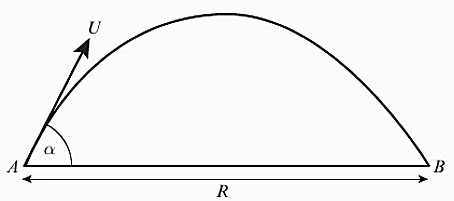
**Projection motion Formulae**

You must be able to derive general formulae related to the motion of a particle which is projected from a point on a horizontal plane and moves freely under gravity.

**Deriving the Time of Flight (T) and the Range (R)**



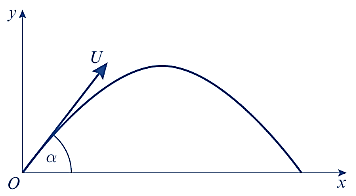
A particle is projected from a point on a horizontal plane with an initial velocity at an angle above the horizontal and moves freely under gravity until it hits the plane at point .

Given that that acceleration due to gravity is , find expressions for:

1. the time of flight,
2. the range, , on the horizontal plane.

**Deriving the Equation of the Trajectory**

When a particle is projected from a point O, on a horizontal plane, the equation of the trajectory may be obtained by taking x and y axes through the point of projection, O, as shown on the diagram.



A particle is projected from a point with speed at an angle of elevation and moves freely under gravity. When the particle has moved a horizontal distance , its height above the point of projection is .

1. Show that

A particle is projected from a point on a horizontal plane, with speed 28 ms-1 at an angle of elevation . The particle passes through a point , which is at a horizontal distance of 32m from and at a height of 8m above the plane.

(b) Find the two possible values of , giving your answers to the nearest degree.

**Exam Note**: You may be asked to derive these. But don’t attempt to memorise them or actually use them to solve exam problems – instead use the techniques used earlier in the chapter.

For a particle projected with initial velocity at angle above horizontal and moving freely under gravity:

* Time of flight
* Time to reach greatest height
* Range on horizontal plane
* Equation of trajectory:   
  where is vertical height of particle and horizontal distance.

Exercise 6D Page 123

Mixed Exercise 6 Page 125