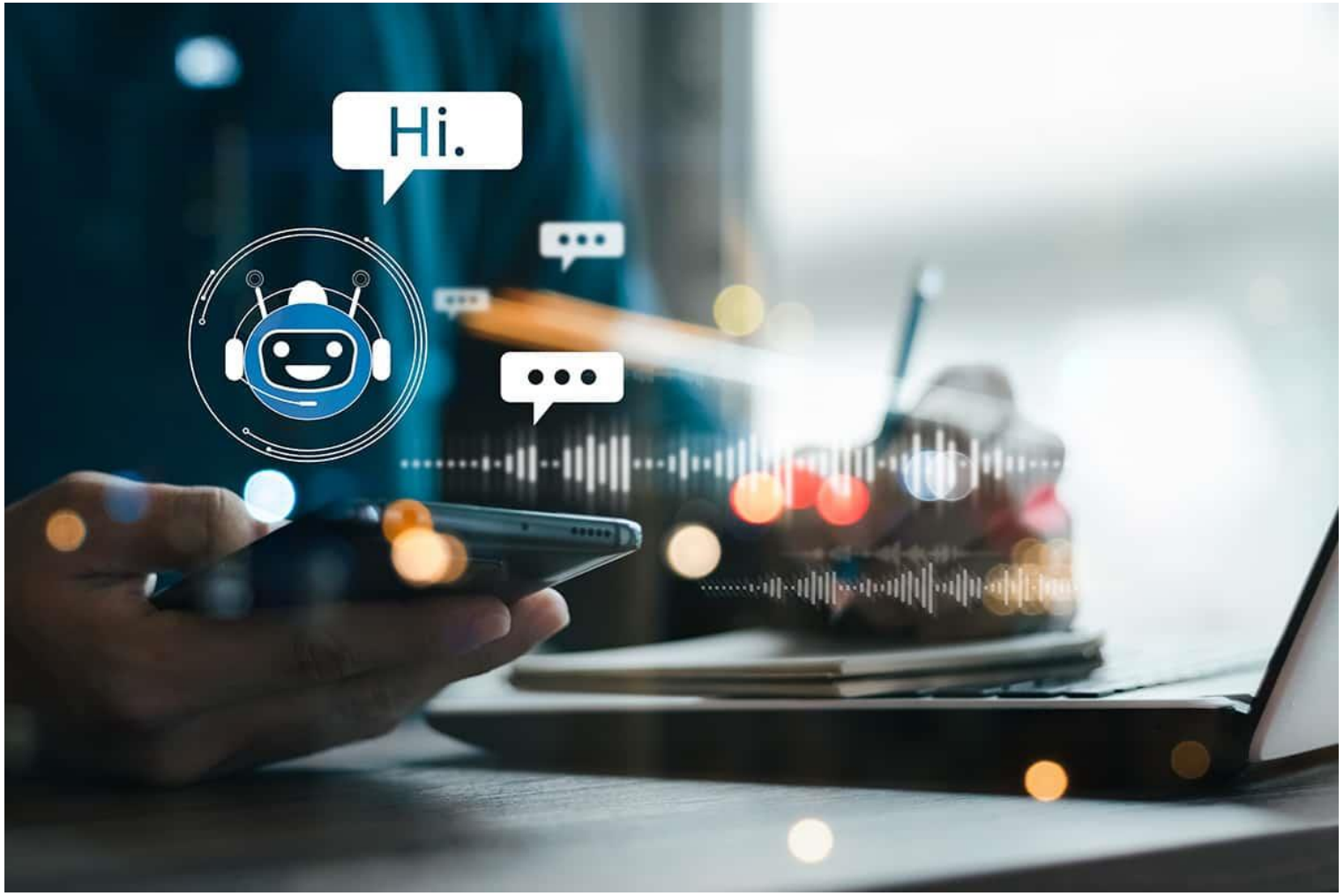
Pre-Physics

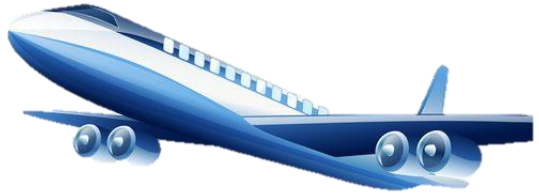


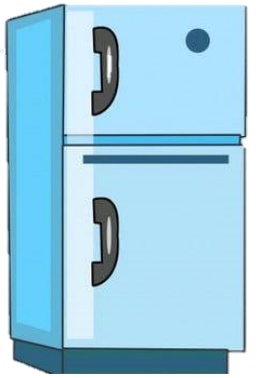
Introduction

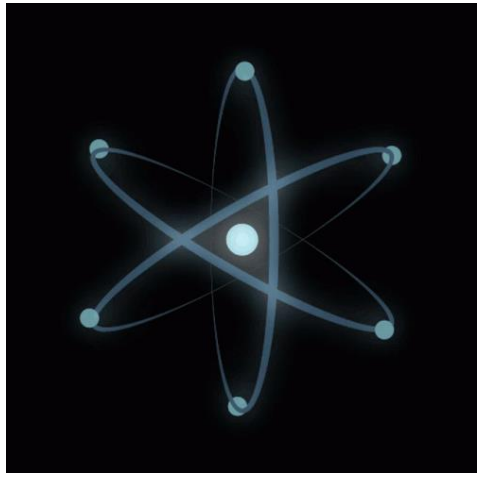
LOUAY KARAKER

What is physics?

HOW THINGS WORK?





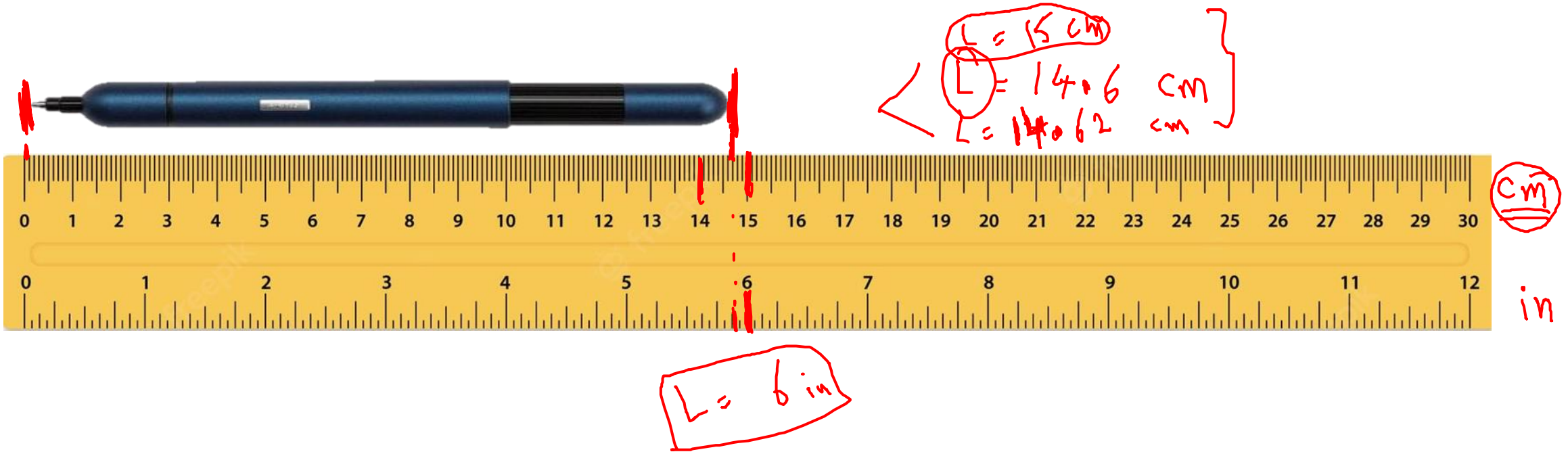


❖ The study of physics can be divided into six main areas:

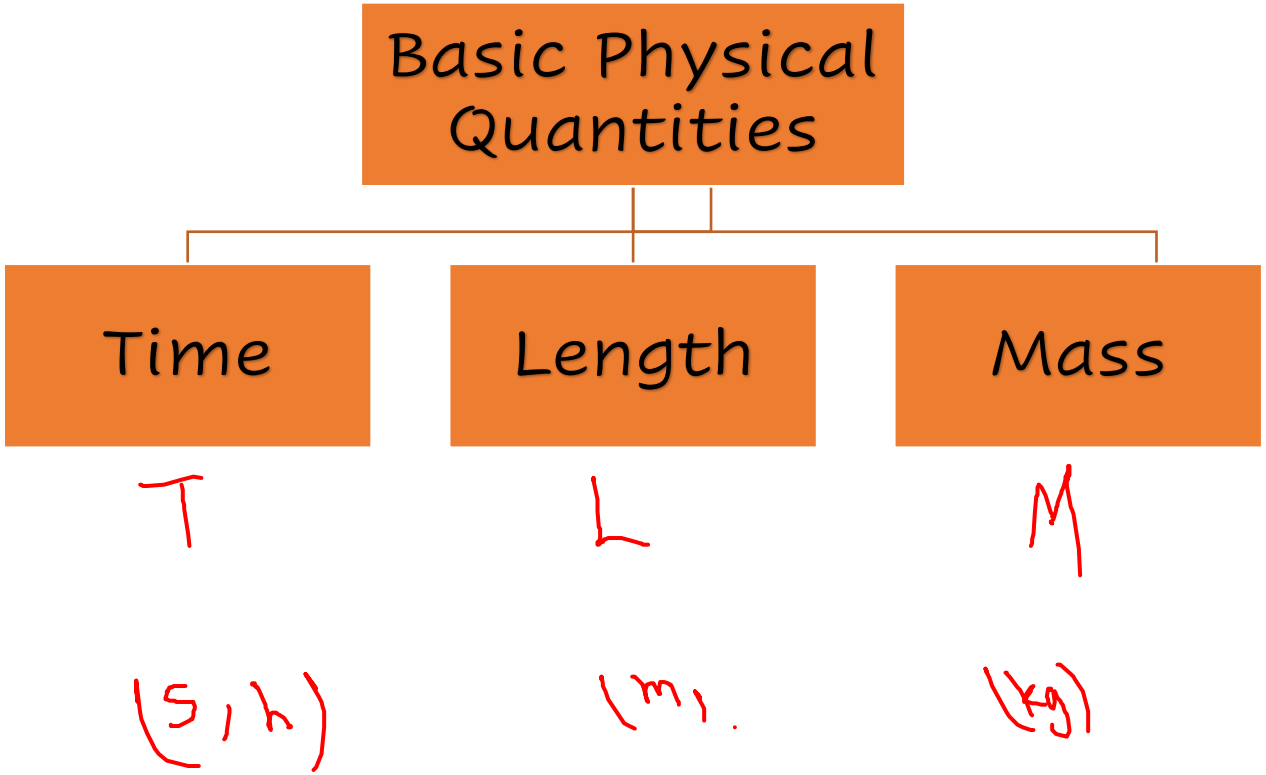
- **1.** Classical mechanic → Physics I
- **2.** Relativity
- **3.** Thermodynamics
- **4.** Electromagnetism → Physics II
- **5.** Optics
- **6.** Quantum mechanics

Physics and Measurement

- Physics is based on experimental observations and quantitative measurements.
- These observations have described by numbers and units.
- Numbers give us how large our measurement was, and the units tell us the nature of this measurement.



Physical Quantities



Velocity = 100 km/h

$= \frac{L}{T}$

Derived Physical Quantities:

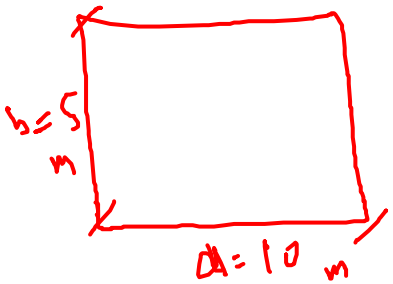
$A = [L] \times [L] = [L]^2$

$V = [L] \times [L] \times [L] = [L]^3$

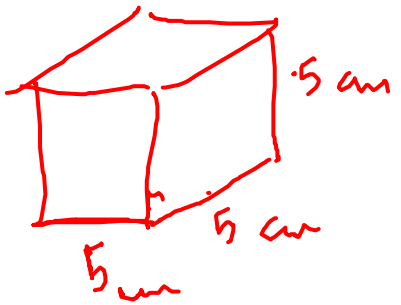
$v = \frac{[L]}{[T]} = [L] \cdot [T]^{-1}$

$\rho = \frac{M}{V} = \frac{[M]}{[L]^3} = [M] \cdot [L]^{-3}$

(Density)



$A = 10 \times 5 = 50\ m^2$



$V = 5 \times 5 \times 5 = 125\ cm^3$

Unit Systems

	L	T	M
① SI unit system:	m	S	kg
	meter	seconds	kilogram
② British system:	ft	$	lb

1 ft = 12 in

Table 1.5 Dimensions and Units of Four Derived Quantities

Quantity	Area (A)	Volume (V)	Speed (v)	Acceleration (a)
Dimensions	L^2	L^3	L/T	L/T^2
SI units	m^2	m^3	m/s	m/s^2
U.S. customary units	ft^2	ft^3	ft/s	ft/s^2

L×L

m×m

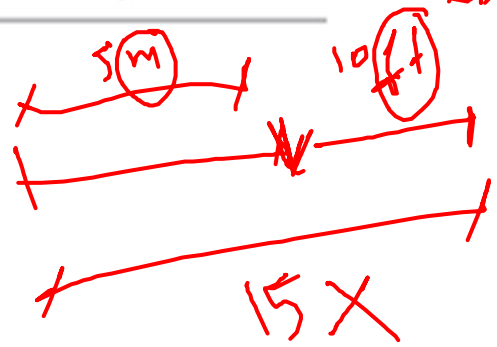
ft×ft

Mass

M

kg

lb



$\rho = \frac{M}{[L]^3}$ $\left(\frac{kg}{m^3}\right)$ $\left(\frac{lb}{ft^3}\right)$

$\rho = 15 \frac{kg}{m^3}$

$\rho = 17 \frac{lb}{ft^3}$

Conversion of Units:

Sometimes it is necessary to convert units from one measurement system to another.

Factors between SI and U.S. customary units of length are as follows:

1 mile = 1609 m = 1.609 km

1 ft = 0.3048 m = 30.48 cm

1 m = 39.37 in = 3.281 ft

1 in = 0.0254 m = 2.54 cm

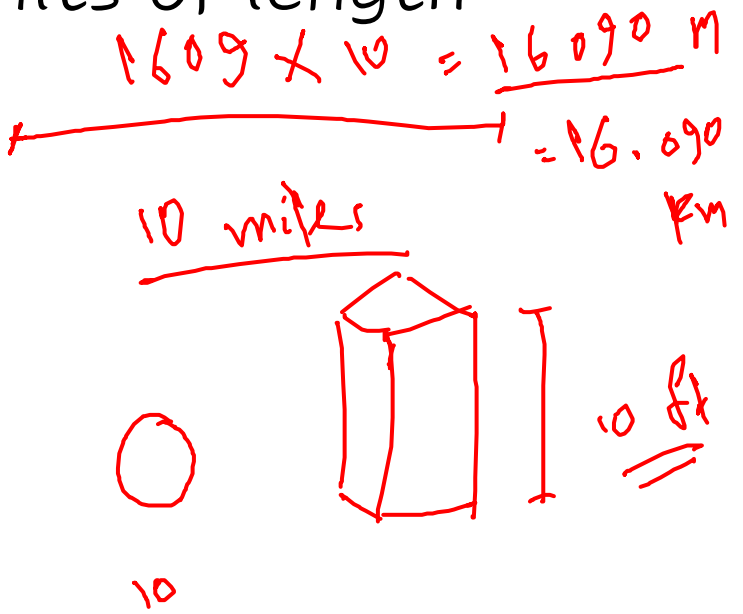
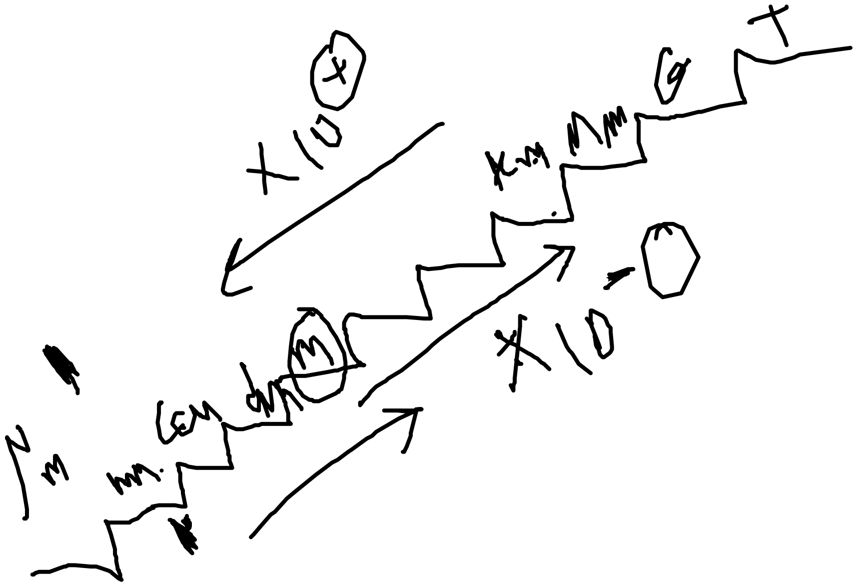


Table 1.4 Prefixes for Powers of Ten

Power	Prefix	Abbreviation	Power	Prefix	Abbreviation
10^{-24}	yocto	y	10^{3}	kilo	k
10^{-21}	zepto	z	10^{6}	mega	M
10^{-18}	atto	a	10^{9}	giga	G
10^{-15}	femto	f	10^{12}	tera	T
10^{-12}	pico	p	10^{15}	peta	P
10^{-9}	nano	n	10^{18}	exa	E
10^{-6}	micro	μ	10^{21}	zetta	Z
10^{-3}	milli	m	10^{24}	yotta	Y
10^{-2}	centi	c			
10^{-1}	deci	d			



$50000\ m = 50000 \times 10^{-3} = 50\ Km$

$50\ Km = 50 \times 10^{+3} = 50000\ m$

$700\ Cm = 700 \times 10^{-2} = 7\ m$

$8.2\ \mu m = 8.2 \times 10^{-6}\ m$

$75000000\ mm = 75000000 \times 10^{-6}\ k = 75\ Km$


delete
Break

Important notes for problem solving:

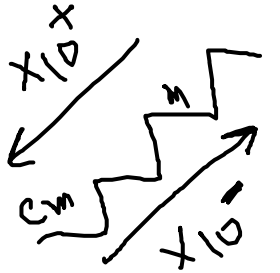
- ✓ All units in the problem should be in the same system.
- ✓ Need to know conversion.
- ✓ Only quantities with same units can be added or subtracted.

Example 1:

- This expression: 50 m + 12 cm = ? Yields:
  - a) 5012 cm
  - b) 50.12 cm
  - c) 5012 m
  - d) 5.012 m

$50 \times 10^{2}\ \text{cm} + 12\ \text{cm} = 5000 + 12 = 5012\ \text{cm}$

$50\ \text{m} + 12 \times 10^{-2}\ \text{m} = 50 + 0.12\ \text{m} = 50.12\ \text{m}$



- This expression: 50 cm x 12 kg = ? Yields:
  - ✗a) 0.6 m.kg
  - ✓b) 600 cm.kg
  - ✗c) 60000 cm.g
  - ✗d) All of above

$50 \times 12 = 600\ \text{cm}\cdot\text{kg}$

$50 \times 10^{-2} \times 12 = 6\ \text{m}\cdot\text{kg}$

$50 \times 12 \times 10^{3}\ \text{g} = 600000\ \text{cm}\cdot\text{g}$

Example 2:

The fourteen tallest peaks in the world (Fig. 6 and Table 6) are referred to as "eight-thousandes," meaning their summits are over 8000 m above sea level. What is the elevation, in feet, of an elevation of 8000 m?

1 mile = 1609 m = 1.609 km
1 ft = 0.3048 m = 30.48 cm
1 m = 39.37 in = 3.281 ft
1 in = 0.0254 m = 2.54 cm

1 m : 3.281 ft
8000 m : x ft

$x = 8000 \times \frac{3.281}{1} = 26\,248$ ft

PHYSICS APPLIED
The world's tallest peaks

A. Viansson

FIGURE 6 The world's second highest peak, K2, whose summit is considered the most difficult of the "8000-ers." K2 is seen here from the north (China).

TABLE 6
The 8000-m Peaks

Peak	Height (m)
Mt. Everest	8850
K2	8611
Kangchenjunga	8586
Lhotse	8516
Makalu	8462
Cho Oyu	8201
Dhaulagiri	8167
Manaslu	8156
Nanga Parbat	8125
Annapurna	8091
Gasherbrum I	8068
Broad Peak	8047
Gasherbrum II	8035
Shisha Pangma	8013

Example 3:

You have seen a nice apartment whose floor area is 880 square feet What is its area in square meters?

1 mile = 1609 m = 1.609 km
1 ft = 0.3048 m = 30.48 cm
1 m = 39.37 in = 3.281 ft
1 in = 0.0254 m = 2.54 cm

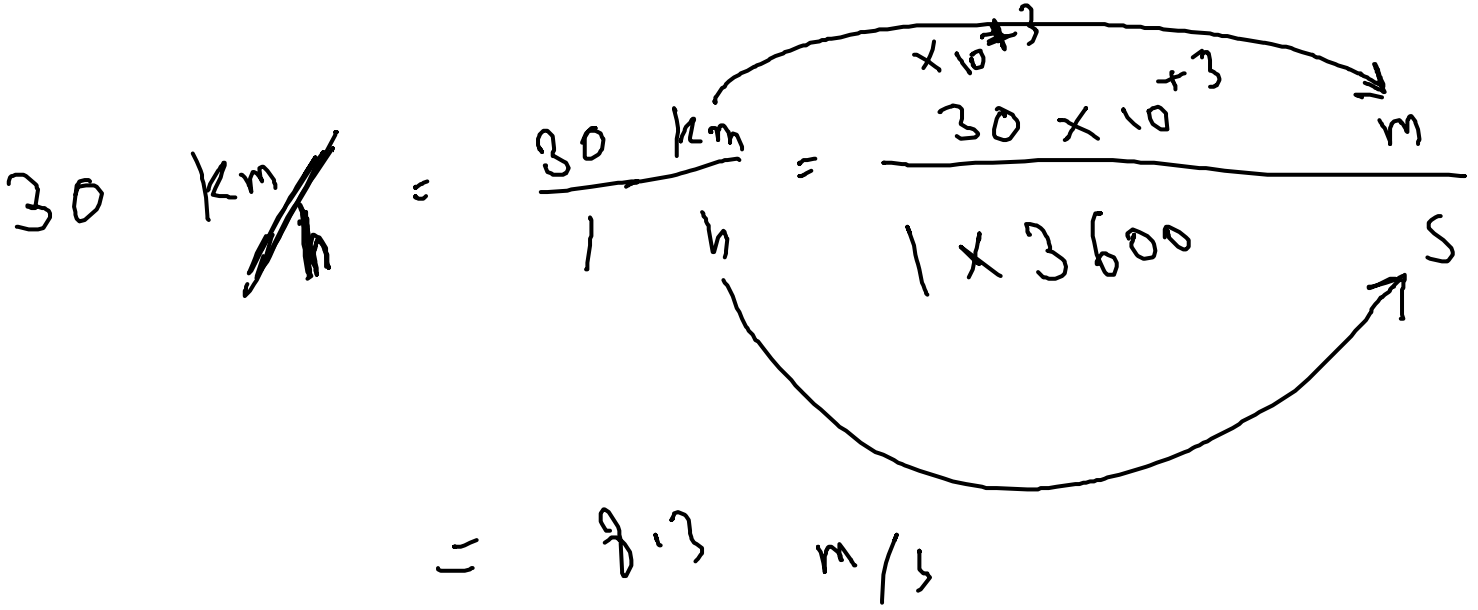
$$A = 880 \ ft^2$$

$$= 880 \times (0.3048)^2$$

$$= 81.75 \ m^2$$

Example 4:

- Express a speed of 30 kilometres per hour as meters per second.



1 mile = 1609 m = 1.609 km
1 ft = 0.3048 m = 30.48 cm
1 m = 39.37 in = 3.281 ft
1 in = 0.0254 m = 2.54 cm

1 h = 60 mins

1 mins = 60 s

1 h = 60 × 60 s

= 3600 s

Example 5:

- On an interstate highway in a rural region of Wyoming, a car is traveling at a speed of 38.0 m/s. Is the driver exceeding the speed limit of 75.0 mi/h?

$$\frac{75.0\ \text{mi}}{1\ \text{h}} = \frac{75.0 \times 1609}{1 \times 3600}\ \frac{\text{m}}{\text{s}} = 33.5\ \text{m/s}$$

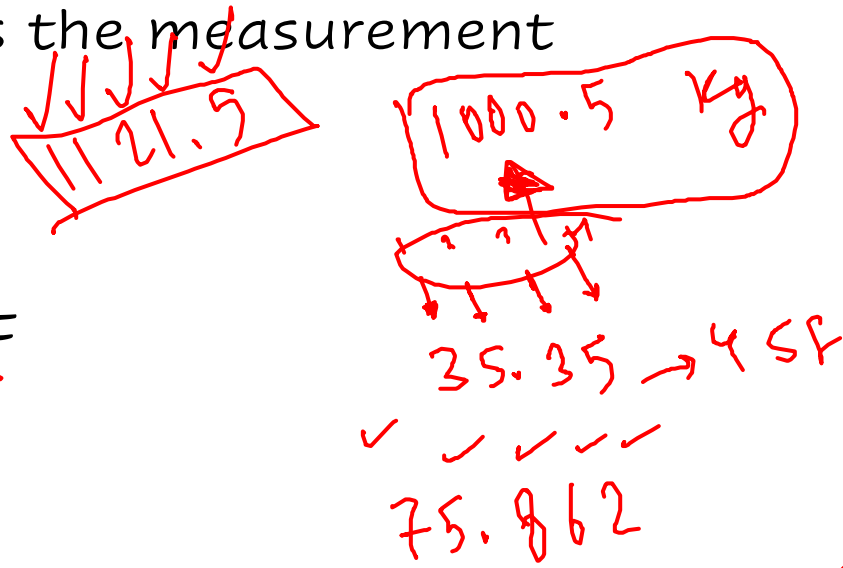
1 mile = 1609 m = 1.609 km
1 ft = 0.3048 m = 30.48 cm
1 m = 39.37 in = 3.281 ft
1 in = 0.0254 m = 2.54 cm

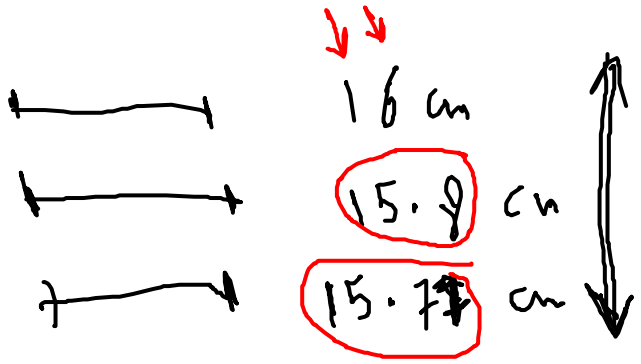
$$33.5\ \text{m/s} < 38.0\ \text{m/s}$$

Significant Figures

The number of **significant figures** in a measurement can be used to express something about the uncertainty.

The number of significant figures is related to the number of numerical digits used to express the measurement





1 → 9 SF

0 may be SF

Ex:

7.2 → 2 SF

Rulers of 0 :

1. 3.02 — 0 between 2 SF is SF

2. 0.4 — 0 left side of (.) is not SF

3. 0.04 — 0 right side of (.) but left side of a number is not SF

4. 0.040 — 0 right side of (.) and right side of a number is SF

5. 100 100.0 — In not fraction numbers : 0 right side of number is not SF but in right side of (.) is SF

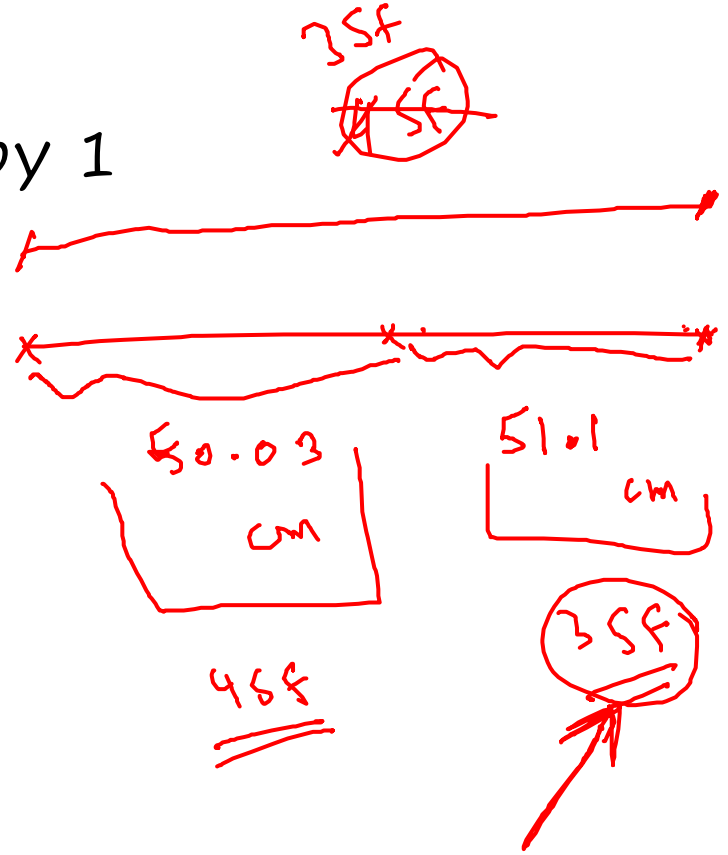
Round off Rule:

0,1,2,3,4 ..... Drop
5,6,7,8,9 ..... Increase the previous digit by 1

Ex:

50.03 + 51.1 = 101.13 ✗

= 101.1 cm ✓



59.218 = 59.22

59.218 = 59.2 ✓

Multiplication and Division Rule :

When multiplying several quantities, the number of significant figures in the final answer is the same as the number of significant figures in the quantity having the smallest number of significant figures. The same rule applies to division.

Ex :

$11.3 \times 6.8 = 76.84 \rightarrow 77$

$2.0 / 3.0 = 0.66666667 \rightarrow 0.67$

$2 / 3.0 = 0.7$

Addition and Subtraction Rule:

When numbers are added or subtracted, the number of decimal places in the result should equal the smallest number of decimal places of any term in the sum or difference

3 SF 1 4 SF

$23.2 + 5.174 = 28.374 \rightarrow 28.4$ ✓

4 SF 1 SF

$1.0001 + 0.0003 = 1.0004$

$27.153 + 138.2 - 11.74 = 153.6$

Example 6:

How many significant figures are in the following numbers?

(a) 78.9 ± 0.2 → 3SF

(b) 3.788 x 10^9

(c) 2.46 x 10^-6

(d) 0.0053

3SF

3.788 × 10^9 → 4 SF

2.46 × 10^-6 → 3 SF

0.0053 → 2 SF

Example 7:

A carpet is to be installed in a rectangular room whose length is measured to be 12.71 m and whose width is measured to be 3.46 m. Find the area of the room.

$A = 12.71 \times 3.46 = 43.9766$

4SF 3SF 3SF

$= 44.0 \ m^2$

Example 8:

A rectangular plate has a length of (21.3 ± 0.2) cm and a width of (9.8 ± 0.1) cm. Calculate the area of the plate, including its uncertainty.

3SF 2SF

$A = (21.3 \pm 0.2) \times (9.8 \pm 0.1)$

$= 209.74 \left(\pm \quad 2.13 \pm 1.96\right)$

$= 209.74 \quad 4.09$

$A = 210 \pm 4 \text{ cm}^2$


THANK YOU