Projectile Motion

1

Projectile Motion

- **Projectiles**
  - > **objects given an initial velocity that then move under the force of gravity**
- **Trajectory**
  - > **the path followed by a projectile**
  - > **The path is a curve called a parabola**

2

Independence of Dimensions

Why do both balls hit at the same time?

3

Independence of Dimensions

- **Since the horizontal and vertical motion of an object are independent of each other, the motion equations can be used to determine the exact position of a projectile.**
- **However, we must first distinguish between the x and y components of any vectors.**

4

Independence of Dimensions

- **With no acceleration in the horizontal direction, we can find the horizontal <u>position</u> by using the equation:**

  >

- **The <u>velocity</u> in the horizontal direction will not change, therefore:**

  >

5

Independence of Dimensions

- **Since there <u>is</u> acceleration (gravity) in the vertical direction the position can be found using the equation:**

  >

- **The acceleration causes a change in velocity in the vertical direction. We can find the final velocity using the equations:**

  >

  >

6

Projectile Problem

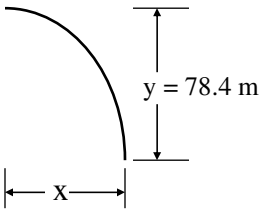
- **A stone is thrown horizontally at a speed of 15 m/s from the top of a cliff 78.4 m high.**
  - > **How long is the stone in the air?**
  - > **How far from the cliff does the stone land?**
  - > **What is the horizontal and vertical components of the velocity just before the stone hits the ground?**

	X	Y
x or y		
x_o or y_o		
v_0		
v		
a		
t		

7

Projectile Problem

- **Find the time**

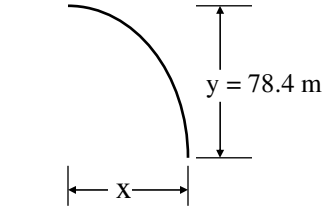


	X	Y
x or y		
x_o or y_o		
v_0		
v		
a		
t		

8

Projectile Problem

- **Find the horizontal distance**

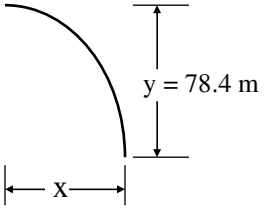


	X	Y
x or y		
x_o or y_o		
v_0		
v		
a		
t		

9

Projectile Problem

- **Find the components**



	X	Y
x or y		
x_o or y_o		
v_0		
v		
a		
t		

10

Horizontal Projectile Problem #2

- **Jordan throws a dart horizontally at a dart board 2.2 meters away. If the initial velocity of the dart is 3.6 m/s, how far does the dart drop before hitting the board?**

	X	Y
x or y		
x_o or y_o		
v_0		
v		
a		
t		

11

Horizontal Projectile Problem #2

	X	Y
x or y		
x_o or y_o		
v_0		
v		
a		
t		

12

Horizontal Projectile Problem #3

- **You are at the top of a 3.5 m high stair case. A friend at the bottom of the stairs forgot her pencil and asks you for one. You notice that she is 8.5 m horizontally away from you. What horizontal velocity should you throw the pencil at to ensure that she gets the pencil?**

	X	Y
x or y		
x_o or y_o		
v_0		
v		
a		
t		

13

Horizontal Projectile Problem #3

	X	Y
x or y		
x_o or y_o		
v_0		
v		
a		
t		

14

Projectiles Launched at an Angle

- **When projectiles are launched at an angle, they are given an initial horizontal and vertical velocity.**
- **The horizontal distance the projectile travels is called the <u>range</u>.**

15

Angled Launch Problem #1

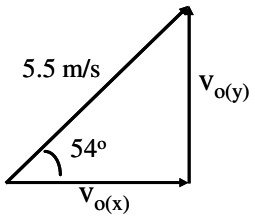
- **A ball is thrown with a initial velocity of 5.5 m/s at an angle of 54^0. Find:**
  - **the time in the air.**
  - **how high the ball went.**
  - **what the range was.**

	X	Y
x or y		
x_o or y_o		
v_0		
v		
a		
t		
t_{max}		
Δy_{max}		

16

Angled Launch Problem #1

- **Find components**

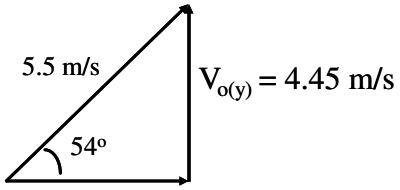


	X	Y
x or y		
x_o or y_o		
v_0		
v		
a		
t		
t_{max}		
Δy_{max}		

17

Angled Launch Problem #1

- **Find time**



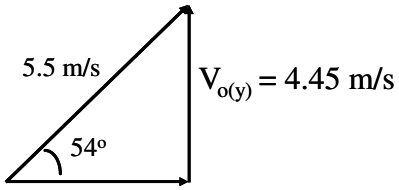
$V_{o(x)} = 3.23$ m/s

	X	Y
x or y		
x_o or y_o		
v_0		
v		
a		
t		
t_{max}		
Δy_{max}		

18

Angled Launch Problem #1

- **Find Max height**



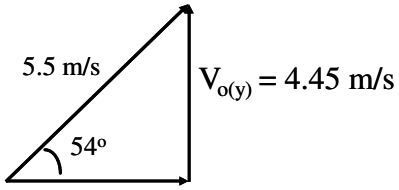
$V_{o(x)} = 3.23$ m/s

	X	Y
x or y		
x_o or y_o		
v_0		
v		
a		
t		
t_{max}		
Δy_{max}		

19

Angled Launch Problem #1

- **Find range**



$V_{o(x)} = 3.23$ m/s

	X	Y
x or y		
x_o or y_o		
v_0		
v		
a		
t		
t_{max}		
Δy_{max}		

20

Angled Launch Problem #2

- **An arrow is shot into the air at 7.5 m/s, at an angle of 36^0. Find:**
  - > **the time in the air.**
  - > **where the target should be placed, assuming it is at the same height as the arrow was shot.**
  - > **the maximum height the arrow reaches.**

	X	Y
x or y		
x_o or y_o		
v_0		
v		
a		
t		
t_{max}		
Δy_{max}		

21