ACTIVITY **1**

AIM

To make a paper scale of given least count: (a) 0.2 cm and (b) 0.5 cm

APPARATUS AND MATERIAL REQUIRED

Thick ivory/drawing sheet; white paper sheet; pencil; sharpener; eraser; metre scale (ruler); fine tipped black ink or gel pen.

## PRINCIPLE

Least count of a measuring instrument is the smallest measurement that can be made accurately with the given measuring instrument. A metre scale normally has graduations at 1 mm (or 0.1 cm) spacing, as the smallest division on its scale. You cannot measure lengths with this scale with accuracy better than 1mm (or 0.1 cm).

You can make paper scale of least count (a) 0.2 cm (b) 0.5 cm, by dividing one centimetre length into smaller divisions by a simple method, without using mm marks.

PROCEDURE

(a) Making Paper Scale of Least Count 0.2 cm

1. Fold a white paper sheet in the middle along its length.

2. Using a sharp pencil, draw a line AB, of length 30 cm in either half of the white paper sheet [Fig. A1.1(a)].

3. Starting with the left end marked A as zero, mark very small dots on the line AB after every 1.0 cm and write 0,1,2 …, 30 at successive dots.

4. Draw thin, sharp straight lines, each 5 cm in length, perpendicular to the line AB at the position of each dot mark.

5. Draw 5 thin, sharp lines parallel to the line AB at distances of 1.0 cm, 2.0 cm, 3.0 cm, 4.0 cm and 5.0 cm respectively. Let the line at 5 cm be DC while those at 1 cm,
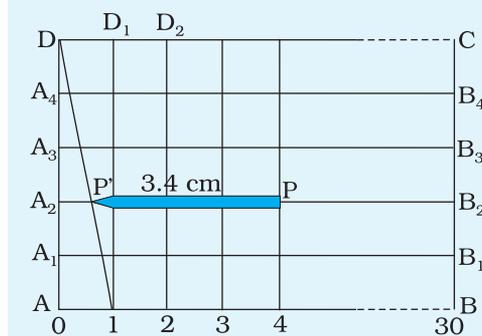

Fig. A1.1(a): *Making a paper scale of least count 0.2 cm*

2 cm, 3 cm, and 4 cm be A_1B_1, A_2B_2, A_3B_3 and A_4B_4 respectively [Fig A 1.1(a)].

6. Join point D with the dot at 1 cm on line AB. Intersection of this line with lines parallel to AB at A_4, A_3, A_2 and A_1 are respectively 0.2 cm, 0.4 cm, 0.6 cm and 0.8 cm in length.

7. Use this arrangement to measure length of a pencil or a knitting needle with least count of 0.2 cm.

(b) Making Paper Scale of Least Count 0.5 cm

1. Using a sharp pencil, draw a line AB of length 30 cm in the other half of the white paper sheet [Fig. A1.1(b)].

2. Repeat steps 3 to 6 as in the above Activity 1.1(a), but draw only two lines parallel to AB at distances 1.0 cm and 2.0 cm instead of 5 cm.

Fig. A1.1(b):

3. Join diagonal 1-D by fine tipped black ink pen [Fig. A 1.1 (b)].
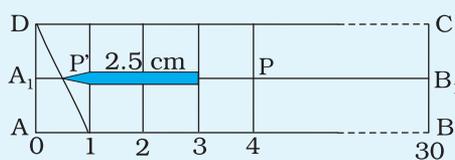
4. Use this scale to measure length of a pencil/knitting needle with least count of 0.5 cm. Fractional part of length 0.5 cm is measured on line A_1B_1.

(c) Measuring the Length of a Pencil Using the Paper Scales A and B

1. Place the pencil PP' along the length of the paper scale A (least count 0.2 cm) such that its end P is on a full mark (say 1.0 cm or 2.0 cm etc. mark). The position of the other end P′ is on diagonal 1–D. If P′ goes beyond the diagonal, place it on next upper line, in which fraction of intersection is 0.2 cm larger, and so on. Thus, in Fig. A 1.1 (a), length of the pencil = 3 cm + .2 × 2 cm = 3.4 cm. Take care that you take the reading with one eye closed and the other eye directly over the required graduation mark. The reading is likely to be incorrect if the eye is inclined to the graduation mark.

2. Repeat preceding step 1, using the paper scale B having least count 0.5 cm and record your observation in proper units.

OBSERVATIONS

Least count of the paper scale **A** = 0.2 cm

Least count of the paper scale **B** = 0.5 cm

RESULT

(i) Scale of least count 0.2 cm and 0.5 cm have been made; and

(ii) Length of pencil as measured by using the scales made above is

(a) ... cm and (b) ... cm.

PRECAUTIONS

(i)   Very sharp pencil should be used.

(ii)   Scale should be cut along the boundary by using a sharp paper cutter.

(iii) Observation should be recorded showing accuracy of the scale.

(iv)   While measuring lengths, full cm mark should be made to coincide with one end of the object and other end should be read on the scale.

SOURCES OF ERROR

The line showing the graduations may not be as sharp as required.

DISCUSSION

1.   The accuracy of measurement of length with the scale so formed depends upon the accuracy of the graduation and thickness of line drawn.

2.   Some personal error is likely to be involved e.g. parallax error.