**6A Horizontal Projections**

1. A ball is thrown horizontally, with speed 20ms-1, from the top of a building of height 30m.

Find:

1. The time the ball takes to reach the ground
2. The horizontal distance travelled in that time
3. A particle is projected horizontally with a velocity of 15ms-1. Find:
4. The horizontal and vertical components of the displacement of the particle from the point of projection after 3 seconds
5. Find the distance of the particle from its starting point after 3 seconds
6. A particle is projected horizontally with a speed of from a point 122.5m above a horizontal plane. The particle hits the plane at a point which is at a horizontal distance of 90m away from the starting point.

Find the initial speed of the particle.

**6B Breaking Down Angled Projections**

1. A ball is thrown horizontally, with speed 20ms-1, from the top of a building of height 30m.

Find:

1. The time the ball takes to reach the ground
2. Write the initial velocity in vector form
3. A particle is projected with velocity , where and are the unit vectors in the horizontal and vertical directions respectively.

Find the initial speed of the particle and its angle of projection.

**6C Angled Projections**

1. A particle P is projected from a point O on a horizontal plane with speed 28ms-1, and with angle of elevation 30°. After projection, the particle moves freely under gravity until it strikes the plane at a point A.

Find:

1. The greatest height above the plane reached by P
2. The time of flight of P
3. The distance OA
4. A particle is projected from a point O with speed Vms-1 at an angle of elevation θ, where tanθ = 4/3. The point O is 42.5m above the horizontal plane. The particle strikes the plane 5 seconds after it is projected.
5. Show that V = 20ms-1
6. Find the distance between O and A
7. A particle is projected from a point O with speed 35ms-1 at an angle of elevation of 30°. The particle moves freely under gravity.

Find the length of time for which the particle is 15m or more above O

1. A ball is struck by a racket at a point A which is 2m above horizontal ground. Immediately after being struck, the ball has velocity (5**i** + 8**j**) ms-1, where **i** and **j** are unit vectors horizontally and vertically respectively.

After being struck, the ball travels freely under gravity until is strikes the ground at a point B, as shown. Find:

1. The greatest height above ground reached by the ball
2. The speed of the ball as it reaches B
3. The angle the velocity of the ball makes with the ground as the ball reaches B

**6D Deriving Formulae**

1. 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 B. Given that the acceleration due to gravity is , find expressions for:
2. The time of flight,
3. The range, , on the horizontal plane
4. A particle is projected from a point with speed and 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 .

Show that:

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

Find the two possible values of θ, giving your answers to the nearest degree.

(Use the formula we have just calculated)