

Projectile motion

AS Level

9702 AS Ch.2

Chapter 2: Accelerated motion

Lesson 2.13

Sections 2.13

Goal: Treat horizontal and vertical motion separately for an object launched horizontally.

 velocity

01 The big picture

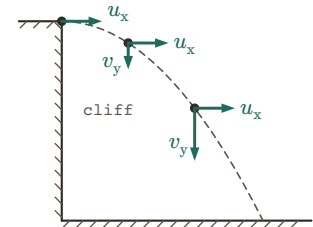
With no air resistance, a projectile's horizontal and vertical motions are independent. Horizontally there is no force, so the velocity stays constant. Vertically it accelerates at g downwards, exactly like a dropped object.

The time in the air is the link: find it from the vertical motion, then use it for the horizontal distance. The path is a parabola.

Projectile [paraphrase]

An object moving under gravity alone after it is launched.

Fig. 1 · Thrown horizontally from a cliff



The horizontal arrows stay the same length; the vertical arrows grow by g every second.

02 Key equations

Horizontal (constant)

$$x = u_x t$$

Vertical (from rest)

$$y = \frac{1}{2} g t^2$$

Vertical velocity

$$v_y = g t$$

Symbols and units

x, y	horizontal, vertical distance	m	u_x	horizontal velocity	m s^{-1}	v_y	vertical velocity	m s^{-1}
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03 Sample problems with solutions

Sample 1 · Rolling off a table

A ball rolls off a table 1.8 m high at 3.0 m s^{-1} . Calculate how far from the table it lands.

Step 1. Vertical: falls 1.8 m from rest:

$$t = \sqrt{\frac{2y}{g}} = \sqrt{\frac{2 \times 1.8}{9.81}} = 0.606 \text{ s}$$

Step 2. Horizontal: constant 3.0 m s^{-1} :

$$x = u_x t = 3.0 \times 0.606 = 1.82 \text{ m}$$

Answer: $x = 1.8 \text{ m}$ from the table

Unit check: $\text{m s}^{-1} \times \text{s} = \text{m} \checkmark$

04 Practice problems

P1 A ball is dropped as an identical ball is thrown horizontally from the same height. Which lands first?
Answer: They land together

P2 A stone is thrown horizontally at 15 m s^{-1} from a 45 m cliff (Fig. 1). How long is it in the air?
Answer: 3.0 s (3.03 s)

P3 How far from the cliff does it land?
Answer: 45 m (45.4 m)

P4 Find its vertical velocity just before it lands.
Answer: 30 m s^{-1} (29.7 m s^{-1}) downwards

05 Other useful information

Common mistakes

- ✗ **Wrong:** Let the horizontal velocity change during the flight.
- ✓ **Right:** With no air resistance it stays u_x ; only v_y grows.

Exam tips

- Make two columns, horizontal and vertical; only t crosses between them.

What the syllabus asks

- 9702 topic 2: uniform velocity plus a perpendicular uniform acceleration. Coursebook 2.13.

Explore: [Practice questions for this lesson](#)