



ACTIVITY

AIM

To make a paper scale of given least count, e.g., 0.2 cm, 0.5 cm .

MATERIAL REQUIRED

A paper cutter, thick ivory/drawing sheet used by engineering student, a thick white paper sheet, a pair of scissors, a meter scale, gum or fevicol, a sharp pencil, eraser, sharpener and black ink or gel pen.

DIAGRAM



Scale of least count 0.2 cm.



Scale of least count 0.5 cm.

THEORY

Least Count

The minimum measurement that can be measured by an instrument accurately is called its least count. A meter scale has graduations at 1 mm or 0.1 cm spacing as the smallest division on its scale hence, it has the least count of 1 mm or 0.1 cm.

Range of an Instrument

The difference between maximum and minimum readings taken by the instrument is called the range of an instrument.

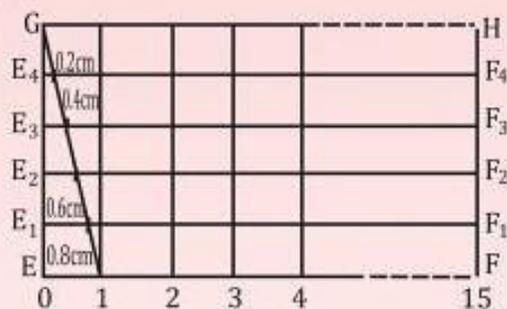
PROCEDURE

A. Making of Paper Scale of Least Count

1. First, fold a white paper sheet in the middle along lengthwise.
2. After folding a white paper sheet, with the help of a sharp pencil, draw a line EF of 15 cm long in the upper half along the length of the paper.
3. Now, take the point E as zero-mark point on EF and start marking the very small dots after every distance of and start writing as 0, 1, 2, up to 15.
4. By using a sharp pencil, draw a thin sharp straight line of 5 cm perpendicular to EF at the first dot mark. Draw the same perpendicular line at each dot mark. In this way, we will get 15 straight lines

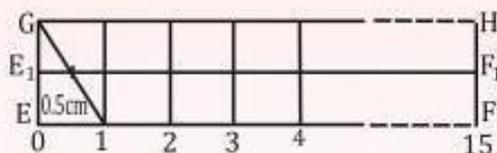
perpendicular to the line.

5. Now, draw 5 thin straight lines $E_1F_1, E_2F_2, E_3F_3, E_4F_4$ and GH parallel to line EF at a distance of 0.1 cm, 0.2 cm, 0.3 cm, 0.4 cm and 0.5 cm respectively.
6. From the point G of line GH at 5 cm from the line EF , draw a line joining the point G , and the first dot mark at 1 cm on line EF . Eventually, we will get the intersection of this line with lines parallel to EF at 0.2 cm, 0.4 cm, 0.6 cm and 0.8 cm from points E_4, E_3, E_2 , and E_1 respectively.
7. You will find that your paper scale of the least count of 0.2 cm is ready for use.



B. Making of Paper Scale of Least Count

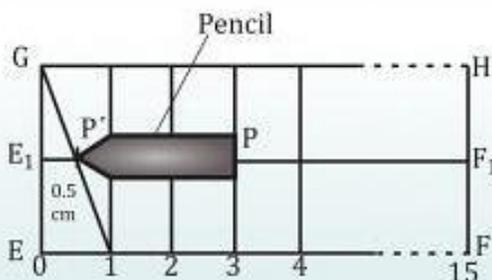
8. First, fold a white paper sheet in the middle lengthwise.
9. After folding a white paper sheet, with the help of sharp pencil, draw a line EF 15 cm long in the upper half along the length of paper.
10. Now, repeat the steps 3 to 6 of above activity 1 but here draw only two lines E_1F_1 and GH at distances 1 cm and 2 cm respectively parallel to the line EF .
11. Now, join the point G of line GH drawn at 2 from the line EF and first dot mark at 1 cm on line EF by using a black ink pen. Thus, a diagonal is formed.

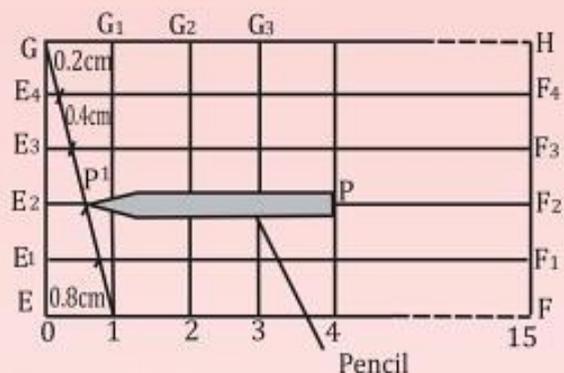


12. You will find that your paper scale of least count 0.5 is ready for use.

C. Measuring the Length of Pencil with the help of Paper Scale

13. Firstly, place the pencil on the paper scale in such a way that its one end P lies on a full mark (say 1 cm or 2 cm etc. mark). The other end P' should lie on the diagonal. If it is not so, then place the pencil on the next upper line having the fraction of intersection to be 0.2 cm larger and so on. In the following figure, the length of the pencil can be calculated as:





Measuring the length of pencil with the help of paper scale of least count 0.2cm

14. Length of pencil = 3 cm + 0.2 × 2 cm = 3.4 cm

15. Repeat the above step 1 and use the paper scale of 0.5 cm least count and record the observations.

The length of the pencil can be calculated as:

Length of pencil = 2 + 0.5 × 1 = 2.5 cm

NOTE: At the time of taking reading, take care that you observe the reading with one eye closed and the other eye directly over the required graduation mark. If the eye is inclined to the graduation mark, the reading may be incorrect.

OBSERVATIONS

1. Least count of the first scale, (X) = 0.2 cm.
2. Least count of the second scale, (Y) = 0.5 cm.

Table for length of the pencil using scale (A)

S. No.	Reading at one end A of the pencil a ₁ (cm)	Reading at other-end B a ₂ (cm)	Length of the pencil = a ₂ - a ₁ (cm)
1.	1.0		
2.	2.0		

Mean length of the pencil = cm.

Table for length of the pencil using scale (B)

S. No.	Reading at one end A of the pencil a ₁ (cm)	Reading at other-end B a ₂ (cm)	Length of the pencil = a ₂ - a ₁ (cm)
1.	1.0		
2.	2.0		

Mean length of the pencil = cm.

RESULT

1. The scales of the least count 0.2 cm and 0.5 cm have been made.
2. The length of the pencil as measured with the help of:
 - (i) first scale (X) of least count 0.2 cm is _____ cm.
 - (ii) second scale (Y) of least count 0.5 cm is _____ cm.



PRECAUTIONS

1. A very sharp pencil should be used for the marking of the divisions.
2. There should be an overlapping of one end of the object (whose length is to be determined) with a full centimeter mark.
3. The scale boundaries should be made by using a sharp paper cutter.
4. The paper scale should be pasted on thick ivory paper or drawing sheet to make it usable.

SOURCES OF ERROR

1. The parallax error may occur while taking the measurements.
2. A sharp pencil may not be used for marking divisions.
3. The graduation marks may not have an equal gap.

VIVA VOCE

Q1. Define the least count of an instrument.

Ans. The minimum measurement that can be measured by the instrument accurately is called the least count of an instrument.

Q2. Which is the most mandatory and important information that must be kept in mind while performing this activity?

Ans. While performing this activity, the most mandatory and important information is the marking of graduations which should be done accurately.

Q3. In this experiment, you have two scales X and Y with their least counts 0.2 cm and 0.5 cm respectively. So, which one of them will measure the length of the given pencil more accurately?

Ans. The paper scale (X) with the least count 0.2 cm will measure the length of the given pencil more accurately.

Q4. What difference you have concluded in procedure of this experiment, in making the paper scale (X) with least count 0.2 cm and the paper scale (Y) with least count 0.5 cm?

Ans. It is very important to know that in the case of paper scale, on dividing each gap of 1cm into five equal parts, each individual part of 1 cm must have length 0.2 cm.
While in the case of paper scale (Y), on dividing each gap of 1 cm into two equal parts, each individual part of 1 cm gap will be of length 0.5 cm

Q5. What do you mean by the range of a device?

Ans. Range of a device is defined as the difference between the maximum and minimum values that can be measured by device.

Q6. What does accuracy mean?

Ans. It is a very crucial term in experimental physics. So, accuracy means how close the measured value is to the true value of the quantity.

Q7. What is the range of this paper scale which you have prepared in this activity?

Ans. The range of paper scale prepared in this activity is 15 cm.