

TOPIC: Motion in plane

Pre-Content/content Post-Content	Learning outcomes/Objectives	
	General	Specific
<u>Pre Content</u> Instantaneous speed, average speed, instantaneous acceleration, average acceleration, uniform acceleration, s-t, v-t, a-t graphs, equations of method using graph and calculus method, free fall, relative velocity. <u>Content</u> Cartesian coordinates, vector and its types, vector representation, resolution of a vector in plane, triangle and parallelogram law of vector addition, equilibrium, relative velocity and equations of motion in two and three dimensions, projectile motion. <u>Post Content</u> Numerical problems of: Projectile motion; Position, velocity, acceleration, relative velocity using formulae and equations of motion for two and three dimensions.	Students will be able to: perform vector algebra apply the kinematic equations for two and three dimensions. describe projectile motion.	Students will be able to: - describe the Cartesian coordinate system in two and three dimension systems. - explain the sum of vectors using head to tail rule. - define resultant, negative, unit, null, position and equal vectors - resolve a vector into its rectangular components. - determine the sum of vectors using triangle law of addition and parallelogram law of addition. - define equilibrium of vectors. - rewrite equations of motion in two and three dimensions. - Solve numerical problems on equations of motion in two and three dimensions. - Determine relative velocity for motion in two and three dimensions. - define projectile, projectile motion and trajectory of projectile. - derive the relation for time of flight, maximum height and horizontal range of a projectile.

Home Work /Assignments:

- NCERT exercise discussed in the class is given as the home task.
- Assignment worksheets are given at the end of the chapter.

Teacher's Activity	Student's Activity	Teacher's observation and Remedial
Teacher will help students to recall the x-y plane used in making graphs and will connect the topic with Cartesian coordinates. represent vector in the Cartesian coordinates and explain various types of vector. explain the triangle law and parallelogram law of vector addition and provide challenging questions on the same. derive the expression for the resultant of the vectors using parallelogram law of vector addition verify parallelogram law of vector addition experimentally by using the concept of equilibrium of forces . guide students to derive the equations of motion in two dimensions and three dimensions and practice numerical problems on the same. provide questions on relative velocity in two dimensions. Annexure 3 (A) demonstrate the projectile motion. provide challenging questions on the topic "Projectile Motion".	Students will Connect the existing knowledge of x-y plane with the new Cartesian coordinate system. define the null vector, negative vector, unit vector, position vector and equal vectors. apply the triangle law and parallelogram law of vector addition to solve given questions and problems. comprehend the derivation and calculate resultant vector for the given questions. perform an experiment to verify the parallelogram law of vector addition using equilibrium of forces. derive equations of motion for two and three dimensions and apply the same to solve given problems. practice daily – life problems based on the concept of relative velocity in two dimensions. Annexure 3(a) perform the activity and understand the terms angle of projection, maximum height and range. solve numerical and conceptual problems on the projectile motion.	

Teaching Aids: Active inspire, ICR, projectile motion instrument in Science Park

Methodology/Innovative: Enquiry, Discussion, Demonstration and experimentation.

Interdisciplinary Links: Mathematics.

Annexure 3(A), (a) - Let us Project

Subject	Physics
Class	XI
Chapter/Unit	Motion in a Plane
Topic	Projectile Motion
Time	15 minutes
Nature of Activity	Pair Work

What will I learn (Learning Outcome)?

To illustrate projectile motion.

Skills: Applying, Analyzing and Creating

What I have to do?

To demonstrate that

- the path of a projectile is parabolic in shape.
- range of a projectile depends on the angle of projection/launching

What do I require?

A small and light weight ball, water colors, white sheets, ruler, eraser and a cardboard/table.

What do I need to know?

A projectile is an object projected into space by the exertion of a force. The path of a projectile is parabola. Each projectile has a maximum height and range. Height is the vertical distance travelled by the projectile whereas the range is the horizontal distance. For any given speed, Height or Range can be maximized by changing the angle of projection.

➤ Teacher's Activity

Teacher will

1. ask students to recall the concept of projectile motion and how is it different from free fall.
2. make pairs of the students and will explain the steps of the activity.
3. ensure that each participant of the pair performs the activity on his/her own.

How will I proceed?

➤ Student's Activity

1. Take some water color in a bowl and mix water in it to make a thick solution.
2. Dip the ball in the bowl and ensure that it gets colored all over.
3. Place the white sheet on a cardboard/table and fix it.
4. At one end of the sheet place an eraser and keep a 15 cm range scale/ruler above the eraser(0 cm mark of the ruler to be placed on eraser and 15 cm mark to be on the sheet making an inclined plane)
5. Keep the ball at the 0 cm mark of the scale and release on the white sheet and observe the colored pattern formed on it as the balls moves.
6. Make sure that the fan is off while doing this activity (so that the motion of the ball is not affected)
7. Mark the starting point and end point of the motion of the ball and measure the distance between the two using a ruler.
8. Repeat steps 1 -7 by keeping the ruler at different angles with the horizontal axis (keeping the initial velocity same for each angle; which can be achieved by keeping the same slope/inclination).

What have I observed?

S. No.	Angle of Projection	Range (m)

What have I learnt?

- Path of a projectile is _____.
- Range of a projectile depends on its _____, keeping its initial velocity constant

What am I curious to learn?

- Let us observe the effect of angle of projection on the height of a projectile using the same apparatus.
- Let us throw a ball vertically upwards and observe if the ball falls at the same point from where it was thrown up? Can I explain my observation?

Let me evaluate myself

1. What is meant by a projectile?

2. What is the path of a projectile? Support your answer with a mathematical proof.

3. Derive the expressions for the Time of flight, Height and Range of a projectile. Using the expressions of Height and Range of a projectile, deduce the angle at which Height is maximum and the angle at which its Range is maximum.

4. If a projectile is thrown with an initial velocity 'u', making an angle θ with the horizontal, then for what value of θ both Range and Height will become equal?

5. An object is launched at a velocity of 20 m/s in a direction making an angle of 30° with the horizontal. What is the
- a) maximum height reached by the object?
 - b) total flight time of the object?
 - c) horizontal range of the object?
 - d) magnitude of the velocity of the object just before it hits the ground?
