

E1.12 Rates

Name: _____ Class: _____ Date: _____

Total: 12 marks

KEY WORDS average speed 平均速度 • density 密度 • mass 质量 • volume 体积 • rates 比率

Objective

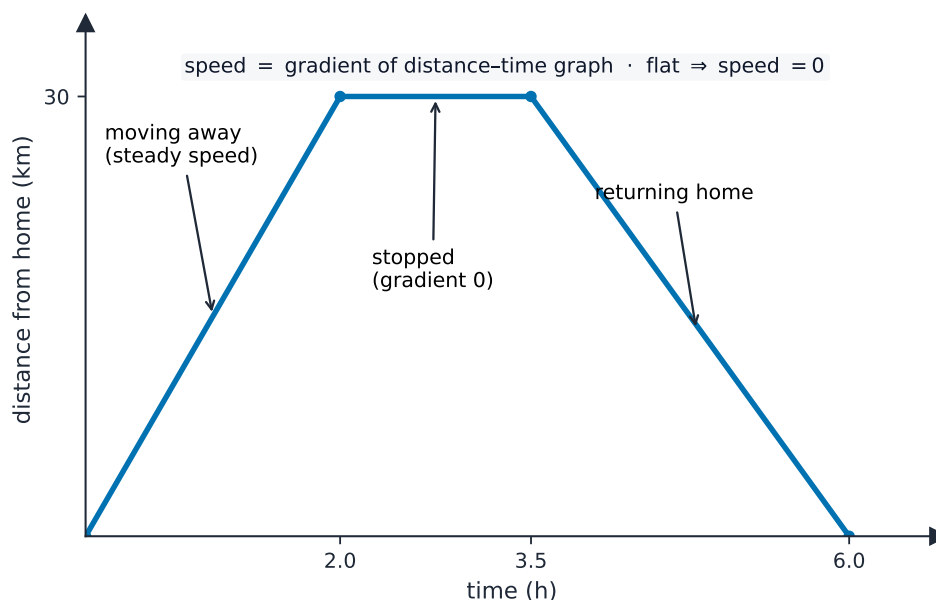
Build the skills to answer Extended exam questions on **rates** 比率 — **average speed** 平均速度, **density** 密度, and other rates that combine two quantities.

You must be able to:

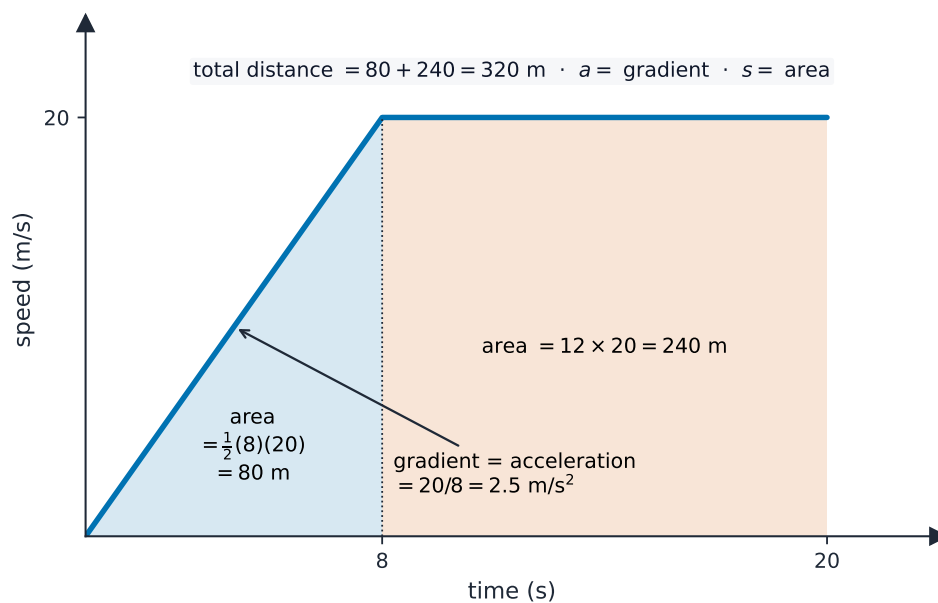
- use average speed = $\frac{\text{distance}}{\text{time}}$
- use density = $\frac{\text{mass}}{\text{volume}}$
- convert times correctly and rearrange a rate formula

1 Worked examples

■ Speed, distance, time



A rate compares two quantities in different units



A rate also reads off a speed-time graph

$$\text{average speed} = \frac{\text{total distance}}{\text{total time}} \quad \text{density} = \frac{\text{mass}}{\text{volume}}$$

- **Worked:** 45 km in 3 h 45 min = 3.75 h $\rightarrow$ speed = $\frac{45}{3.75} = 12$ km/h.
- Change minutes to a decimal of an hour (45 min = 0.75 h) — **not** 3.45.

Answer shapes: M1 a correct method, A1 the correct answer.

2 Practice

2.1 A car travels 120 km in 2 hours. Calculate its average speed. [1]

2.2 A metal block has mass 240 g and volume 30 cm³. Calculate its density. [2]

2.3 A runner's average speed is 5 m/s. How far does she run in 40 seconds? [2]

3 Exam-style questions

3.1 A train travels 150 km in 1 hour 30 minutes. Calculate its average speed in km/h. [2]

3.2 Gold has a density of 19.3 g/cm^3 . Calculate the mass of a gold bar of volume 50 cm^3 . [2]

3.3 A cyclist travels 36 km at an average speed of 24 km/h. Calculate the time taken, in minutes. [3]

Solutions

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

2.1 $\frac{120}{2} = 60 \text{ km/h.}$

2.2 density = $\frac{240}{30} = 8 \text{ g/cm}^3$.

2.3 distance = $5 \times 40 = 200 \text{ m.}$

3.1 1 h 30 min = 1.5 h $\rightarrow$ speed = $\frac{150}{1.5} = 100 \text{ km/h.}$

3.2 mass = density $\times$ volume = $19.3 \times 50 = 965 \text{ g.}$

3.3 time = $\frac{36}{24} = 1.5 \text{ h} = 1.5 \times 60 = 90 \text{ minutes.}$