

MEASUREMENT OF THE ATMOSPHERIC PRESSURE

It can be measured by barometers, so a barometer is an instrument which is used to measure atmospheric pressure.

These barometers are of three types :

- [A] Simple barometer
 - [B] Fortin's barometer
 - [C] Aneroid barometer
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[A] SIMPLE BAROMETER

This was designed by Torricelli, using mercury as liquid.

WHAT IS BAROMETER? - DEFINITION

Barometer - Is it going to rain today? Is it going to stay fine? How can you tell about the weather behaviour?

One easy way is to measure air pressure and predict weather it will rain today or not.

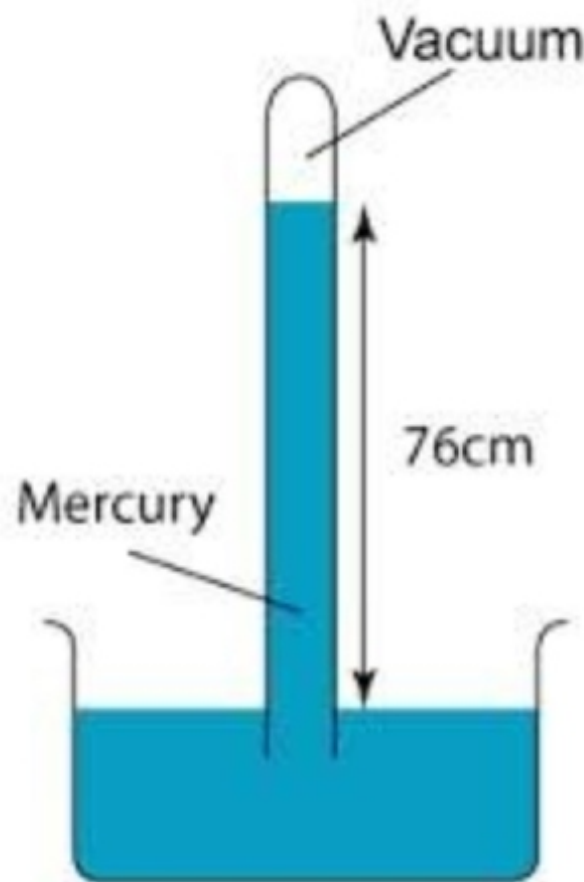
1. If the air pressure is rising and its high then chances are it'll be a fine day.

2. If the pressure is falling, it's more likely to be wet, windy and dull.

The instruments that measure air pressure are called **Barometers**.

People have been using barometers for weather forecasting and research purposes.

SIMPLE BAROMETER - DIAGRAM



An inverted glass tube is standing in the bath of mercury and air pressure is exerted on the surface of mercury. The pressure at the top of the mercury column is zero as there is a vacuum there. Due to atmospheric pressure we can see some raise in glass tube. The height raised in glass tube is equivalent to the atmospheric pressure.

Factors Affecting the Height of Barometer

1. If shape of tube changes or tube is tilted the vertical height remains same.
2. If some air is there in the uppermost part in the tube *i.e.*, in the vacuum, then due to air pressure height of mercury column decreases.

Advantages using Mercury as Barometer Liquid

1. Density is high ($13.6 \times 10^3 \text{ kg/m}^3$) so tube of barometer of less length is required, otherwise for liquid like water very high height is required which is difficult to handle.
2. Vapour pressure of mercury is negligible.
3. It does not stick with tube.
4. It is opaque and shining so convenient in taking observations.
5. Easily available in pure state.

Disadvantages of using Water in the Barometers

1. More height (10.4 m) is required due to less density of water.
2. High vapour pressure.
3. It sticks with glass tube.
4. It is transparent so difficult to take observation.

Demerits

1. No protection for glass tube.
2. Surface of trough filled with mercury is open, chances of mixing of impurities are there.
3. It is not portable.
4. No scale is fixed to measure height.

Above demerits are improved in fortin barometer which is modified barometer.

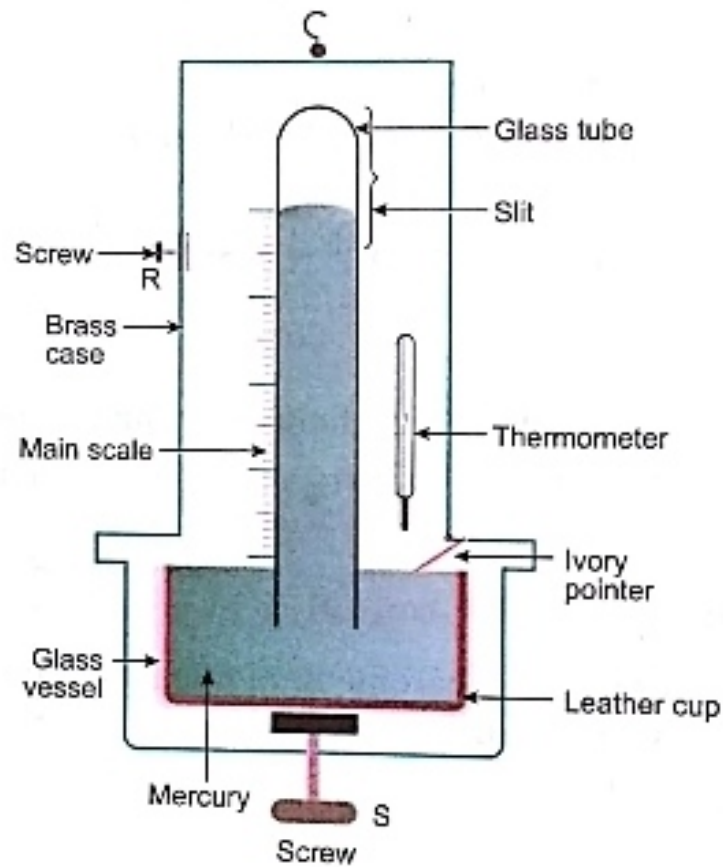
[B] FORTIN'S BAROMETER

It is used in laboratory to measure atmospheric pressure. Mercury is also used in this as barometer liquid.

Construction

This barometer has a narrow glass tube of length about 90 cm and it is closed at one end and open at other end. This tube is completely filled with pure mercury and kept inverted in a glass vessel having a leather cup at the bottom. The open end of the tube is dipped into mercury of the cup. The glass tube is protected with a brass case. At the bottom of the brass tube a screw S is fitted, the leather cup can be adjusted with screw S . The mercury level in the glass vessel is adjusted to coincide with the zero mark of main scale graduated in mm attached with brass tube. The upper part of mercury should touch with ivory pointer. A vernier scale is

fitted which slides over a main scale for accurate measurement. A thermometer is also fitted to record room temperature.



Measurement of Pressure

The level of mercury in the leather cup is raised up or down with screw *S* to make a touch of ivory point *I* to level of mercury. Now position of mercury level can be noted with main and vernier scale. Sum of main scale and vernier scale gives the barometer height. Then

$$p = h d g$$

where *h* is height measured above.

$$d = 13.6 \times 10^3 \text{ kg/m}^{-3}, g = 9.8 \text{ ms}^{-2}$$

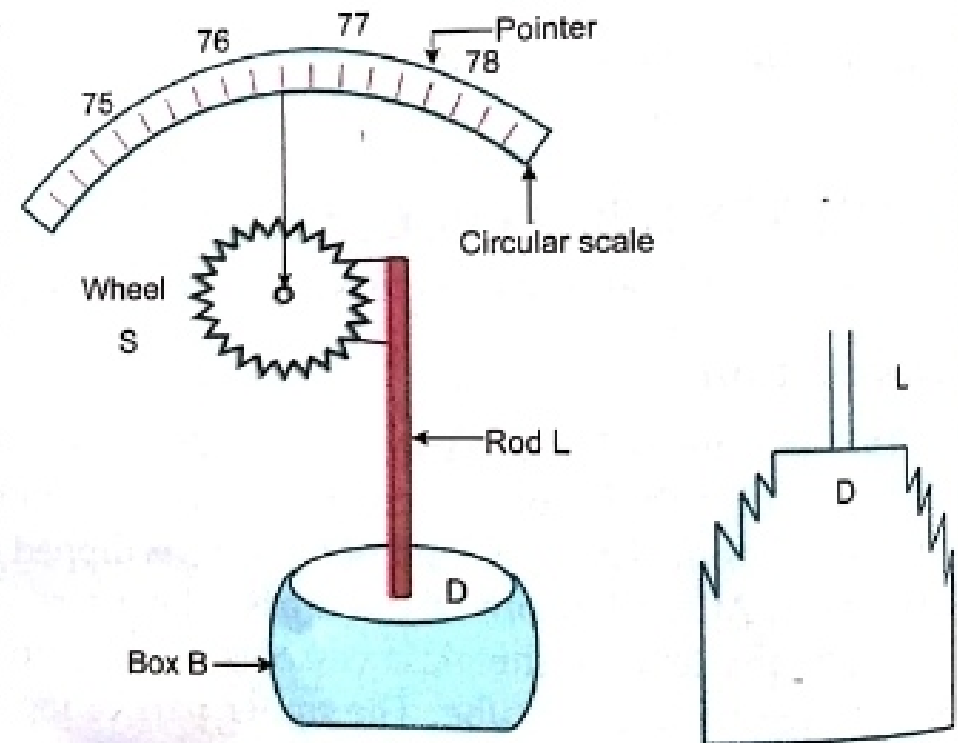
[C] ANEROID BAROMETER

It is a light and portable barometer and has no liquid and it is calibrated directly to read the atmospheric pressure and there is no prior adjustment.

Construction

It consists of a metallic box *B* which is partially evacuated. The top *D* of the box is spring and is corrugated in the shape of a diaphragm. A rod *L* toothed is fixed at the middle of diaphragm. The teeth of the rod fit into the teeth of a wheel *S* attached with pointer which can slide over a circular graduated scale from which atmospheric pressure can be read directly in terms of height of barometric height.

When atmospheric pressure increases it presses the diaphragm *D* and rod *L* gets depressed downwards. The wheel *S* rotates clockwise and pointer *P* moves to right on circular scale and when atmospheric pressure decreases the diaphragm comes up and rod *L* also moves up and wheel *S* rotates anti-clockwise and pointer *P* moves to left on circular scale.



Uses

1. It is used to measure atmospheric pressure.
2. It is used for weather forecasting.
3. It is also used as an altimeter to measure the height of a place.

VARIATION OF ATMOSPHERIC PRESSURE WITH ALTITUDE

As we go up and up in space the length of air column as well as density both decreases due to which atmospheric pressure also decreases and this variation is reflected in the following graph.

CONSEQUENCES OF VARIATION OF ATMOSPHERIC PRESSURE

1. It is difficult to breath at high altitude and some times bleeding occurs through nose.
2. There is leakage in ink pen due to low pressure.

WEATHER FORECASTING BY BAROMETER

These are as follows :

1. If barometer height suddenly falls, it indicates storm or cyclone due to decrease in pressure.
2. If barometer height gradually falls, it is indication of rain.
3. If height of barometer gradually increases it indicates dry weather.
4. If there is sudden rise in barometer height, it indicates extremely dry weather.
5. Weather remains normal, if there is no abrupt change in the barometer height.

ALTIMETER

It is simply an aneroid barometer used in aircraft to measure altitude. As we go above the sea level atmospheric pressure decreases. Its scale is calibrated in terms of height ascending towards left on the circular scale because atmospheric pressure decreases with increase of height above the sea level. So, it is a wonderful device to measure height and it is easy in handling.

