PROJECT 8

AIM

To study Fortin's Barometer and use it to measure the atmospheric pressure.

APPARATUS AND MATERIAL REQUIRED

Fortin's Barometer and a thermometer.

DESCRIPTION OF APPARATUS

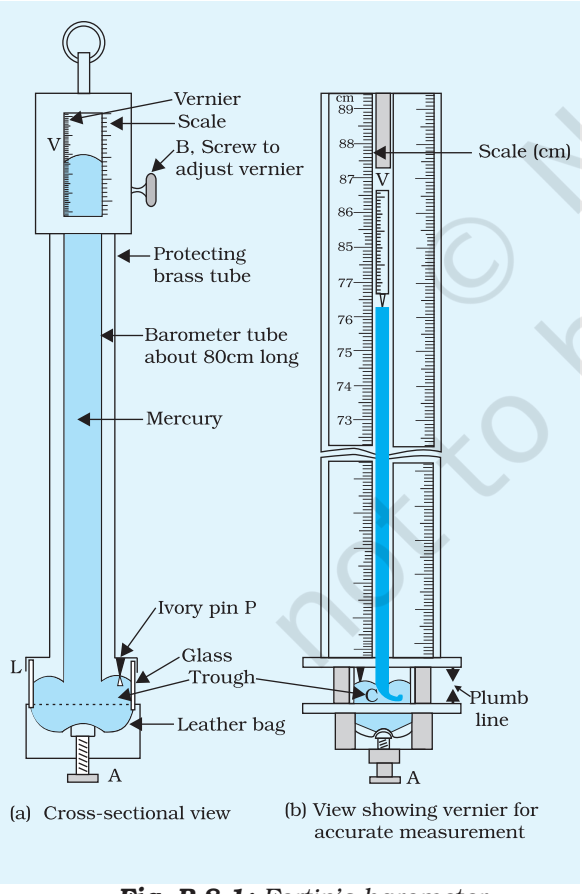


Fig. P 8.1: *Fortin's barometer*

Fortins's Barometer

It consists of a uniform glass tube about 80 cm long, open at one end. It is filled with mercury and turned upside down carefully in a trough of mercury C. The lower part of the trough is made of leather and the level of mercury in the trough can be adjusted by means of screw A [Fig. P 8.1 (a)]. The upper side of the trough is closed by a leather patch L in such a way that the contact is maintained between the outside air and the mercury in the trough. There is a small ivory pin P fixed with its pointed tip touching the mercury in the trough. The function of the pin P is to adjust the zero of the scale at the same level as the mercury in the trough. The glass tube is enclosed in a brass tube for protection. There are two vertical slits diametrically opposite each other so that the level of mercury in the tube can be seen [Fig. P 8.1 (b)]. A scale graduated in centimetre is engraved on the brass tube on both sides along the edges of the front slit. The scale graduation does not start from zero but from 68 cm to 85 cm, as the atmospheric pressureremains within these limits. A brass vernier scale slides along the front slit and can be adjusted using screw B.

PRINCIPLE

When a completely filled mercury tube is turned upside down in the trough C, some mercury flows out of the tube in the trough leaving a vacuum on the top.

The level of mercury stabilises when the atmospheric pressure exerted on the surface of mercury in the trough equalises that due to the mercury column in the tube. The height of the mercury column in the tube is proportional to atmospheric pressure under normal conditions, Column of mercury in the glass tube stands at a height of about 76 cm at sea level.

From theoretical point of view, a barometer could be made of any liquid. Mercury is chosen for many reasons mainly it is so dense (13600 kg/m^3) that column supported by air pressure is of a managable height.

A water barometer would be more than 10 m in height.

PROCEDURE

1. Use the plumb line to hang the barometer vertically on a wall.
2. Examine the screws A, B, pin P and vernier V.
3. Determine the least count of the vernier scale.
4. Adjust the level of mercury surface in the trough of the barometer

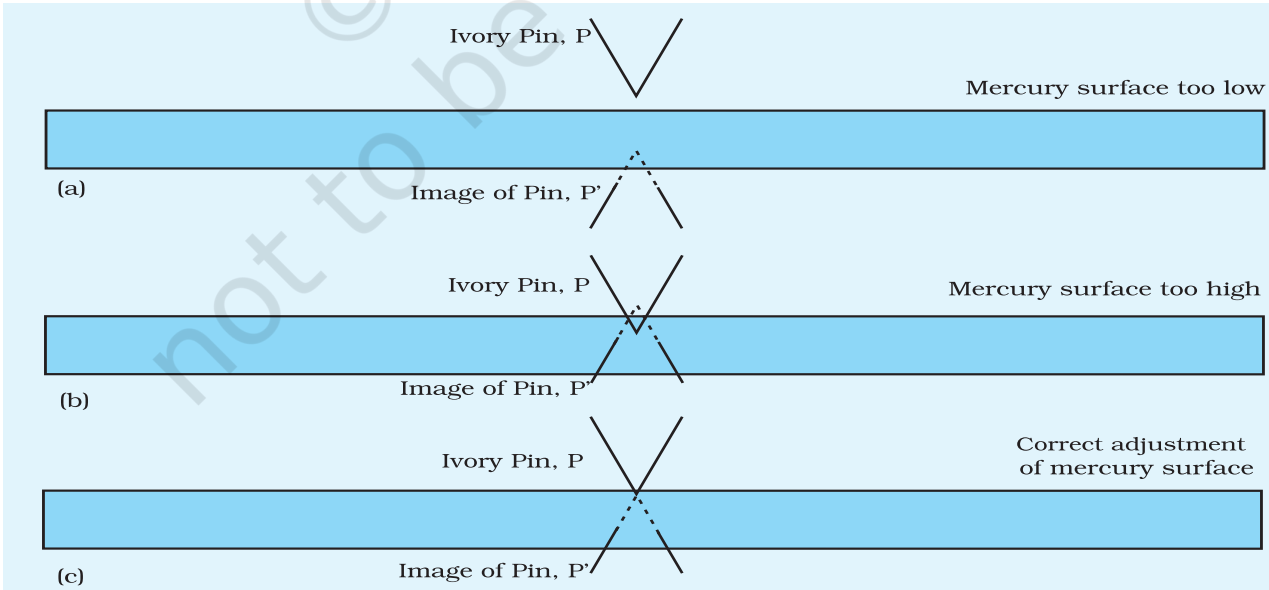
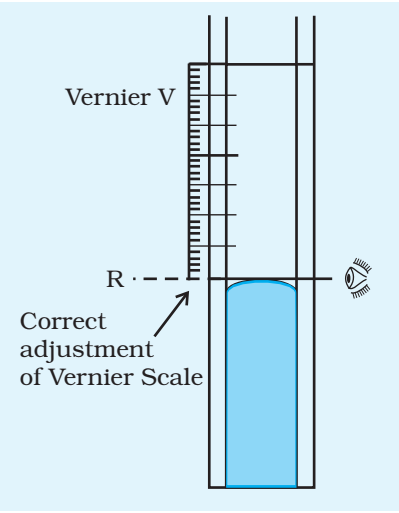


Fig. P 8.2: *Correct adjustment of mercury surface in the reservoir*



with the help of screw A and by looking at the ivory pin and its image on the mercury surface in the trough (Fig. P 8.2).

5. Adjust the vernier using screw B such that the zero of the vernier touches the convex meniscus of mercury in the tube. The eye should be kept at the level of the meniscus (Fig. P 8.3).
6. Note the reading on the main scale and the vernier.
7. Record the room temperature using a thermometer.
8. Repeat the procedure two more times and determine the average atmospheric pressure.

Fig. P 8.3: *Eye should be at the level of meniscus of mercury in the tube*

OBSERVATIONS

(i) Vernier constant or least count = ...

No. of divisions on the vernier = ...

No. of divisions on the main scale = ...

Least count of main scale (1 MSD) = ... cm

Least count of vernier scale

$$= \frac{1 \text{ MSD}}{\text{No. of divisions on vernier scale}} = \ldots \text{cm}$$

(ii) Room Temperature = ... °C

Table P 8.1: Measuring height of mercury column in a barometer

S. No.	Main scale reading below zero mark of vernier scale, S (cm)	Vernier scale reading n	Height of mercury column $h = (S + n \times \text{least count})$
1			
2			
3			

RESULT

Atmospheric pressure in the laboratory on dd/mm/yr (date) at ... am/pm at room temperature ...°C was measured as ...cm of Hg. Atmospheric pressure = ...N/m^2

PRECAUTIONS

1. The barometer is a fragile instrument and should be handled carefully.
2. The wall mount should be firm in a room of a laboratory and not in any passage.
3. Adequate light must fall on the ivory pin and the vernier scale.
4. Least count should be calculated with care.
5. Screw A should be moved slowly and gently.

SOURCES OF ERROR

1. There may be air bubbles in the barometer tube.
2. Ivory pin may not be fixed properly.
3. Room temperature may change, affecting the observations.

DISCUSSION

1. The barometer should be placed in such a way on the wall that screw A can easily be adjusted by viewing the ivory pin P. A suitable platform can be used to stand and see the vernier reading at eye level.
2. Why does the barometer require adjustment everytime one has to use it?

SELF ASSESSMENT

1. What effect would there be of the following:
   (a) Ivory pin not adjusted as advised?
   (b) Barometer is not vertical but tilted?
   (c) The pin P and scale S not viewed at eye level?
2. If water is used instead of mercury, what problems would you encounter?

SUGGESTED ADDITIONAL EXPERIMENTS/ACTIVITIES

1. Take barometer readings and temperature readings at different times during school hours. Study the pattern for the change in atmospheric pressure over a week.
2. Plot a graph between atmospheric pressure and humidity (as given in the newspaper) for a month. Can we relate humidity to atmospheric pressure?