**Projection at Any Angle**

We can solve problems with particles projected at any angle by resolving the initial velocity into horizontal and vertical components.

**Range** = distance from point at which the particle was projected to the point where it strikes the horizontal plane

**Time of Flight** = time taken by particle to move from its point of projection to the point where it strikes the horizontal plane

A projectile reaches its point of greatest height when the vertical component of its velocity, .

**Example**

[Textbook] A particle is projected from a point on a horizontal plane with speed 28 ms-1 and with angle of elevation . After projection, the particle moves freely under gravity until it strikes the plane at a point . Find:

1. the greatest height above the plane reached by
2. the time of flight of
3. the distance

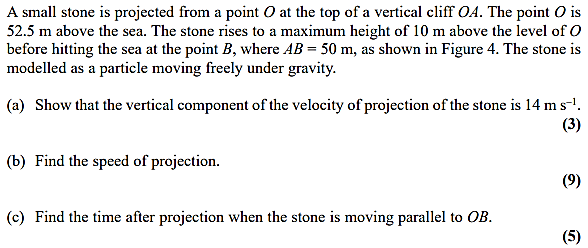
**Example**

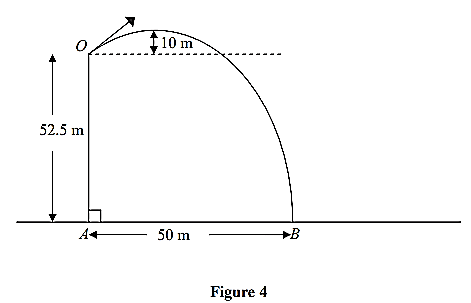
[Textbook] A particle is projected from a point with speed ms-1 and at an angle of elevation of , where . The point is 42.5m above a horizontal plane. The particle strikes the plane at a point , 5 s after it is projected.

(a) Show that . (b) Find the distance between and .

**Example**

[Textbook] A particle is projected from a point with speed ms-1 and at an angle of elevation of . The particle moves freely under gravity. Find the length of time for which the particle is 15 m or more above .

**Test Your Understanding *(EdExcel M2 May 2012 Q7)***



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**Extension Question:**

A ball is projected from ground level at an angle of . Prove that when the ball hits the ground, the distance the ball has travelled along the ground is maximised when .

(Year 2 differentiation knowledge required)