

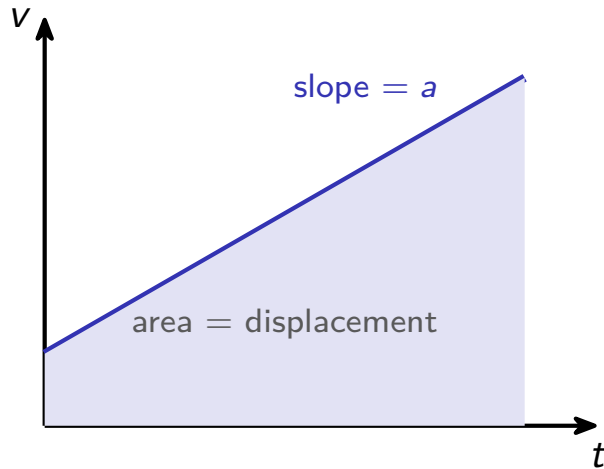
Exercise walk-through

1.3

Representing Motion

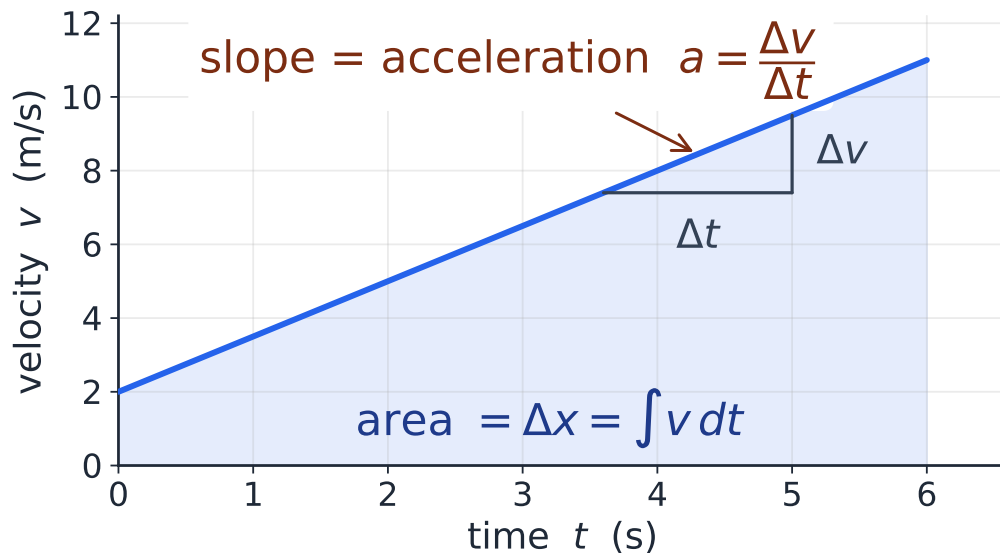
AP Physics 1

Reading motion graphs



A high-speed train: kinematics describes displacement, velocity and acceleration over time

Reading motion graphs, continued



$$a = \text{gradient of } v-t \cdot s = \int v dt = \text{area under the graph}$$

- On a **position–time** graph, the **slope** is velocity (steeper = faster; a curve = changing velocity).
- On a **velocity–time** graph, the slope is acceleration, and the **area** under the line is displacement.

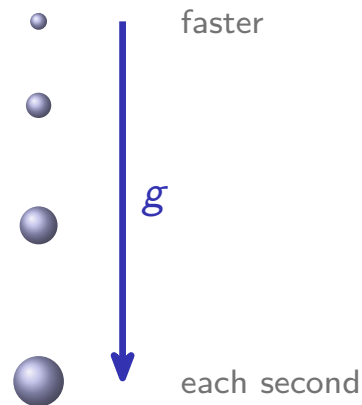
Constant acceleration and free fall

The kinematic equations

$$v = v_0 + at$$

$$x = x_0 + v_0 t + \frac{1}{2}at^2$$

Free fall : gravity alone gives
 $a = g \approx 9.8 \text{ m/s}^2$ downward – the **same**
for every mass.



Exercises 2.1·2.2

2.1 A car accelerates from rest at 2.0 m s^{-2} for 6.0 s . Find its final velocity. [1]

2.2 For the same car, find the distance it travels in that time. [2]

Exercises 2.1·2.2

2.1 A car accelerates from rest at 2.0 m s^{-2} for 6.0 s . Find its final velocity. [1]

2.1

- $v = 0 + 2.0(6.0) = 12 \text{ m s}^{-1}$

2.2 For the same car, find the distance it travels in that time. [2]

2.2

- $\Delta x = \frac{1}{2}(2.0)(6.0)^2 = 36 \text{ m}$

Exercises 2.3-2.4

2.3 On a velocity-time graph, state what (a) the slope and (b) the area under the line represent. [2]

2.4 A stone is dropped from rest. Find its speed after 3.0 s (take $g = 9.8 \text{ m s}^{-2}$). [1]

Exercises 2.3·2.4

2.3 On a velocity-time graph, state what (a) the slope and (b) the area under the line represent. [2]

2.3

(a)

- acceleration

(b)

- displacement

2.4 A stone is dropped from rest. Find its speed after 3.0 s (take $g = 9.8 \text{ m s}^{-2}$). [1]

2.4

- $v = 9.8(3.0) = 29.4 \text{ m s}^{-1}$

Exercises 3.1·3.2

3.1 The area under a velocity-time graph gives the

[1]

☐

- A acceleration
- B displacement
- C speed
- D jerk

3.2 A ball is thrown straight up. At its highest point, its

[1]

☐

- A velocity and acceleration are both zero
- B velocity is zero and acceleration is 9.8 m s^{-2} downward
- C velocity is maximum and acceleration is zero
- D velocity and acceleration both point up

Exercises 3.1·3.2

3.1 The area under a velocity-time graph gives the

[1]

☐

- A acceleration
- B displacement
- C speed
- D jerk

3.1 B

- displacement.

3.2 A ball is thrown straight up. At its highest point, its

[1]

☐

- A velocity and acceleration are both zero
- B velocity is zero and acceleration is 9.8 m s^{-2} downward
- C velocity is maximum and acceleration is zero
- D velocity and acceleration both point up

3.2 B

- the speed is zero at the top but gravity still acts downward

Exercise 3.3 (a)

3.3 A car travelling at 25 m s^{-1} brakes to rest in a distance of 50 m.

(a) Find its acceleration.

[2]

Exercise 3.3 (a)

3.3 A car travelling at 25 m s^{-1} brakes to rest in a distance of 50 m.

(a) Find its acceleration.

[2]

(a)

- $v^2 = v_0^2 + 2a \Delta x \Rightarrow 0 = 25^2 + 2a(50)$, so $a = -6.25 \text{ m s}^{-2}$

Exercise 3.3 (b)

3.3 A car travelling at 25 m s^{-1} brakes to rest in a distance of 50 m.

(b) Find the time it takes to stop.

[1]

Exercise 3.3 (b)

3.3 A car travelling at 25 m s^{-1} brakes to rest in a distance of 50 m.

(b) Find the time it takes to stop.

[1]

(b)

- $t = \frac{0 - 25}{-6.25} = 4.0 \text{ s}$

Exercise 3.4 (a)

3.4 A ball is thrown vertically upward at 20 m s^{-1} (take $g = 10 \text{ m s}^{-2}$).

(a) Find the time to reach the top.

[1]

Exercise 3.4 (a)

3.4 A ball is thrown vertically upward at 20 m s^{-1} (take $g = 10 \text{ m s}^{-2}$).

(a) Find the time to reach the top.

[1]

(a)

- $t = \frac{20}{10} = 2.0 \text{ s}$

Exercise 3.4 (b)

3.4 A ball is thrown vertically upward at 20 m s^{-1} (take $g = 10 \text{ m s}^{-2}$).

(b) Find the maximum height reached.

[2]

Exercise 3.4 (b)

3.4 A ball is thrown vertically upward at 20 m s^{-1} (take $g = 10 \text{ m s}^{-2}$).

(b) Find the maximum height reached.

[2]

(b)

- $$h = \frac{v_0^2}{2g} = \frac{20^2}{20} = 20 \text{ m}$$