temperature of the patient's body.

Description of a clinical thermometer : A clinical thermometer has the markings from 35°C to 42°C. It has a slight bend or kink in the stem just above the bulb. This kink is called constriction. This constriction prevents the mercury from falling back all by itself. The temperature of a healthy person is 37°C. This temperature is marked by a red arrow.

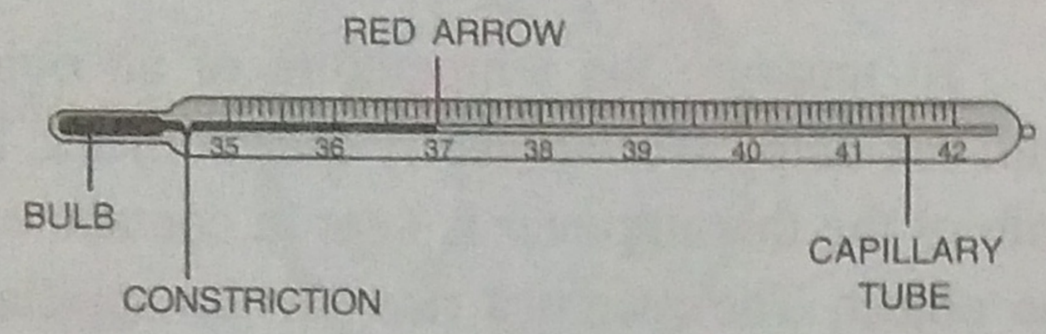

Fig. 2.18 Clinical thermometer

Note : Clinical thermometers marked in °F are also available. They have markings from 95°F to 110°F. The red arrow indicating the temperature of a healthy person is at 98·6 °F

Measuring the temperature of a patient's body with a clinical thermometer

Before use, the bulb of thermometer is washed by keeping it in a beaker containing cold water. Then it is slightly jerked to bring the level of mercury in its capillary tube below the mark 37°C. Then to measure the temperature of a patient's body, its bulb is kept either below the tongue or under the arm's pit of the patient for about a minute after which the thermometer is taken out and its reading is noted. If the temperature of patient's body is above 37°C, he is said to be suffering from fever.

Do You Know ?

1. Normal temperature of human body is 37°C or 98·6°F.
2. Nowadays, instead of the mercury thermometers, digital thermometers are used.
3. A clinical thermometer can not be used to measure the temperature of boiling water (*i.e.* 100 °C) because it can measure only up to 42 °C.

Note : The physical quantities like length, mass, time and temperature are independent of each other. They are not related amongst themselves. Such quantities are called fundamental quantities. On the other hand, area, volume, speed etc. are quantities which are expressed in terms of the measurable fundamental quantities like, length, mass, time etc. They are called derived quantities. *For example :*

$$\text{Area} = \text{Length} \times \text{breadth}$$

$$\text{Volume} = \text{Length} \times \text{breadth} \times \text{height}$$

$$\text{Speed} = \frac{\text{Length of path}}{\text{Time}} = \frac{\text{Distance}}{\text{Time}}$$

MEASUREMENT OF AREA

Each object has a surface. *For example,* a brick, a matchbox, a leaf, a piece of paper, etc. all have a surface. A brick and a matchbox have the surface consisting of six faces. A leaf and a piece of paper have the surface consisting of two faces. *The total surface occupied by an object is called its surface area or simply the area.*

The area can be expressed in terms of the product of two measurements in length.

For example : To find the area of the base of a geometrical box, we measure its length and breadth. If the length of the geometrical box is 20 cm and its breadth is 7 cm, then area of the geometrical box is given as :

Area of the base of a geometrical box

$= \text{length} \times \text{breadth}$

$= 20 \text{ cm} \times 7 \text{ cm}$

$= 140 \text{ cm}^2$

Area of regular shapes

The area of an object of regular shape can be calculated by using the following formulae:

1. Area of a square of side l

   $= \text{side} \times \text{side} = l \times l = l^2$

2. Area of a rectangle of length l and breadth b

   $= \text{length} \times \text{breadth} = l \times b = lb$

3. Area of a triangle of length of base l and height h

   $= \frac{1}{2}$ length of base $\times$ height

   $= \frac{1}{2} lh$

4. Area of a circular lamina of radius r

   $= \pi \times (\text{radius})^2 = \pi r^2$

Where $\pi = \frac{22}{7}$ or 3·14.

Use of graph paper to find the area of a regular or irregular surface

The area of a regular or irregular surface can also be obtained by using a graph paper. A graph paper has small squares, each side of which is 1 mm *i.e.*, the area of one small square is 1 mm × 1 mm = 1 mm^2. But it is very difficult to count these small squares, so we count the squares of each side 1 cm, the area of which is 1 cm × 1 cm = 1 cm^2. This therefore gives an approximete area of the given surface.

Note : In this chapter on graph, 1 cm has been divided into 5 divisions for the clarity of diagrams.

Procedure : Place the given surface on a graph paper. Draw its outline on the paper and remove it. Now count the number of complete squares. To this add the number of incomplete squares which are half or more than half (within the outline). Ignore the squares which are less than half (within the outline). This number when multiplied by the area of one square gives the approximate area of the given surface. Thus,

∴ Approximate area = (No. of complete squares + No. of half or more than half of incomplete squares) × Area of one square.

Examples :

1. In Fig. 2.19, the complete squares marked as (√) are 7 and the half or more than half squares marked as (•) are 3.

   ∴ Area of triangular lamina

   $= (7 + 3) \times 1 \text{ cm}^2$

   $= 10 \text{ cm}^2$

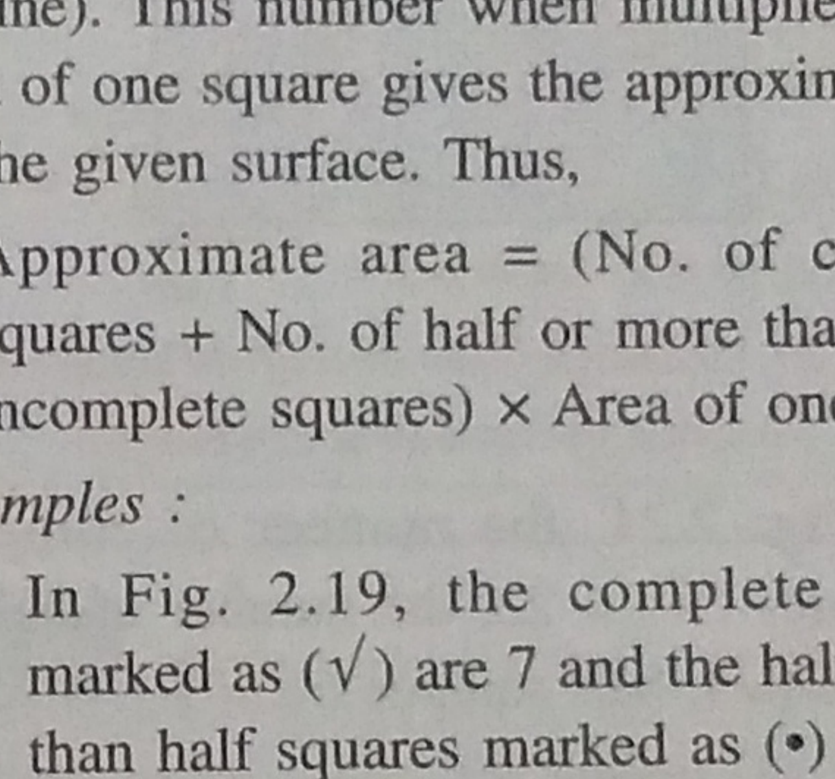

Fig. 2.19 Measurment of area of a triangular lamina

2. In Fig. 2.20, the complete squares are marked as (√) and the half or more than half squares are marked as (•)

The number of complete squares = 13

The number of half or more than half squares = 7

Area of surface

$= (13 + 7) \times 1\ cm^2 = 20\ cm^2$

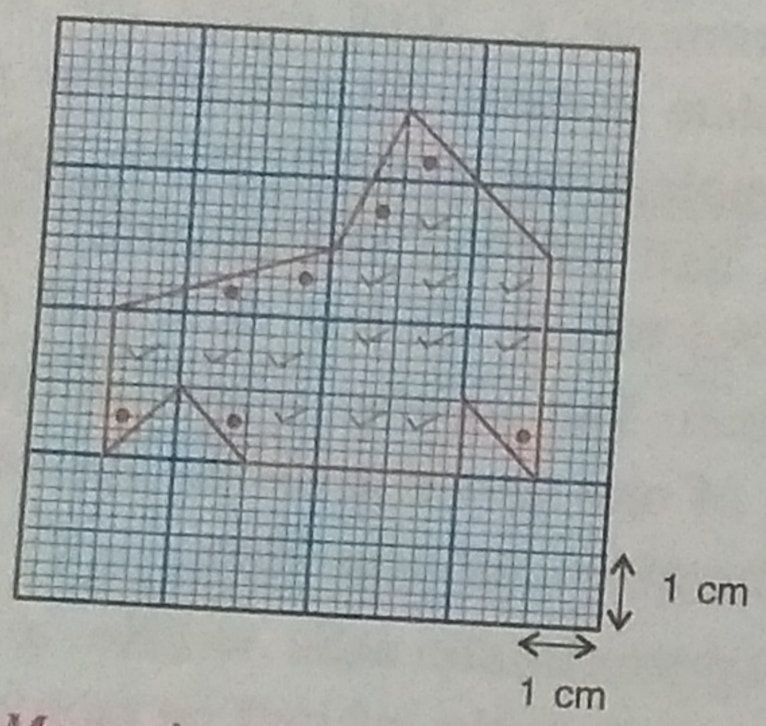

Fig. 2.20 Measuring the area of an irregular surface using a graph paper

3. In Fig. 2.21, the number of complete squares (√) = 22, the number of half or more than half squares (•) = 9

Area of surface

$= (22 + 9) \times 1\ cm^2 = 31\ cm^2$

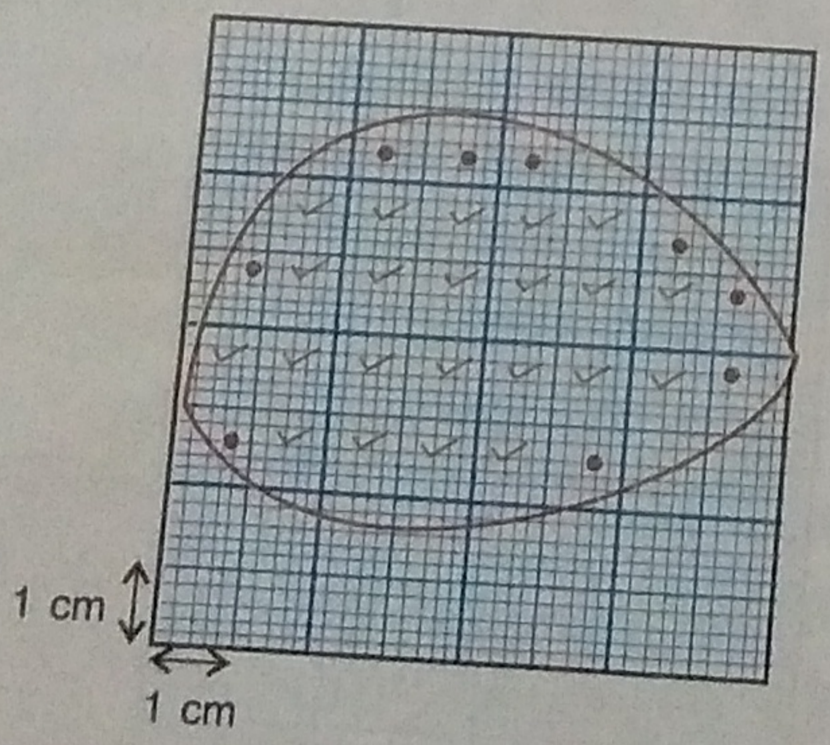

Fig. 2.21 Measuring the area of an irregular surface using a graph paper

Units of area

The S.I. unit of area is square metre or metre^2 which in short form is written as m^2.

One square metre is the area of a square of each side of 1 metre (Fig. 2.22).

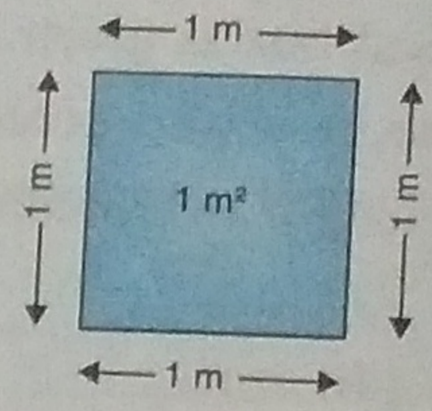

Fig. 2.22 A square of area = 1 m^2

Multiple and sub multiple units of area

Square metre is a convenient unit to express the area of a room or the area of a plot of land for a building, etc. But to express the area of a big agricultural field or a city, we use the bigger units of area called the **decametre^2 (are) hectare** and **square kilometer.**

Decametre square (are) : *One square decametre (or are) is the area of a square of each side 1 decametre i.e., 10 metre.* Thus,

1 decametre^2 = 10 metre × 10 metre

= 100 metre^2

or 1 decametre^2 (or 1 are)

= 100 m^2

Hectare : *One hectare is the area of a square of each side 100 metre.* Thus,

1 hectare = 100 metre × 100 metre

= 10000 metre^2 (or 10^4 m^2)

Square kilometre : *One square kilometre is the area of a square of each side 1 kilometre.* Thus,

1 km^2 = 1 km × 1 km

= 1000 m × 1000 m = 10^6 m^2

But to express the area of small objects such as a book, matchbox, pin head, pencil etc. small units such as square decimetre (dm^2), square centimetre (cm^2) and square millimetre (mm^2) are used.

Square decimetre : *One square decimetre is the area of a square of each side 1 decimetre* (= 10 cm). Thus,

$$1\ dm^2 = 10\ cm \times 10\ cm = 100\ cm^2$$

Square centimetre : *One square centimetre is the area of a square of each side 1 centimetre*. Thus,

$$1\ cm^2 = \left(\frac{1}{100}\ m\right) \times \left(\frac{1}{100}\ m\right) = \frac{1}{10000}\ m^2$$

$$= 10^{-4}\ m^2$$

Similarly $1\ mm^2 = 1\ mm \times 1\ mm$

$$= \frac{1}{1000}\ m \times \frac{1}{1000}\ m$$

$$= 10^{-6}\ m^2$$

Thus, the different units of area are related as follows :

$$1 \text{ are} = 100\ m^2$$

$$1 \text{ hectare} = 10000\ m^2 = 100 \text{ are}$$

$$1\ km^2 = 1000{,}000\ m^2$$

$$= 100 \text{ hectare}$$

$$1\ dm^2 = 100\ cm^2 = 10^{-2}\ m^2$$

$$1\ cm^2 = (1/10000)\ m^2 \text{ or } 10^{-4}\ m^2$$

and $1\ mm^2 = 10^{-6}\ m^2$

Do You Know ?

(1) 1 square yard = 1 yard × 1 yard

= 0·9144 m × 0·9144 m

= 0·836 m^2 (or 0·84 m^2 nearly)

(2) 1 square ft = 0·09290 m^2

(3) 1 acre = 4046·856 m^2

RECAPITULATION

- The observation of a phenomenon is made possible by using the five senses: sight, smell, touch, hearing and taste.
- Our senses are not always reliable. They are subjective.
- Sometimes it is necessary to make an exact measurement.
- Physics is a science of measurement.
- We use instruments to get an exact measurement.
- Four basic measurements in our daily life are: measurement of length, measurement of mass, measurement of time, and measurement of temperature.
- Measurement is basically a process of comparison of the given quantity with a standard unit.
- For measuring a quantity we need a unit, and then we find the number of times that unit is contained in that quantity.
- The unit selected for measurement should be of a convenient size, internationally acceptable and it must not change with place or time.

- The distance between two fixed points is called length.
- The S.I. unit of length is metre (m). Its multiple is kilometre (km), where 1 km = 1000 m. Its sub multiples are centimetre (cm) and millimetre (mm), where 1 cm = 10^{-2} m and 1mm = 10^{-3} m.
- The FPS unit of length is foot (ft) and its sub multiple is inch where 1 ft = 12 inch and 1 ft = 30·48 cm.
- The most common instruments used to measure length are the metre ruler and the measuring tape which are marked in cm and mm.
- To measure a length accurately with a metre ruler, the ruler should be placed with its markings close to the object and parallel to its length. The eye is kept in front of and in line with the reading to be taken.
- The quantity of matter contained in a body is called its mass.
- The S.I. unit of mass is kilogram (kg). Its multiples are quintal and metric tonne. 1 quintal=100 kg and 1 metric tonne = 10 quintal = 1000 kg. Its sub multiples are gram (g) and milligram (mg) where 1 g = 10^{-3} kg and 1 mg = 10^{-6} kg.
- The FPS unit of mass is pound (lb) where 1lb = 453·59 g.
- Mass of a body is measured by using a beam balance or an electronic balance.
- The interval between two instances or events is called time.
- The S.I. unit of time is second (s). 1 s = $\frac{1}{86400}$ of a mean solar day. The C.G.S. and F.P.S. unit of time is also second (s).
- The multiple units of time are minute (min), hour (h), day and year where 1 min = 60 s, 1 h = 3600 s, 1 day = 86400 s and 1 year = $3{\cdot}15 \times 10^7$ s.
- The time at any instant is recorded by a pendulum clock or watch and the time interval of an event is measured by using a stop watch or a stop clock.
- The temperature is the measure of the degree of hotness or coldness of a body. It is measured by a laboratory thermometer.
- The S.I. unit of temperature is kelvin (K), but the common unit of temperature are degree celsius (°C) and degree fahrenheit (°F).
- Doctors use a clinical thermometer to measure a patient's body temperature.
- The normal temperature of the human body is 37°C or 98·6°F.
- The total surface occupied by an object is called its area. Area is expressed as the product of measured lengths of two sides.
- The S.I. unit of area is square metre (m^2).
- One square metre is the area of a square of each side one metre.
- The bigger (or multiple) units of area are square decametre, hectare and square kilometre (km^2), where 1 dk m^2 = 100 m^2, 1 hectare = 10^4 m^2 and 1 km^2 = 10^6 m^2.
- The smaller (or sub multiple) units of area are dm^2, cm^2 and mm^2 where 1 cm^2 = 10^{-4} m^2 and 1 mm^2 = 10^{-6} m^2.