

Exercise walk-through

C1.12

Rates

IGCSE Mathematics

You must be able to

- Calculate and rearrange distance, time and rate relationships
- Keep rate units consistent
- Include stopped time in a whole-journey average

1

The method

Method — Key knowledge: Rates

A rate compares quantities per unit, such as yuan per hour. Multiply rate by amount to find a total; divide total by rate to find the amount. Average speed is total distance divided by total time, including stops. Convert minutes to hours by dividing by 60. For unfamiliar rates, use the formula given in the question.

Exercises 2.1·2.3

2.1 A worker earns 32 yuan per hour. Find the pay for 7.5 hours. [2]

2.2 A tap supplies 12 litres per minute. Find the time to fill 90 litres. [2]

2.3 A car travels 156 km in 2 hours 36 minutes. Find its average speed. [2]

Exercises 2.1·2.3

2.1 A worker earns 32 yuan per hour. Find the pay for 7.5 hours. [2]

2.1

- $P = rt = 32 \times 7.5 = \mathbf{240}$ yuan.
-

2.2 A tap supplies 12 litres per minute. Find the time to fill 90 litres. [2]

2.2

- $t = V/r = 90/12 = \mathbf{7.5}$ minutes.
-

2.3 A car travels 156 km in 2 hours 36 minutes. Find its average speed. [2]

2.3

- $t = 2 + 36/60 = 2.6$ h; $v = d/t = 156/2.6 = \mathbf{60}$ km/h.

Exercise 2.4

2.4 Population density is population divided by area. Find it for 8400 people in 12 km^2 . [2]

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2.4

- $D = P/A = 8400/12 = \mathbf{700}$ people per km^2 .

Exercise 3.1 (a)

3.1 Apply the rates methods below. Show working and include units where appropriate.



135 km uses 9 litres

(a) A van uses 9 litres to travel 135 km. Find its fuel use in litres per 100 km. [2]

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(a)

- $r = (9/135) \times 100 = \mathbf{20/3}$ litres per 100 km (about 6.67).

Exercise 3.1 (b)

3.1 Apply the rates methods below. Show working and include units where appropriate.



135 km uses 9 litres

(b) At this rate, find the fuel needed for 240 km.

[2]

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135 km uses 9 litres

(b) At this rate, find the fuel needed for 240 km.

[2]

(b)

- $F = (9/135) \times 240 = \mathbf{16}$ litres.

Exercise 3.1 (c)

3.1 Apply the rates methods below. Show working and include units where appropriate.



135 km uses 9 litres

(c) The 240 km trip takes 3 hours driving plus 1 hour stopped. Find the average speed for the whole trip. [2]

Exercise 3.1 (c)

3.1 Apply the rates methods below. Show working and include units where appropriate.



135 km uses 9 litres

(c) The 240 km trip takes 3 hours driving plus 1 hour stopped. Find the average speed for the whole trip. [2]

(c)

- $t = 3 + 1 = 4$ h; $v = d/t = 240/4 = \mathbf{60}$ km/h.

Exercise 3.2 (a)

3.2 A cyclist travels 18 km in 45 min, rests for 15 min, then travels 12 km in 40 min.

(a) Find the speed in each moving stage in km/h and identify the faster stage. [3]

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(a)

- Convert times to hours and use $v = d/t$.
- $v_1 = 18/(45/60) = \mathbf{24}$ and $v_2 = 12/(40/60) = \mathbf{18}$ km/h.
- The first stage is faster.

Exercise 3.2 (b)

3.2 A cyclist travels 18 km in 45 min, rests for 15 min, then travels 12 km in 40 min.

(b) Find the average speed for the whole trip. Explain why 21 km/h is not the correct whole-trip average. [3]

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(b) Find the average speed for the whole trip. Explain why 21 km/h is not the correct whole-trip average. [3]

(b)

- Total time includes the rest: $t = (45 + 15 + 40)/60 = 5/3$ h.
- $v_{\text{avg}} = 30/(5/3) = \mathbf{18}$ km/h.
- The value 21 simply averages stage speeds and ignores the rest and unequal stage times.