(10^4 \text{ cm}^2) \text{ s}^{-2} \\ &= 10^7 \text{ g cm}^2 \text{ s}^{-2}. \end{aligned}$$

(c) Convert  $3.0 \text{ m s}^{-2}$  to  $\text{km h}^{-2}$ .

Solution:

We know that  $1 \text{ m} = 10^{-3} \text{ km}$  and  $1 \text{ s} = \frac{1}{3600} \text{ h}$ .

Therefore,

$$\begin{aligned} 3.0 \text{ m s}^{-2} &= 3.0 \times 10^{-3} \times (3600)^2 \text{ km h}^{-2} \\ &= 3.0 \times 10^{-3} \times 12,960,000 \text{ km h}^{-2} \\ &= 38,880 \text{ km h}^{-2} \\ &\approx 3.9 \times 10^4 \text{ km h}^{-2}. \end{aligned}$$

(b) Convert  $1 \text{ m}$  to light-years.

Solution:

We know that  $1 \text{ light-year (ly)} \approx 9.46 \times 10^{15} \text{ m}$ .

Therefore,

$$\begin{aligned} 1 \text{ m} &= \frac{1}{9.46 \times 10^{15}} \text{ ly} \\ &= 1.06 \times 10^{-16} \text{ ly}. \end{aligned}$$

(d) Convert  $G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$  to  $\text{cm}^3 \text{ s}^{-2} \text{ g}^{-1}$ .

Solution:

We know that  $1 \text{ N} = 1 \text{ kg m s}^{-2}$ , so the unit of  $G$  is  $[G] = \text{m}^3 \text{ s}^{-2} \text{ kg}^{-1}$ .

Also,  $1 \text{ m}^3 = 10^6 \text{ cm}^3$  and  $1 \text{ kg}^{-1} = 10^{-3} \text{ g}^{-1}$ .

Therefore,

$$\begin{aligned} G &= 6.67 \times 10^{-11} \times 10^6 \times 10^{-3} \text{ cm}^3 \text{ s}^{-2} \text{ g}^{-1} \\ &= 6.67 \times 10^{-8} \text{ cm}^3 \text{ s}^{-2} \text{ g}^{-1}. \end{aligned}$$

## EXERCISE SOLUTION: QUESTION 1.3

A calorie is about 4.2 J, where  $1 \text{ J} = 1 \text{ kg m}^2 \text{ s}^{-2}$ . New base units are  $\alpha \text{ kg}$  for mass,  $\beta \text{ m}$  for length and  $\gamma \text{ s}$  for time. Show that one calorie has numerical value  $4.2 \alpha^{-1} \beta^{-2} \gamma^2$  in the new units.

Solution: Energy has dimensions  $[M L^2 T^{-2}]$ . Name the new energy unit  $E'$ .

One new energy unit equals:

$$E' = (\alpha \text{ kg})(\beta \text{ m})^2 (\gamma \text{ s})^{-2} = \alpha \beta^2 \gamma^{-2} \text{ J}$$

The physical energy stays the same; only its numerical value changes.

If the new numerical value is  $n'$ :

$$n' E' = 4.2 \text{ J}$$

$$n' = \frac{4.2}{\alpha \beta^2 \gamma^{-2}} = 4.2 \alpha^{-1} \beta^{-2} \gamma^2$$

$$n' = 4.2 \alpha^{-1} \beta^{-2} \gamma^2$$

# EXERCISE SOLUTION: QUESTION 1.4

Q. 1.4 Why are 'large' and 'small' meaningless for a dimensional quantity without a comparison standard? Reframe the statements where needed.

Answer: A measured size, speed or mass must be compared with another quantity of the same kind.

| Statement                                               | Answer / clearer wording                                      |
|---------------------------------------------------------|---------------------------------------------------------------|
| (a) Atoms are very small objects.                       | Atoms are very small compared with a grain of sand.           |
| (b) A jet plane moves with great speed.                 | A jet plane moves much faster than a car.                     |
| (c) Jupiter has a very large mass.                      | Jupiter is much more massive than Earth.                      |
| (d) This room contains a large number of air molecules. | Acceptable: a count is dimensionless.                         |
| (e) A proton is much more massive than an electron.     | Already clear: the electron is the comparison standard.       |
| (f) Sound travels much more slowly than light.          | Already clear: the speed of light is the comparison standard. |



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