ENGINEERING DRAWING

B. TECH (FIRST YEAR)

SCALE

Definition

A scale is defined as the ratio of the linear dimensions of the object as represented in a drawing to the actual dimensions of the same.

Necessity

- **Drawings drawn with the same size as the objects are called full sized drawing.**

- **It is not convenient, always, to draw drawings of the object to its actual size. e.g. Buildings, Heavy machines, Bridges, Watches, Electronic devices etc.**

- **Hence scales are used to prepare drawing at**
    - **Full size**
    - **Reduced size**
    - **Enlarged size**

BIS Recommended Scales

Reducing scales **1:Y (Y>1)**	**1:2** **1:20** **1:200** **1:2000**	**1:5** **1:50** **1:500** **1:5000**	**1:10** **1:100** **1:1000** **1:10000**
Enlarging scales **X:1 (X>1)**	**50:1** **5:1**	**20:1** **2:1**	**10:1**
Full size scales			**1:1**

Intermediate scales can be used in exceptional cases where recommended scales can not be applied for functional reasons.

Types of Scale

- ***Engineers Scale*** **:**

  The relation between the dimension on the drawing and the actual dimension of the object is mentioned numerically (like 10 mm = 15 m).

- ***Graphical Scale*****:**

  Scale is drawn on the drawing itself. This takes care of the shrinkage of the engineer's scale when the drawing becomes old.

Types of Graphical Scale

- **Plain Scale**
- **Diagonal Scale**
- **Vernier Scale**
- **Comparative scale**

Representative fraction (R.F.)

$$\text{R.F.} = \frac{\text{Length of an object on the drawing}}{\text{Actual Length of the object}}$$

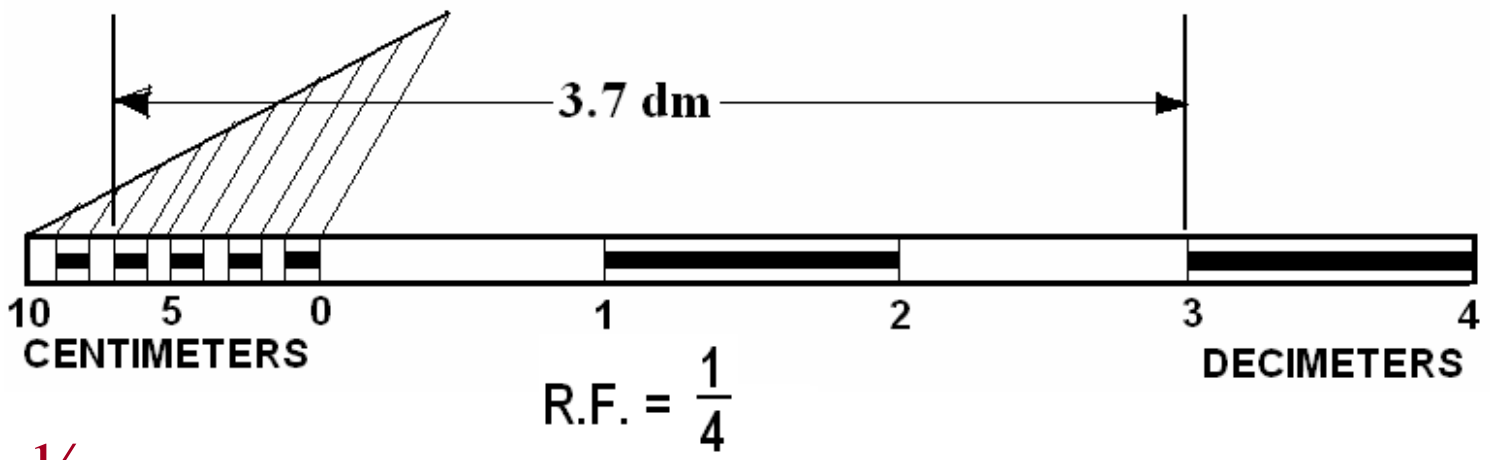
When a 1 cm long line in a drawing represents 1 meter length of the object,

$$R.F = \frac{1\,cm}{1\,m} = \frac{1\,cm}{1\,x\,100\,cm} = \frac{1}{100}$$

Plain scale

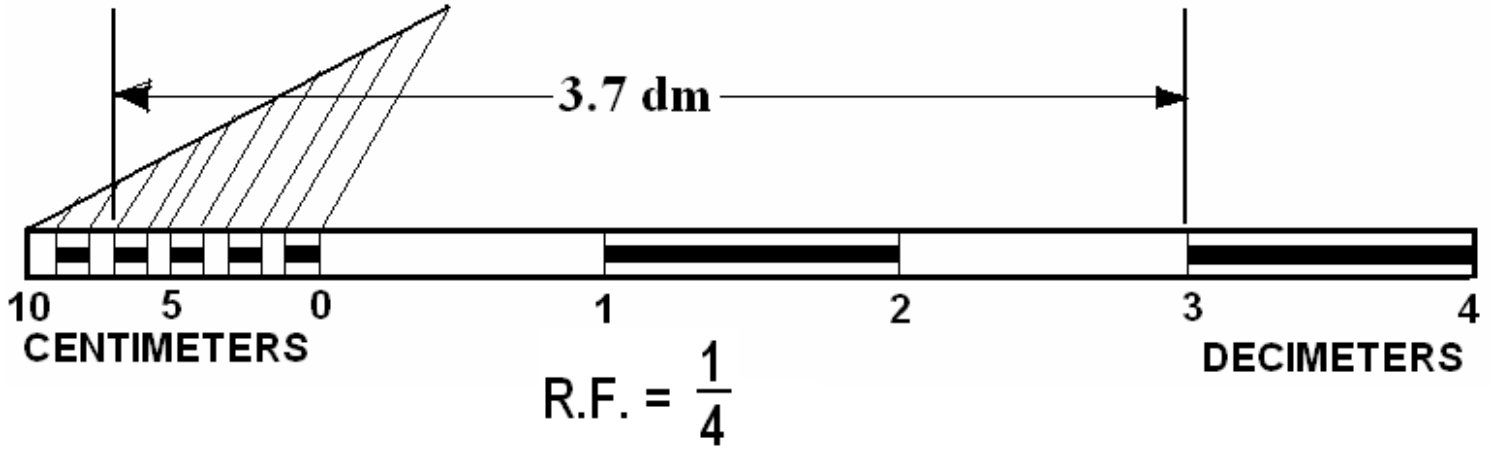
- A plain scale consists of a line divided into suitable number of equal units. The first unit is subdivided into smaller parts.
- The zero should be placed at the end of the 1st main unit.
- From the zero mark, the units should be numbered to the right and the sub-divisions to the left.
- The units and the subdivisions should be labeled clearly.
- The R.F. should be mentioned below the scale.

Construct a scale of 1:4, to show centimeters and long enough to measure up to 5 decimeters.



- **R.F. = ¼**
- **Length of the scale = R.F. × max. length = ¼ × 5 dm = 12.5 cm.**
- **Draw a line 12.5 cm long and divide it in to 5 equal divisions, each representing 1 dm.**
- **Mark 0 at the end of the first division and 1, 2, 3 and 4 at the end of each subsequent division to its right.**
- **Divide the first division into 10 equal sub-divisions, each representing 1 cm.**
- **Mark cm to the left of 0 as shown.**

Question: **Construct a scale of 1:4, to show centimeters and long enough to measure up to 5 decimeters**



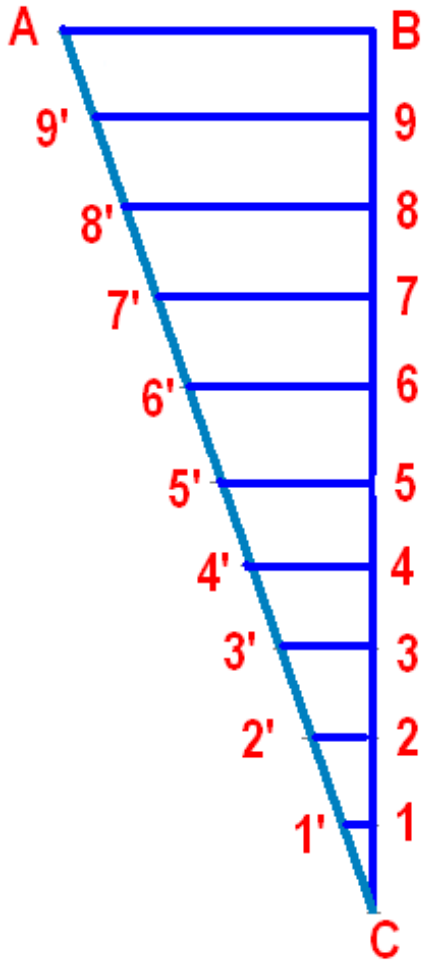
- **Draw the scale as a rectangle of small width (about 3 mm) instead of only a line.**
- **Draw the division lines showing decimeters throughout the width of the scale.**
- **Draw thick and dark horizontal lines in the middle of all alternate divisions and sub-divisions.**
- **Below the scale, print DECIMETERS on the right hand side, CENTIMERTERS on the left hand side, and R.F. in the middle.**

Diagonal Scale

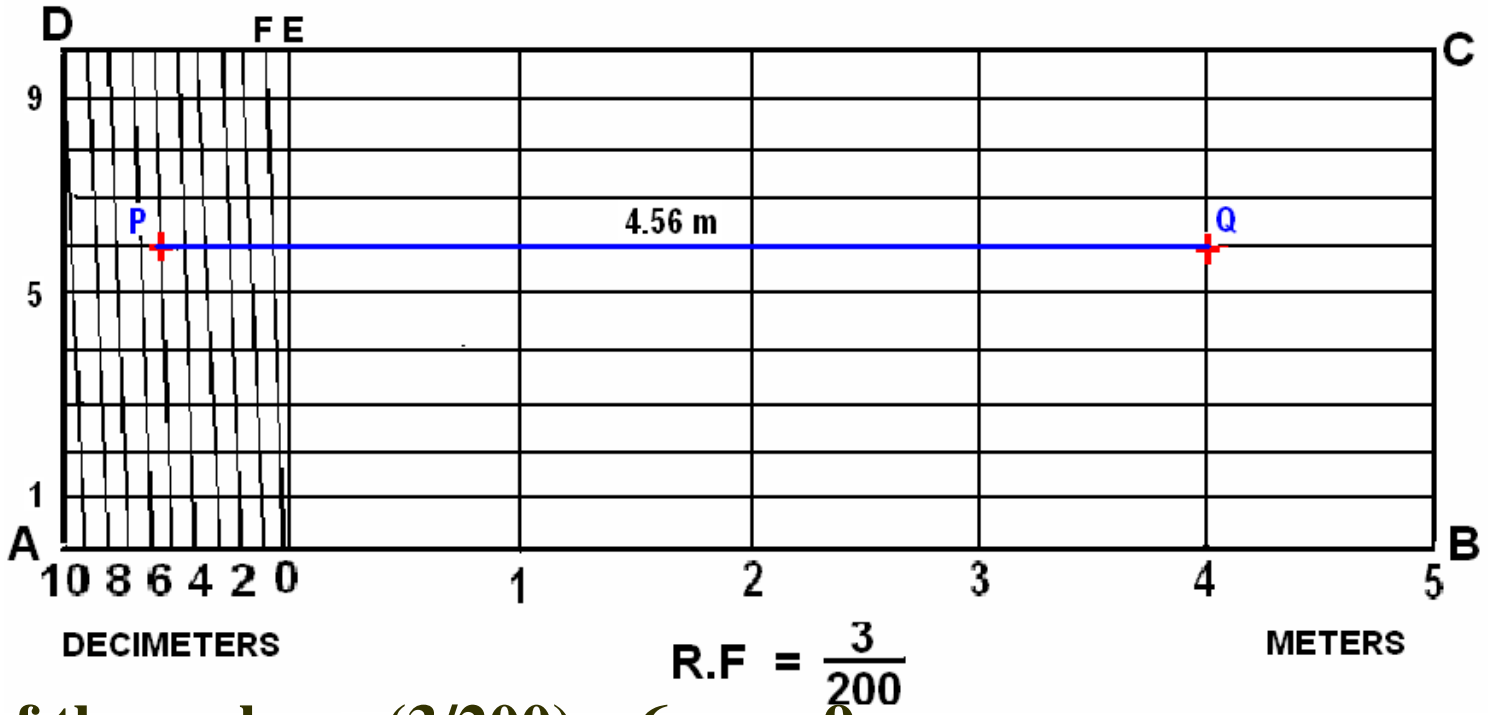
- **Through Diagonal scale, measurements can be up to second decimal (e.g. 4.35).**
- **Diagonal scales are used to measure distances in a unit and its immediate two subdivisions; e.g. *dm, cm & mm,* or *yard, foot & inch*.**
- **Diagonal scale can measure more accurately than the plain scale.**

Diagonal scale…..Concept

- At end B of line AB, draw a perpendicular.
- Step-off ten equal divisions of any length along the perpendicular starting from B and ending at C.
- Number the division points 9,8,7,…..1.
- Join A with C.
- Through the points 1, 2, 3, etc., draw lines parallel to AB and cutting AC at 1′, 2′, 3′, etc.
- Since the triangles are similar; 1′1 = 0.1 AB, 2′2 = 0.2AB, …. 9′9 = 0.9AB.
- Gives divisions of a given short line AB in multiples of 1/10 its length, e.g. 0.1AB, 0.2AB, 0.3AB, etc.

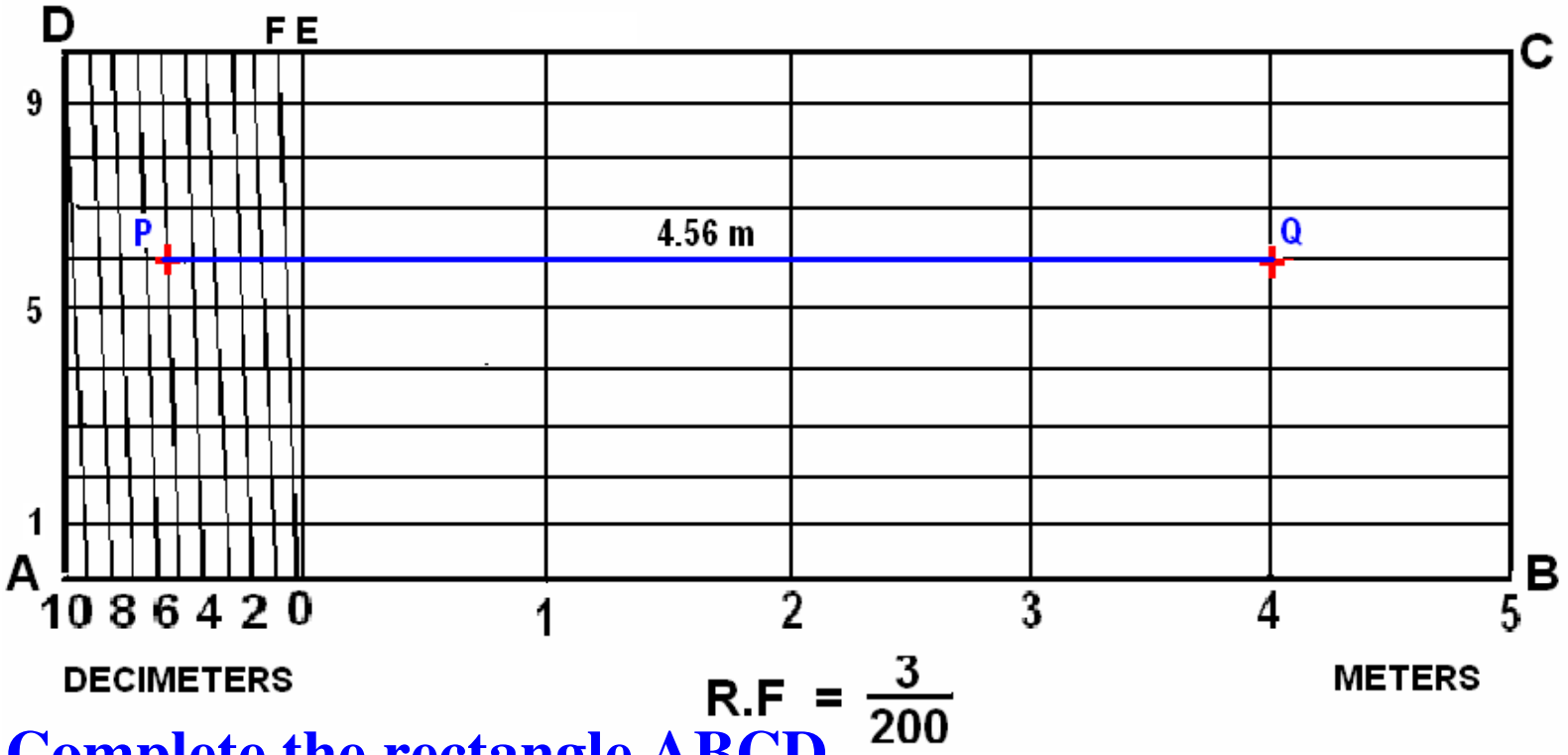


Construct a Diagonal scale of RF = 3:200 (i.e. 1:66 2/3) showing meters, decimeters and centimeters. The scale should measure up to 6 meters. Show a distance of 4.56 meters



- **Length of the scale = (3/200) x 6 m = 9 cm**
- **Draw a line AB = 9 cm . Divide it in to 6 equal parts.**
- **Divide the first part A0 into 10 equal divisions.**
- **At A draw a perpendicular and step-off along it 10 equal divisions, ending at D.**

Diagonal Scale



- **Complete the rectangle ABCD.**
- **Draw perpendiculars at meter-divisions i.e. 1, 2, 3, and 4.**
- **Draw horizontal lines through the division points on AD. Join D with the end of the first division along A0 (i.e. 9).**
- **Through the remaining points i.e. 8, 7, 6, … draw lines // to D9.**
- **PQ = 4.56 meters**

Vernier Scales

- **Similar to Diagonal scale, Vernier scale is used for measuring up to second decimal.**
- **A Vernier scale consists of (i) a primary scale and (ii) a vernier.**
- **The primary scale is a plain scale fully divided in to minor divisions.**
- **The graduations on the vernier are derived from those on the primary scale.**

Least count (LC) is the minimum distance that can be measured.

Forward Vernier Scale :

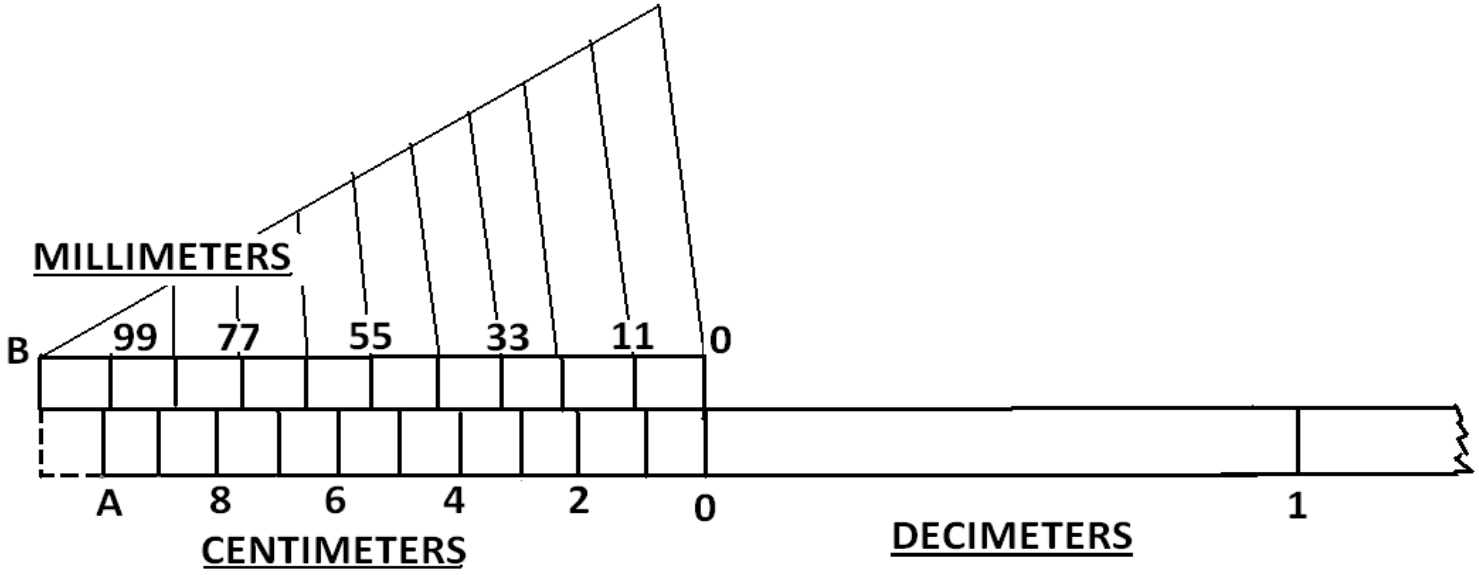
MSD>VSD; LC = MSD-VSD

Backward Vernier scale:

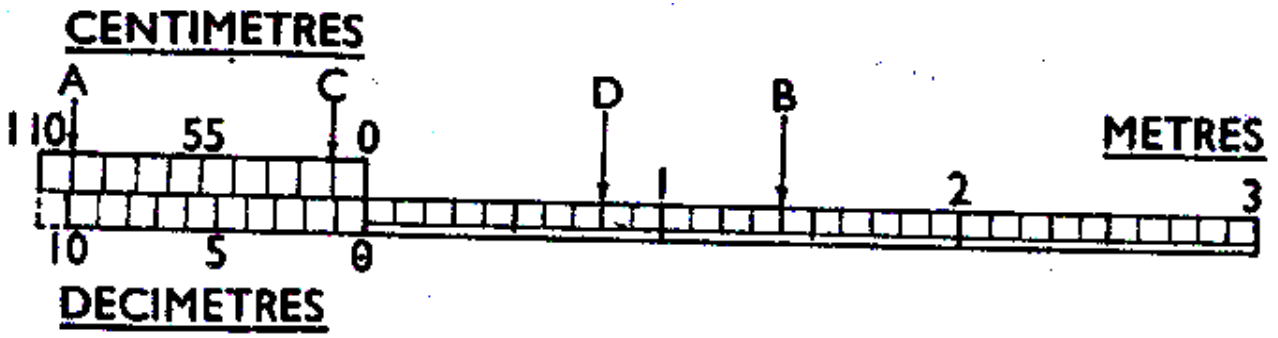
VSD>MSD; LC = VSD - MSD

Vernier scale…. Concept

- **Length A0 represents 10 cm and is divided in to 10 equal parts each representing 1 cm.**
- **B0 = 11 (i.e. 10+1) such equal parts = 11 cm.**
- **Divide B0 into 10 equal divisions. Each division of B0 will be equal to 11/10 = 1.1 cm or 11 mm.**
- **Difference between 1 part of *A0* and one part of *B0* = 1.1 cm -1.0 cm = 0.1cm or 1 mm.**



Question: Draw a Vernier scale of R.F. = 1/25 to read up to 4 meters. On it show lengths 2.39 m and 0.91 m



- Length of Scale = (1/25) × (4 × 100) = 16 cm
- Draw a 16 cm long line and divide it into 4 equal parts. Each part is 1 meter. Divide each of these parts in to 10 equal parts to show decimeter (10 cm).
- Take 11 parts of dm length and divide it in to 10 equal parts. Each of these parts will show a length of 1.1 dm or 11 cm.
- To measure 2.39 m, place one leg of the divider at *A* on 99 cm mark and other leg at *B* on 1.4 mark. (0.99 + 1.4 = 2.39).
- To measure 0.91 m, place the divider at *C* and *D* (0.8 +0.11 = 0.91).

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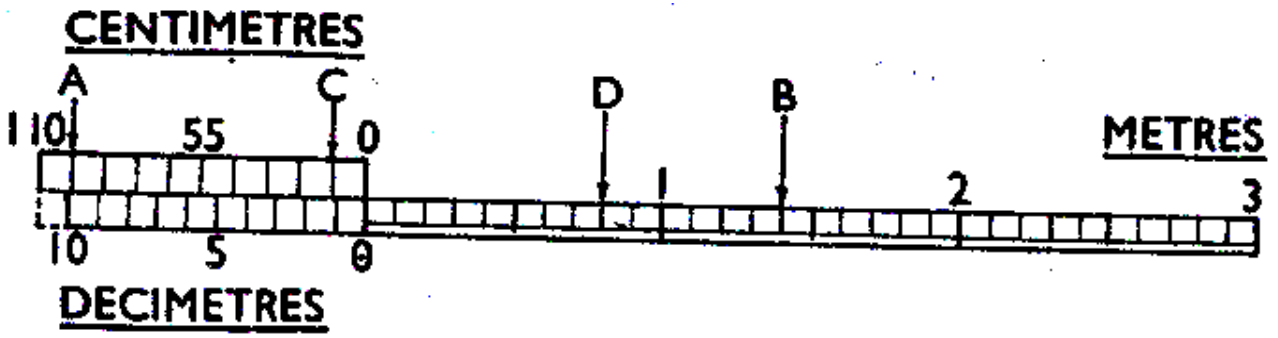

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