RATES OF CHANGE

BUILDING BLOCKS

NAME _____ CLASS _____ DATE _____

KEY IDEA

"Per" means "for each".

£3 per kg means £3 for each kilogram.



3 kg cost £9

1 Draw a line to match each rate to its meaning.

6 litres per minute	£8 for each hour worked
£8 per hour	50 words typed each minute
50 words per minute	6 litres every minute

2 Grapes cost £4 per kg. Use the frames.

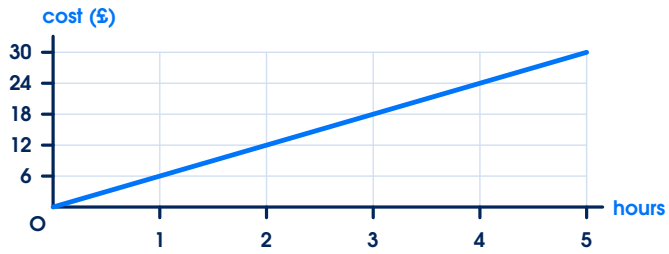
a) Find the cost of 3 kg.

× 3 (1 kg = £4 → 3 kg = £ ☐) ☐

b) Find the cost of ½ kg.

☐ (1 kg = £4 → ½ kg = £ ☐) ☐

3 The graph shows the cost of hiring a kayak.



a) Cost for 2 hours? £ ☐

b) Hours for £30? ☐ hours

c) Rate: £ ☐ per hour

4 Find the cost of 1 kg of carrots in each shop.

a) Shop A: 2 kg for £6

÷ 2 (2 kg = £6 → 1 kg = £ ☐) ☐

b) Shop B: 3 kg for £10.50

☐ (3 kg = £10.50 → 1 kg = £ ☐) ☐

c) Which shop is cheaper for each kilogram?

SHOP A SHOP B

RATES OF CHANGE

SUPPORT

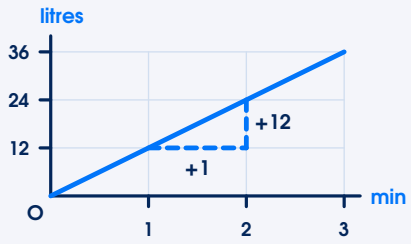
NAME _____ CLASS _____ DATE _____

KEY IDEA

A rate of change tells you how much one amount changes for each 1 of another.

litres per minute £ per hour km per hour

On a straight-line graph: up ÷ across.



1 Find each rate. Find the amount for 1 minute or 1 hour.

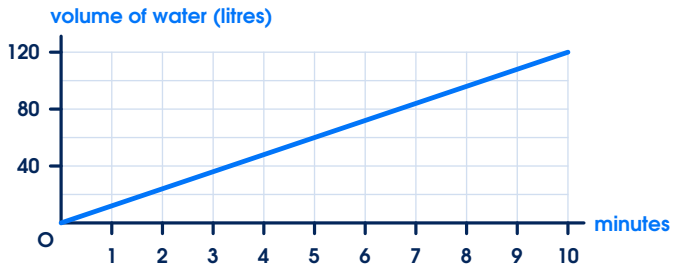
a) Zak types 300 words in 5 minutes.

÷ 5 (5 minutes = 300 words ; 1 minute = ☐ words) ☐

b) Jo earns £42 for 6 hours of work.

☐ (6 hours = £42 ; 1 hour = £ ☐) ☐

2 The graph shows water filling a paddling pool.



a) Volume after 5 minutes? ☐ litres

b) Fills at ☐ litres per minute

c) Circle the units:

LITRES PER MINUTE MINUTES PER LITRE

3 Circle the sensible unit for each rate.

a) A car on a motorway: 70 — MILES PER HOUR MILES PER SECOND

b) A plant grows 2 — CM PER WEEK KM PER WEEK

c) Petrol costs £1.45 — PER LITRE PER HOUR

4 A candle burns down at a constant rate of 2 cm per hour.

a) How much burns in 4 hours?

× 4 (1 hour = 2 cm ; 4 hours = ☐ cm) ☐

b) How long to burn 15 cm?

☐ (1 hour = 2 cm ; ☐ hours = 15 cm) ☐

RATES OF CHANGE

CORE

NAME _____ CLASS _____ DATE _____

KEY IDEA

Rate of change = change in y ÷ change in x, with units "y-units per x-unit" (e.g. £ per mile). It is the gradient of the graph. A straight line has a constant rate of change.

FLUENCY

1 Work out each rate of change. Give the units.

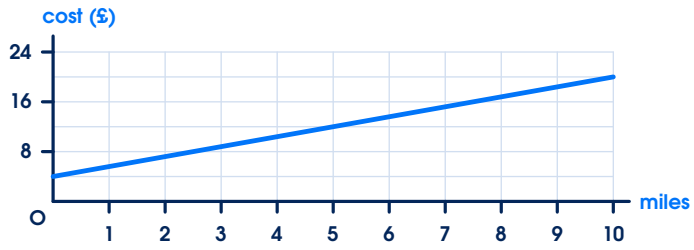
a) A lift rises 45 m in 15 seconds. _____

b) A taxi charges £27 for 18 miles. _____

c) Ella burns 450 calories in 50 minutes. _____

d) 2.4 litres of paint cover 30 m². _____

2 The graph shows the cost of a taxi journey.



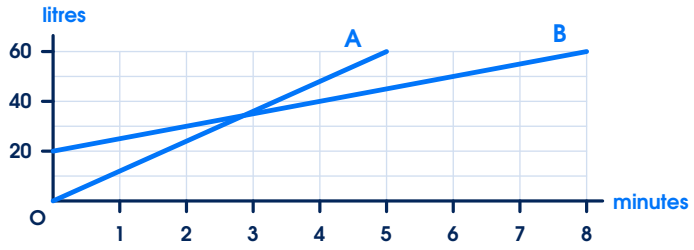
a) Fixed charge? _____

b) Rate of change (with units): _____

c) Cost for 6.5 miles? _____

REASONING

3 Jade says, "Tank B fills faster because it has more water at the start."



a) Work out both rates.

A: _____ litres/min

B: _____ litres/min

b) Is Jade right? Explain.

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4 Ryan says, "3 seconds per metre is faster than 0.5 metres per second, because 3 is bigger." Explain why Ryan is wrong.

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RATES OF CHANGE

GREATER DEPTH

NAME _____ CLASS _____ DATE _____

REASONING

1 Is each statement always, sometimes or never true? Circle your answer.

If it is sometimes true, give an example of when it is true and when it is not.

a) A rate of change has time in its units. ALWAYS SOMETIMES NEVER

b) A straight line has the same rate of change everywhere. ALWAYS SOMETIMES NEVER

c) If y falls as x rises, the rate of change is positive. ALWAYS SOMETIMES NEVER

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PROBLEM SOLVING

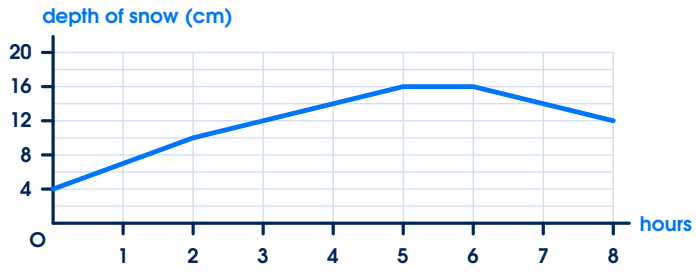
2 Car A uses 6.5 litres of fuel per 100 km. Car B travels 18 km per litre of fuel.

a) Which car is more economical? Show your working.

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b) Fuel costs £1.45 per litre. Find the fuel cost for car B to travel 270 km. ☐

3 The graph shows the depth of snow on a path during one day.



a) When was it rising fastest? ☐

b) Rate of change in the last 2 hours, with units: ☐

c) What does b) tell you?

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★ CHALLENGE FOR ALL

4 Ana types 45 words per minute and Ben types 30 words per minute. They share a 9000-word report. Ana starts at 10:00 and Ben joins her at 10:20.

a) At what time do they finish? ☐

b) How many words does Ben type? ☐

RATES OF CHANGE ? ANSWERS

ANSWERS

BUILDING BLOCKS

1. 6 litres per minute → 6 litres every minute · £8 per hour → £8 for each hour worked · 50 words per minute → 50 words typed each minute
2. a) × 3 on both sides: £12 · b) ÷ 2 on both sides: £2
3. a) £12 · b) 5 hours · c) £6 per hour
4. a) ÷ 2 on both sides: £3 · b) ÷ 3 on both sides: £3.50 · c) SHOP A

SUPPORT

1. a) ÷ 5 on both sides: 60 words, so 60 words per minute · b) ÷ 6 on both sides: £7, so £7 per hour
2. a) 60 litres · b) 12 litres per minute · c) LITRES PER MINUTE
3. a) MILES PER HOUR · b) CM PER WEEK · c) PER LITRE
4. a) × 4 on both sides: 8 cm · b) × 7.5 on both sides: 7.5 hours

CORE

1. a) 3 m/s · b) £1.50 per mile · c) 9 calories per minute · d) 12.5 m^2 per litre (or 0.08 litres per m^2)
2. a) £4 · b) 16 ÷ 10 = £1.60 per mile · c) 4 + 6.5 × 1.60 = £14.40
3. a) A: 60 ÷ 5 = 12 litres/min · B: 40 ÷ 8 = 5 litres/min · b) No: the rate is the gradient, not the starting amount, and A's line is steeper
4. 3 seconds per metre is 1/3 m/s ≈ 0.33 m/s, so 0.5 m/s is faster; with seconds per metre a bigger number means slower

GREATER DEPTH

1. a) Sometimes: km per hour does, £ per mile does not · b) Always · c) Never: it is negative
2. a) Car A: 100 ÷ 6.5 ≈ 15.4 km per litre, so car B (18 km per litre) is more economical · b) 270 ÷ 18 = 15 litres; 15 × £1.45 = £21.75
3. a) 0 to 2 hours (3 cm per hour) · b) −4 ÷ 2 = −2 cm per hour · c) the snow is melting: the depth falls by 2 cm each hour
4. a) Ana alone types 900 words by 10:20; 8100 words left at 75 words per minute = 108 minutes, so 12:08 · b) 30 × 108 = 3240 words