



32

GENERAL LABORATORY EQUIPMENTS

A biology student has to work with various types of equipment while performing different experiments. It is useful to know the principle behind the working of some of these. One main category out of these you have learnt in the previous lesson i.e. the microscopes. A few others will be explained in this lesson



OBJECTIVES

After completing this lesson you will be able to :

- *explain the working of an incubator and mention its uses;*
- *explain the working of a kymograph and list its uses;*
- *define pH and state the applications of a pH meter;*
- *explain the working and mention the uses of autoclave;*
- *explain the working and mention the uses of colorimeter;*
- *describe the parts of a distillation unit and mention its applications;*
- *Describe the working and use of spectrophotometer;*
- *list the latest weighting balances used in laboratories and mention their need;*
- *explain the use of centrifuge and explain the principle of centrifugation;*
- *explain the working of microtome;*
- *describe the working and use of sphygmomanometer.*

32.1 SOME INSTRUMENTS USED IN THE LAB

The following are some of the instruments :

1. Incubator (oven) regulated by a thermostat

Thermostat is an appliance fitted, to regulate the temperature, inside an oven or a refrigerator etc.

Incubator is an appliance shaped like a box which maintains the desired temperature inside it (Fig. 32.1).



Notes

Structure : (Parts)

- (i) A box or container with insulated walls and a door fitted with a latch to close the door firmly.
- (ii) A hole in the center of its roof for insertion of a thermometer to read the temperature of the inside chamber.
- (iii) Its base contains a heating unit heated through electricity.
- (iv) On the front of the base on one side is a knob which can switch-on and switch-off the instrument.
- (v) On the backside is fitted a thermostat to regulate the desired temperature.
- (vi) In the centre of the front or besides the knob, a bulb is fitted to indicate whether the instrument is off or on
- (vii) The internal chamber is provided with one or more shelves.

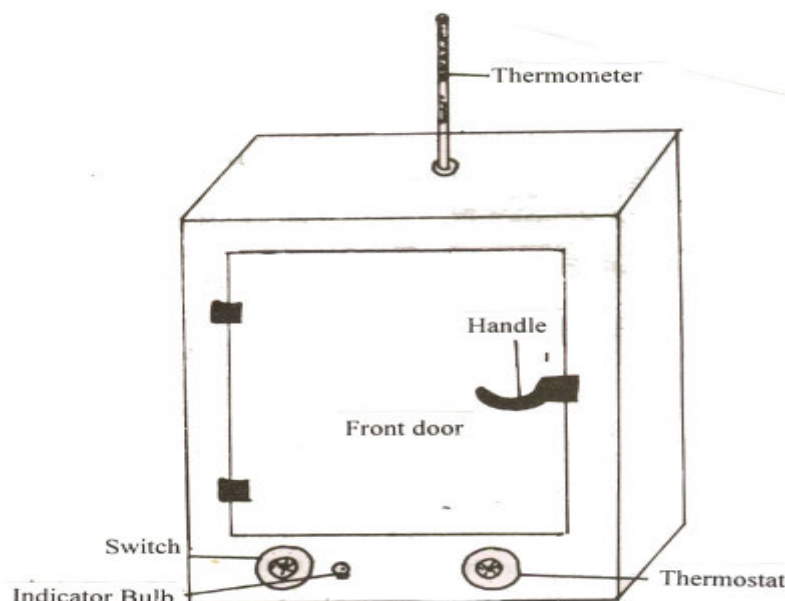


Fig. 32.1 An incubator.

Uses : The incubator is used for the following :

- (i) to keep section cutting material embedded in paraffin wax (at 50-55°C)
- (ii) incubate eggs : for this a dish containing water is kept inside the incubator to provide moisture to the eggs. The eggs are rotated daily to prevent sticking of the embryo to the shell membranes. The temperature is maintained at about 38°- 40°C.
- (iii) to study the action of chemicals, enzymes etc. at different temperatures.
- (iv) specimens such as pinned and stretched insects can be dried in it, so that they are not spoiled.



Notes

2. Autoclave : It is an electrically operated instrument which disinfects the glass-ware before a research work is started. It works under required pressure. However, pressure cooker can be a substitute for disinfecting the small glass ware under pressure for a definite time. The autoclave works on the same principle as the pressure cooker.

3. Kymograph

The instrument consists of the following parts :

- (i) **An electric motor :** This motor rotates a drum. The drum can be rotated at different speeds.
- (ii) **A muscle or heart mount :** The muscle is fixed at one end. The free end of the muscle is connected to a lever. The ventricle of heart is held by a hook for recording the heart beat. The hook is tied to the lever by a string. (Fig. 32.2 and Fig. 32.3)

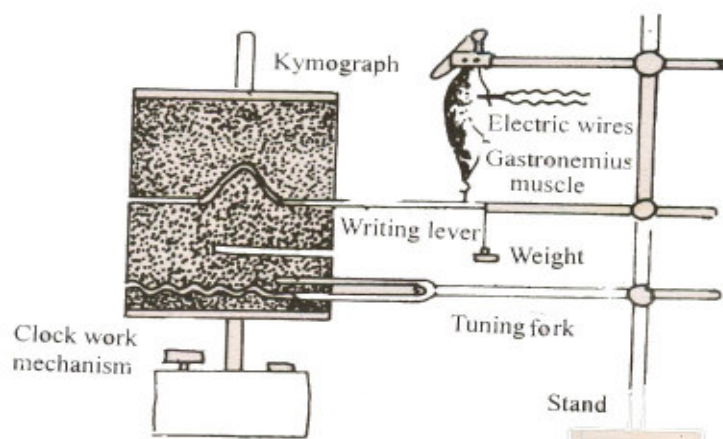


Fig. 32.2 Kymograph assembly for studying muscle contractions

- (iii) The lever is balanced, to bend up and down freely. A sharp pointer or pen device is fitted to the lever opposite to that connected to the muscle.
- (iv) Movement of lever due to muscle contraction or heart beat makes the pointer to produce a tracing on a paper which is wrapped on the drum.
- (v) When the paper is blackened with soot, a white streak is formed on it by the pointer.
- (vi) On stimulation by an electric current the muscle contracts and pulls the lever down to make the corresponding dips in the line produced on the recording paper.
- (vii) As the muscle relaxes the lever moves up to its original position which is again recorded as the continuing straight line.



Notes

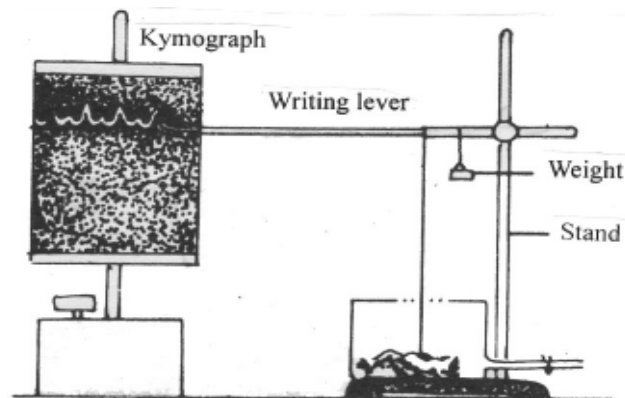


Fig. 32.3 Kymograph assembly for studying heart contraction.

Uses :

1. Used commonly for recording the reaction of a muscle when its motor nerve is stimulated.
2. Also used for recording the ventricular contraction of perfused heart.

4. Distillation Unit

Distilled water is that water that has been cleared of all salts and other impurities which were dissolved in it.

Distilled water is an important requirement in the laboratory. Chemically, it is water from which all the impurities have been removed.

A distillation unit, commonly used in Science laboratories, consists of the following parts

- (i) **Distilling Flask :** The size of flask varies depending on requirement. It is filled with water and heated over flame or hot plate.
- (ii) **Leibig's Condenser :** It consists of an inner glass tube surrounded by a glass jacket through which water is circulated. The steam, passing through inner tube condenses due to cooling effect of cold water flowing in the glass jacket.
- (iii) **Adapter :** It is used to facilitate delivery of distillate into the receiver.
- (iv) **Receiver :** It is a simple conical flask attached to adapter, where distillate is collected. All the connections are done through corks.

Certain precautions are taken before the start of distillation process :

1. All corks should fit tightly.
2. The apparatus should be held firmly by the help of clamp.
3. The condenser should be full of water.
4. Distillation flask should be kept over the wiregauze before heating.

Distilled water is used for preparing several reagents.



Notes

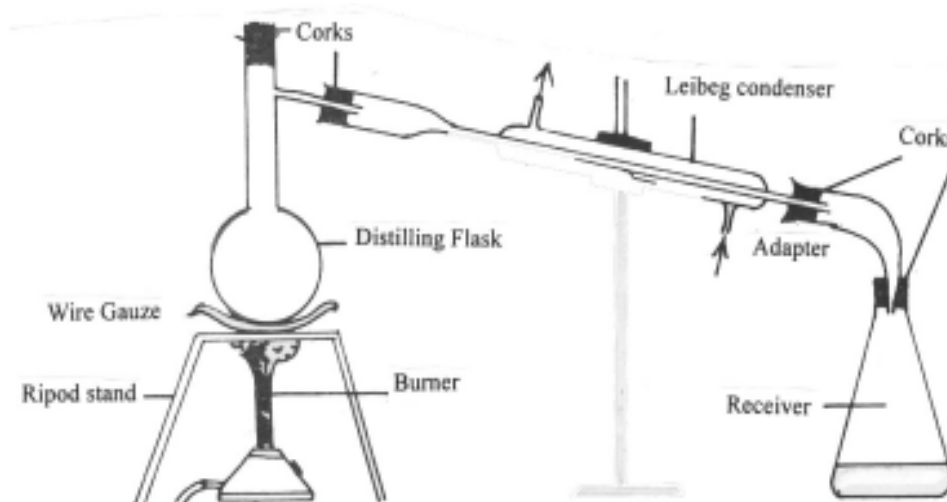


Fig. 32.4 A distillation unit

5. pH meter

pH of a solution is defined as the negative logarithm of hydrogen ion concentration.

pH value is a number on a scale 0 to 14 indicating hydrogen ion concentration. If value is below 7, the solution is acidic and if above 7 the solution is alkaline. The pH value at 7 means neutral i.e. neither acidic nor alkaline.

How to find pH of a sample: There are two methods : (i) Paper Strip Method
(ii) using pH meter

- (i) **Paper Strip method** : Readymade strips are available which change colour at different pH values. Different strips are dipped in the solution one after another. The change in colour of strips indicates the pH value of the solution. This method gives only a general estimation of pH and not the precise pH.
- (ii) **pH meter** : It gives accurate pH value of the solution. It is in the form of a compact box. The material to be examined is placed in one socket with electrodes. The deflection of the needle on the built-in galvanometer gives the pH value of the solution.

Need for knowing pH values:

- (i) All enzymatic actions in animals and plants including microorganisms take place at a specific pH value.
- (ii) pH value of soil is important for the growth of crops.
- (iii) pH value of blood is kept within the normal range through homeostasis.
- (iv) pH value is used, in industries (leather and food processing)



Notes

6. Spectrophotometer

Molecules (e.g. DNA proteins etc.) absorb and emit electromagnetic radiation of particular wavelength. This property of molecules is used in spectrophotometry. **Spectrophotometry** is a technique which is widely used to measure the absorption of radiation in the visible and UV regions of the spectrum. **Colorimeter** also functions on the same principles but it is a simpler instrument in which filters are used.

Colorimetry is a technique of estimating the amount or density of the compound imparting colour to the cellular component present in a solution.

7. Colorimeter

It is an instrument to measure the absorption in the green, blue or red regions of the visible spectrum. There are two types of colorimeters.

- (i) Visual colour colorimeter
- (ii) Photo electric colorimeter

The components in a colorimeter and the spectrophotometer are as follows (Fig. 32.5)

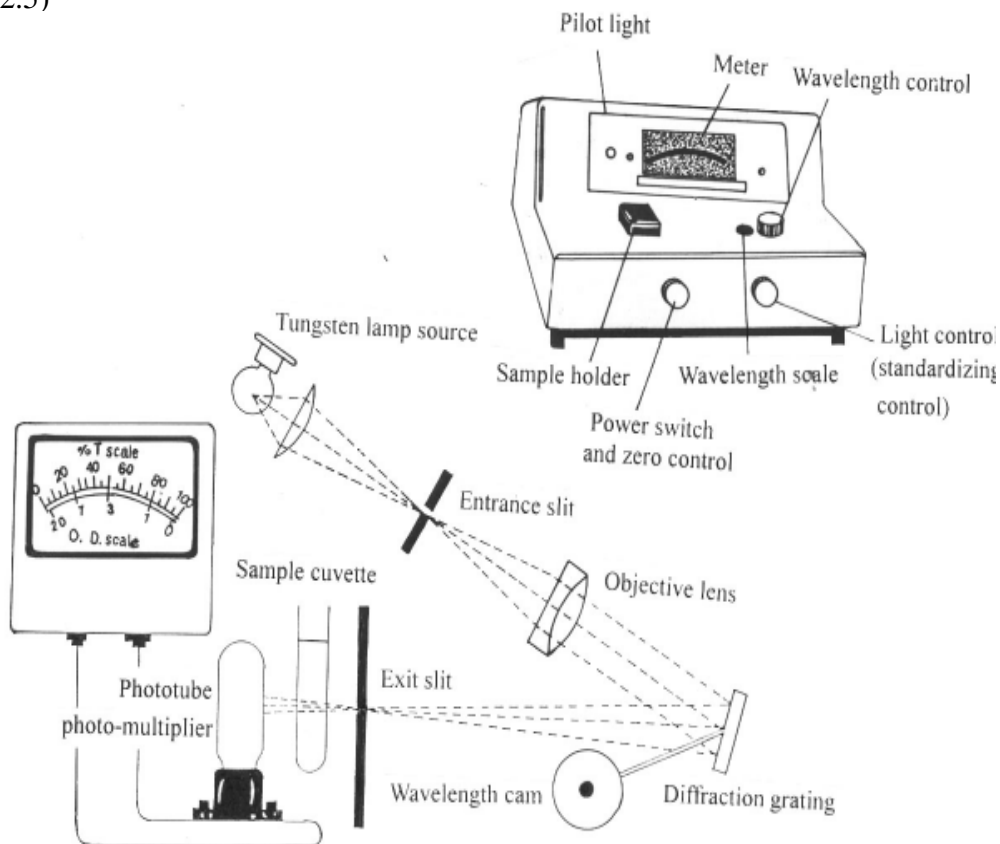
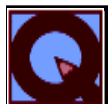


Fig 32.5 Components of a spectrophotometer.



Notes

1. **A light source** : High intensity tungsten bulb for operation in the visible spectrum (400-700 nm) and Deuterium or Tungsten halogen lamps for UV spectrophotometry. The lamps are fitted with quartz as glass does not transmit UV rays.
2. **Cuvettes** made of glass or plastic are cleaned before adding the sample solution.
3. **Galvanometer or read out device** : The reading of the standard solution is first taken for comparison with the sample



INTEXT QUESTIONS 32.1

1. What is the pH value that indicates that a particular solution is neutral?
.....
2. Name the two main parts of a Kymograph?
.....
3. What is the final product we get from a distillation unit?
.....
4. Mention the use of thermostat in an incubator.
.....
5. What provides the power to the heating unit of incubator?
.....
6. Name the various components of a spectrophotometer.
.....

32.2 SOME OTHER TYPES OF INSTRUMENTS

Here you will learn about some other types of instruments.

1. Sphygmomanometer (Blood Pressure Instrument)

By this instrument, blood pressure of a person is measured.

There are three types of this instrument which are commonly used.

- (i) The old or conventional type using a mercury column.
- (ii) Dial type instrument without mercury column. The blood pressure (B.P.) is directly shown on the dial in a gadget attached to a hand pump through a tube.
- (iii) The third type is the modern electronic instrument.

The common part in all the above types of instruments is an inflatable rubber bag enclosed in a case called 'cuff'. The cuff is wrapped around the arm, above the elbow and below the shoulder joint. This bag is inflated by a rubber hand pump



Notes

(a small balloon like structure) The hand pump is fitted with a screw to release air. In the conventional type of instrument another tube connects the inflatable bag with the mercury column, movement of which, when adjusted records the systole and diastole of heart.

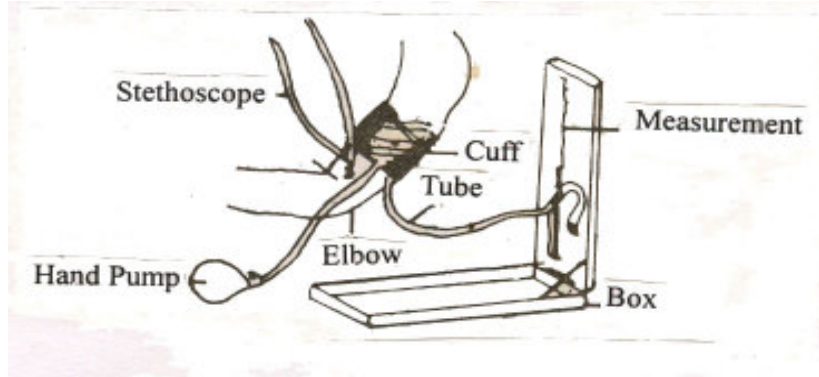


Fig. 32.6 Sphygmomanometer

Stethoscope is also used to listen the throbbing in the artery while measuring B.P.

2. Microtome

The older type of microtome is called rocking microtome. It has a knife fixed vertically in front. The tissue which has to be cut is embedded in paraffin wax trimmed into small block and is then fixed on the block holder. By moving a knob, the working handle at the rear on the base, causes the long, rocking arm to rock up and down. Due to this action a series up sections are cut from the block of paraffin wax, fixed on the block holder. Adjustment in the microtome is done for obtaining the required thickness of the sections.

The newer models of microtome are of the rotary type. In this there is a wheel which is rotated by hand. The rest of the working is on the same general principle.

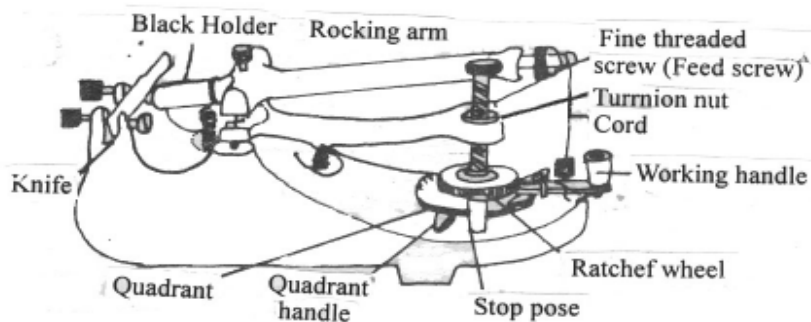


Fig. 32.7 A Rocking Microtome

Microtomes can cut thin sections easily upto the thickness of 8-10 microns (1 micron = one thousandth of a millimeter).



Notes

3. Centrifuge

Centrifuge is a spinning apparatus. It is used for separating objects of different densities usually from a liquid medium,

Different types of centrifuges are used for different purposes namely clinical centrifuge, ultracentrifuge etc. A centrifuge consists of a head (rotor) operated by hand or motor. Attached to the rotor are a number of metallic tubes. In these tubes are placed specially designed glass tubes with tapering bottom. According to the requirement the head may contain sockets in which bottles are placed. **The tubes should be properly balanced in a centrifuge to prevent wobbling.**

Like the mixie used in the kitchen, a centrifuge can be rotated at different speeds. The tissue is crushed or homogenised made into a solution and upon rotation in a centrifuge at the required speed, a **precipitate** is formed at the base of the test tube. The solution on top of the precipitate is termed **supernatant**. The ultracentrifuge can fractionate cells. Various organelles separate out as **fractions** when homogenised tissue is centrifuged at varying speeds.

4. Weighing Balance

There are different types of weighing balances which are used in laboratories. A physical balance is commonly used in the laboratory. However, more accurate weighing is done by **microbalances**. These balances are covered within a glass cover. Such balances are usually single pan balances and weights of the objects are read on a scale seen from outside. The most convenient balances these days are the digital balances which you might have seen at the jewellery shops.



INTEXT QUESTIONS 32.2

1. Mention the chief precaution one should take while using a centrifuge.

.....

2. Give the range of thin sections that can be cut in a microtome.

.....

3. Mention the use of Sphygmomanometer.

.....

4. Why is stethoscope used while measuring the blood pressure?

.....

MODULE - 6ATools and Techniques in
Biology**Notes****WHAT YOU HAVE LEARNT**

- Incubator is a chamber in which the temperature is regulated by a thermostat. It is used for incubating eggs and for keeping wax in a liquid condition used for section cutting.
- Autoclave is a device for sterilising glassware etc.
- Kymograph consists of an electric motor and a muscle/heart mount for recording muscle contractions.
- Distilled water is obtained by using distillation unit.
- pH can be found by either paper strips that show change in colour or by pH meters that give a direct reading on the built in galvanometer.
- Colorimeter enables to find out the density of colour in a solution.
- There are three kinds of blood pressure instruments, mercury instrument, dial type with hand pump and electronic sphygmomanometer.
- Microtome is used for cutting sections for microscopic examination. There are two kinds of microtomes - rocking and rotor.
- Centrifuge is used for separating cell organelles.
- Microbalances give very fine measurements of weights.

**TERMINAL QUESTIONS**

1. How can you prepare distilled water in a laboratory?
2. Mention the different parts of a distillation unit.
3. Explain briefly the different parts of a microtome and the use of this gadget.
4. Define pH. Mention the different methods by which pH can be measured.
5. What is the range of pH value of an acidic solution?
6. Mention the uses of an incubator.
7. Why is a thermostat fixed in an incubator?
8. Which of the balance gives the most accurate weight?

**ANSWERS TO INTEXT QUESTIONS**

- 32.1**
1. 7
 2. (i) Electric motor
(ii) A muscle or heart mount
 3. Distilled Water
 4. To regulate the temperature at any given level.
 5. Electricity.
 6. light source (Tungsten halogen lamp, cuvettes with solution, read out device)
- 32.2**
1. The tubes should be properly balanced on the rotor.
 2. 8-10 microns.
 3. To Measure blood pressure of humans.
 4. To listen to the throbbing in the artery (beating of heart)

**Notes**