PROJECTILES

The last things done were more about linear and gravitational motions.

A projectile can be defined as a body launched at an angle and allowed to move freely under the influence of gravity.

A projectile is an object moving in two dimensions under the influence of Earth’s gravity; its path describes a parabola

The path followed by a projectile is called the trajectory. A projectile motion is 2-dimensional i.e. it has both x and y coordinates. The x-component of acceleration due to gravity is zero since g is acting vertically downward. The y component is constant and is equal to g

A projectile is a body that is given an initial velocity and then follows a path that is determined completely by the effects of gravitational acceleration and air resistance

PROJECTILE MOTION

This is defined as a motion that describes a parabola (semi-circle)

Case 1: Vertical Projection.

When a body is thrown vertically upwards at an angle (or not) and allowed to move under the influence of gravity.

The horizontal component of the velocity (), is constant and the vertical component of the velocity (), changes by equal amount of equal times

The following should be noted.

TIME REQUIRED TO REACH MAXIMUM HEIGHT (VERTICAL PROJECTION)

Recall

This formula is used since the body is going up (required to reach maximum height) and since it is going up it is decelerating due to gravity.

At maximum height,

Therefore

Becomes

At maximum height,

But

Therefore

TIME OF FLIGHT (VERTICAL PROJECTION)

This can be defined as the total time taken during the projectile motion. The time required to reach maximum height is also the time required to fall from the given height.

Therefore,

MAXIMUM HEIGHT REACHED

Recall

At maximum height,

But

Therefore,

If there is no angle given and you don’t need to find an angle then

RANGE (VERTICAL PROJECTION)

This can be defined as the total horizontal distance covered by a body in a projectile motion.

But

And

But in math,

CASE 2: HORIZONTAL PROJECTION

An example will be when a ball is rolled off a cliff or a tall building

Secondly, there is no horizontal acceleration. Only vertical

The distances will be

The following formulae should be noted.

The angle that the velocity, v made with the x-axis is given as

Time of flight is given as

Range, x

Case 3:

An object shot from the back of a building of height (H) and initial velocity (u)

Range (x)

But

And

Therefore

QUESTIONS ON PROJECTILES

1. A bullet is fired from a gun with a velocity whose horizontal component is 100ms and the vertical component is 200ms. How long does the bullet take to reach its highest point? (Answer: 20s)
2. What is the maximum height attained? (Answer: 2000m)
3. What is the range covered? (Answer: 40000m)
4. An object is thrown up with a velocityin.
5. Find the time taken for the object to reach its maximum height (Answer: 0.82)
6. Find the horizontal range (Answer: 8.2)
7. An object is thrown vertically upward from the top of a mountain of height 100m with the initial velocity of 10ms making an angle of 30 degrees with the top of the mountain
8. Calculate the maximum height attained by the object from the level ground. (Answer: 101.25)
9. Time taken to reach maximum height (Answer: 0.5
10. Time of flight (Answer: 5 or 4)
11. The maximum horizontal distance covered by the object (43.3m)
12. A ball is thrown vertically upwards from the ground with an initial velocity of 20ms. The maximum height reached by the ball is (Answer: 20m) and the time spent in the air by the ball is (4s)

A ball is thrown vertically upwards from the top of a building with a velocity of 10ms. If it takes 4s for the ball to reach the ground level, the height of the building is (Answer: 40m)