

Kinematics

1 Horizontal Projections

For a **constant speed** use $Speed = \frac{Distance}{Time}$

For a **constant acceleration** use **SUVAT**

For all projections:

- Assume air resistance to be zero
- Resolve horizontal and vertical motion
- Horizontal - Constant speed
- Vertical - Constant acceleration

2 Angular projections

The same as horizontal projections but the initial vertical velocity isn't zero.

Example:

A particle is projected at a speed of 49ms^{-1} at an angle of 45° above the horizontal.

What is the time taken for the particle to reach its maximum height?

- $u = 49 \sin 45$
- $v = 0$
- $a = -g$
- $t = ?$

$$0 = 49 \sin 45 - gt$$

$$t = \frac{49 \sin 45}{g} = \frac{5\sqrt{2}}{2} \approx 3.54$$

What is the maximum height reached?

- $u = 49 \sin 45$
- $v = 0$
- $a = -g$
- $s = ?$

$$v^2 = u^2 + 2as$$

$$0 = (49 \sin 45)^2 - 2gs$$

$$S = \frac{(49 \sin 45)^2}{2g} = 61.3$$

What is the time of the flight?

- $u = 49 \sin 45$
- $a = -g$
- $S = 0$
- $t = ?$

$$S = ut + \frac{1}{2}at^2$$

$$0 = (49 \sin 45)t - \frac{1}{2}gt^2$$

$$0 = t(49 \sin 45 - \frac{gt}{2})$$

$$t = 0$$

$$49 \sin 45 = \frac{gt}{2}$$
$$t = \frac{2 \times 49 \sin 45}{g} = 7.07$$

What is the horizontal range of the particle?

- $t=7.07$
- $\text{Speed}=49 \cos 45$

$$S = 49 \cos 45 \times 7.07 = 245$$