IGCSE MATHEMATICS • EXERCISE SHEET

E2.9 Graphs in practical situations

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

KEY WORDS distance-time graph 路程 — 时间图像 • speed-time graph 速度 — 时间图像 • gradient 斜率 • acceleration 加速度 • average speed 平均速度

Objective

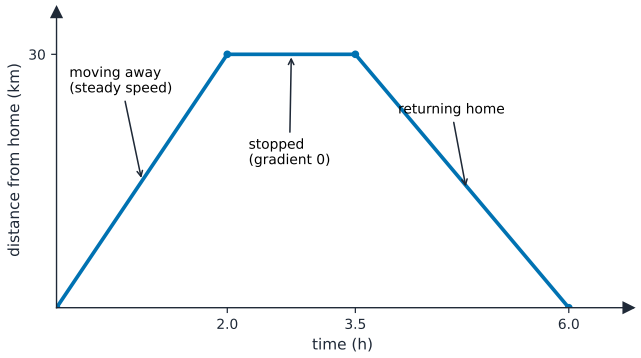
Build the skills to answer Extended exam questions on **graphs in practical situations** 实际情境中的图像 — reading a **distance–time graph** 路程 — 时间图像 and a **speed–time graph** 速度 — 时间图像, finding a **rate of change** 变化率 from a gradient, and finding a **distance** 距离 from the area under a speed–time graph.

You must be able to:

- find a speed from the gradient of a distance–time graph
- find an acceleration from the gradient of a speed–time graph
- find the distance travelled from the area under a speed–time graph

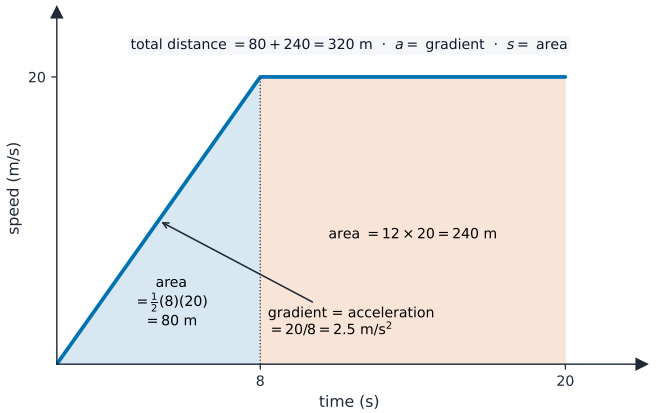
1 Worked examples

■ Gradient is a rate; area under a speed–time graph is a distance



speed = gradient of distance–time graph · flat ⇒ speed = 0

On a distance–time graph the gradient is the speed, and a horizontal line means at rest



On a speed–time graph the gradient is the acceleration and the area is the distance

- **Distance–time:** gradient = speed. A steeper line is faster; a horizontal line means stopped. 90 km in 1.5 h is 60 km/h.
- **Speed–time:** gradient = acceleration. From 0 to 20 m/s in 8 s is $20 \div 8 = 2.5$ m/s^2. A negative gradient is a deceleration.
- **Area under a speed–time graph = distance.** Split it into triangles and rectangles. That first stage covers $\frac{1}{2} \times 8 \times 20 = 80$ m.
- **Average speed = total distance ÷ total time**, never the average of the speeds.

Answer shapes (marked by **method marks** — M1 for a correct method, A1 for the correct answer): the triangle or rectangle you use for a gradient or an area is the method mark, so show it on the graph.

2 Practice

2.1 On a distance–time graph, a car travels 90 km in 1.5 hours. Find its speed in km/h. [2]

2.2 On a speed–time graph, the speed rises uniformly from 0 to 20 m/s in 8 seconds. Find the acceleration. [2]

2.3 Find the distance travelled during those 8 seconds. [2]

3 Exam-style questions

3.1 A car accelerates uniformly from rest to 24 m/s in 12 seconds. It then travels at 24 m/s for 30 seconds, and finally decelerates uniformly to rest in a further 8 seconds.

(a) Calculate the acceleration during the first stage. [2]

(b) Calculate the total distance travelled. [4]

(c) Calculate the average speed for the whole journey. [2]

Solutions

Marking: **M1** a correct method, **A1** the correct answer.

Each answer shows the steps, then the **result**.

2.1

- speed = distance ÷ time = $90 \div 1.5$

$$= \mathbf{60} \text{ km/h}$$

2.2

- acceleration = change in speed ÷ time = $20 \div 8$

$$= \mathbf{2.5} \text{ m/s}^{\mathbf{2}}$$

2.3

- the area is a triangle: $\frac{1}{2} \times 8 \times 20$

$$= \mathbf{80} \text{ m}$$

3.1

(a)

- $24 \div 12$

$$= \mathbf{2} \text{ m/s}^{\mathbf{2}}$$

(b)

- first stage, a triangle: $\frac{1}{2} \times 12 \times 24 = 144$ m
- middle stage, a rectangle: $30 \times 24 = 720$ m
- last stage, a triangle: $\frac{1}{2} \times 8 \times 24 = 96$ m

$$144 + 720 + 96 = \mathbf{960} \text{ m}$$

(c)

- total time = $12 + 30 + 8 = 50$ s, so average speed = $960 \div 50$

$$= \mathbf{19.2} \text{ m/s}$$

- note this is NOT the average of 0, 24 and 0