ACTIVITY 5

AIM

To study the variation in the range of a jet of water with the change in the angle of projection.

APPARATUS AND MATERIAL REQUIRED

PVC or rubber pipe, a nozzle, source of water under pressure (i.e., a tap connected to an overhead water tank or water supply line), a measuring tape, large size protractor.

PRINCIPLE

The motion of water particles in a jet of water could be taken as an example of a projectile motion under acceleration due to gravity 'g'. Its range R is given by

$$R = \frac{v_0^2 \sin 2\theta_0}{g}$$

where θ_0 is the angle of projection and v_0 is the velocity of projection.

PROCEDURE

1. **Making a large protractor:** Take a circular plyboard or thick circular cardboard sheet of radius about 25 cm. Draw a diameter through its centre. Cut it along the diameter to form two dees. On one of the dees, draw angles at an interval of 15° starting with 0°.
2. Attach one end of pipe to a tap. At the other end of the pipe fix a nozzle to obtain a jet of water. Ensure that there is no leakage in the pipe.
3. Fix the protractor vertically on the ground with its graduated–face towards yourself, as shown in Fig. A 5.1.
4. Place the jet at the centre O of the protractor and direct the nozzle of the jet along 15° mark on the protractor.
5. Open the tap to obtain a jet of water. The water coming out of the

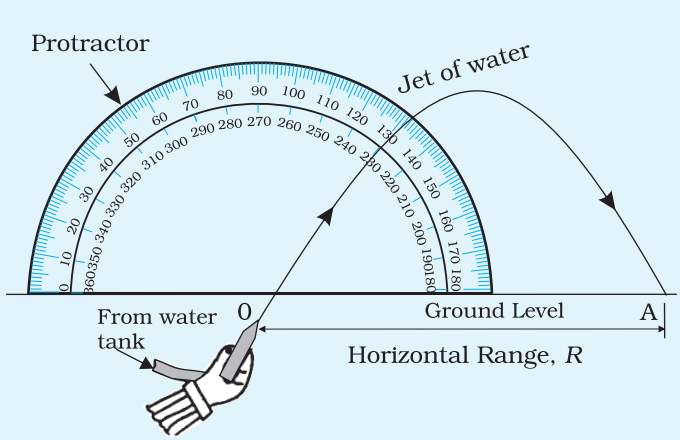

Fig. A 5.1: Setup for studying the variation in the range of a jet of water with the angle of projection

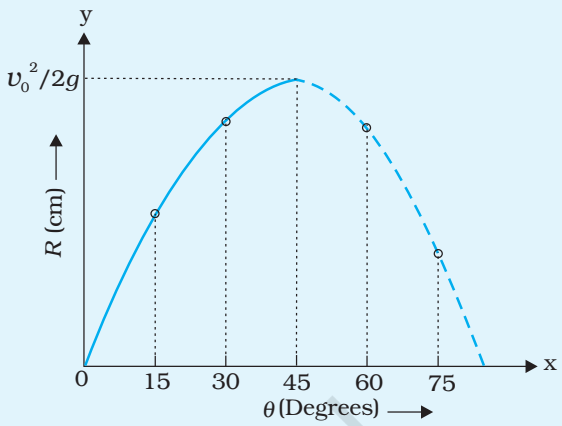

Fig. A 5.2: Variation of range with angle of projection

jet would strike the ground after completing its parabolic trajectory. Ask your friend to mark the point (A) where the water falls. Close the tap.

6. Measure the distance between point O and A. This gives the range R corresponding to the angle of projection, 15°.

7. Now, vary θ_0 in steps of 15° upto 75° and measure the corresponding range for each angle of projection.

8. Plot a graph between the angle of projection θ_0 and range R (Fig. A 5.2).

OBSERVATIONS

Least count of measuring tape = ... cm

Table A 5.1: Measurement of range

S. No.	Angle of projection θ_0 (degrees)	Range R (cm)
1	15°	
2	30°	
3	45°	
4	60°	
5	75°	

GRAPH

Plot a graph between angle of projection (on x-axis) and range (on y-axis).

RESULT

The range of jet of water varies with the angle of projection as shown in Fig. A 5. 2.

The range of jet of water is maximum when θ_0 = ... °

PRECAUTIONS

1. There should not be any leakage in the pipe and the pressure with which water is released from the jet should not vary during the experiment.
2. The jet of water does not strike the ground at a point but gets spread over a small area. The centre of this area should be considered for measurement of the range.
3. The nozzle should be small so as to get a thin stream of water.

SOURCES OF ERROR

1. The pressure of water and hence the projection velocity of water may not remain constant, particularly if there is leakage in the pipe.
2. The markings on the protractor may not be accurate or uniform.

DISCUSSION

1. Why do you get same range for angles of projection 15° and 75°?
2. Why has a big protractor been taken? Would a protractor of radius about 10 cm be preferable? Why?

SELF ASSESSMENT

1. This Activity requires the pressure of inlet water be kept constant to keep projection velocity of water constant. How can this be achieved?
2. How would the range change if the velocity of projection is increased or decreased?

SUGGESTED ADDITIONAL EXPERIMENTS/ACTIVITIES

1. Study the variation in maximum height attained by the water stream for different angles of projection.
2. Study the variation in range of water stream by varying the height at which the water supply tank is kept.
3, Take a toy gun which shoots plastic balls and repeat the Activity using this gun.
4. Calculate velocity of projection by using maximum value of horizontal range measured as above.