GCSE ONLINE TUTORING

ALGEBRA & GRAPHS / TOPIC GUIDE 24

24

Real-life and conversion graphs

Shared GCSE core

Graphs communicate relationships between measured quantities. Read scales and units, interpret gradients in context, and distinguish a valid model from an unjustified extrapolation. Include conversion, pricing and distance–time examples.

rate = vertical change / time change

Always read axis labels, scales and units.

UNDERSTAND THE IDEA. EXPLAIN THE METHOD.

Detailed teaching • Worked examples • Discussion • Original practice • Full solutions

Name: _____

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Your learning guide

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Before you begin

Read coordinates, calculate rates and recognise straight lines.

Your route through this notebook

1. Reading scales, interpolating and converting
2. Pricing graphs and comparing models
3. Distance–time graphs and journeys

How to use it

Read a lesson, cover the worked solutions and try the examples yourself. Complete its practice page before checking the answers at the back. Finish with the mixed review, then return to any method you could not explain.

YOUR PROGRESS

After each lesson, ask: Can I explain the idea? Can I choose a method? Can I check my result? Record any questions you want to revisit.

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LESSON 1 / UNDERSTAND

Reading scales, interpolating and converting

A graph’s axes identify what is measured and in which units. Read the scale from labelled ticks rather than counting squares as units. Interpolation estimates within the range of known data; extrapolation extends beyond it and depends more strongly on assumptions about the model.

A direct conversion graph often passes through the origin and has constant gradient, such as a fixed exchange-rate model. Other conversions include an offset: Celsius and Fahrenheit do not have a zero-to-zero correspondence. Reverse a conversion by entering on the other axis or rearranging the formula.

A reliable method

1. Identify both quantities, their units and their scales.

2. Read across and up carefully, using the correct input axis.

3. State whether an estimate is interpolation or extrapolation.

Worked example 1

A fixed-rate graph uses D = 1.25P, dollars from pounds. Convert £48.

STEP-BY-STEP SOLUTION

D = 1.25 × 48 = 60 dollars. The model assumes this rate and no fees.

Worked example 2

Use F = 1.8C + 32 to convert 20°C, then find C when F = 68.

STEP-BY-STEP SOLUTION

20°C gives 68°F. Reversing: C = (68 − 32)/1.8 = 20°C.

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LESSON 1 / DISCUSS & PRACTISE

Explain it, then try it

DISCUSSION • TEST THE IDEA

A conversion line need not pass through the origin. Check the rule: F = 1.8C + 32 has a 32°F intercept even though its gradient is constant.

Say it in your own words

Explain the key idea to someone else. Use a small example to support your explanation. If you disagree with a claim, show why it fails.

1.1 At E = 1.2P, convert £35 to euros.

1.2 At E = 1.2P, convert 72 euros to pounds.

1.3 Use F = 1.8C + 32 for C = −10.

1.4 A graph is based on measurements from 2 to 10 minutes. Classify a reading at 6 minutes and a prediction at 14 minutes.

Check before turning to the answers: is the size sensible, is the notation clear, and have you included any required units?

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LESSON 2 / UNDERSTAND

Pricing graphs and comparing models

A fixed fee plus a cost per unit produces a straight line. The intercept is the fixed fee and the gradient is the rate. Two pricing graphs intersect where their costs are equal. On either side, compare their heights to see which is cheaper for the relevant input.

The input domain matters. A phone tariff may round usage to whole units, producing a step graph rather than a perfectly continuous line. A line crossing at a fractional number of tickets still needs interpreting using valid whole-ticket counts. State assumptions such as no minimum charge, no discounts and proportional billing.

A reliable method

1. Write each cost rule with its fixed fee and variable rate.

2. Set costs equal to find the break-even input.

3. Compare costs on either side within the valid domain.

Worked example 1

Plan A costs 10 + 3h pounds and Plan B costs 4 + 5h. Find equal cost.

STEP-BY-STEP SOLUTION

10 + 3h = 4 + 5h gives h = 3. Both cost £19. Below 3 hours B is cheaper; above 3 hours A is cheaper.

Worked example 2

Interpret C = 8 + 2.5d for a delivery.

STEP-BY-STEP SOLUTION

The fixed charge is £8; the gradient is £2.50 per distance unit d. If d is kilometres, the gradient is £2.50/km.

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LESSON 2 / DISCUSS & PRACTISE

Explain it, then try it

DISCUSSION • TEST THE IDEA

A steeper cost line can still be cheaper over a short range if its fixed fee is lower. Compare the full expressions, not only gradients.

Say it in your own words

Explain the key idea to someone else. Use a small example to support your explanation. If you disagree with a claim, show why it fails.

2.1 Find cost $C = 6 + 4h$ at $h = 5$.

2.2 Find equal cost for $C = 12 + 2h$ and $C = 4 + 4h$.

2.3 Which of those plans is cheaper at $h = 6$?

2.4 Interpret a cost graph with intercept 15 and gradient 7.

Check before turning to the answers: is the size sensible, is the notation clear, and have you included any required units?

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LESSON 3 / UNDERSTAND

Distance–time graphs and journeys

The gradient of a distance–time graph represents speed when distance travelled is plotted. A horizontal section means distance is unchanged, so the traveller is stationary. A steeper straight section means greater constant speed. Calculate speed using the time and distance changes over the section, not necessarily the coordinates measured from the origin.

A graph labelled distance from home can fall when someone returns towards home; distance travelled cannot decrease. Read the axis label before interpreting direction. Average speed over a whole journey is total distance travelled divided by total elapsed time, including stops if they are part of the interval.

A reliable method

1. Identify whether the vertical axis is distance travelled or distance from a location.

2. Calculate section gradients using differences.

3. For a whole trip, include every travelled section and the relevant elapsed time.

Worked example 1

A traveller covers 6 km in 20 minutes, then rests for 10 minutes. Find moving speed and average speed over 30 minutes.

STEP-BY-STEP SOLUTION

Moving speed = 6/(1/3) = 18 km/h. Whole-interval average = 6/(1/2) = 12 km/h.

Worked example 2

Distance from home falls from 10 km to 4 km over 15 minutes along the same road. Interpret.

STEP-BY-STEP SOLUTION

The traveller moves 6 km towards home. Speed is 6/0.25 = 24 km/h. The negative graph gradient describes decreasing distance from home, not negative speed.

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LESSON 3 / DISCUSS & PRACTISE

Explain it, then try it

DISCUSSION • TEST THE IDEA

A flat distance–time graph does not mean constant non-zero speed; it means no change in distance. Constant speed corresponds to a straight sloping section.

Say it in your own words

Explain the key idea to someone else. Use a small example to support your explanation. If you disagree with a claim, show why it fails.

3.1 A distance–time section rises 8 km in 0.5 hours. Find speed.

3.2 What does a horizontal section mean?

3.3 A cyclist travels 12 km out and 12 km back in 2 hours total. Find average speed.

3.4 A traveller is 9 km from home at 10:00 and 3 km away at 10:20 on a direct return. Find speed.

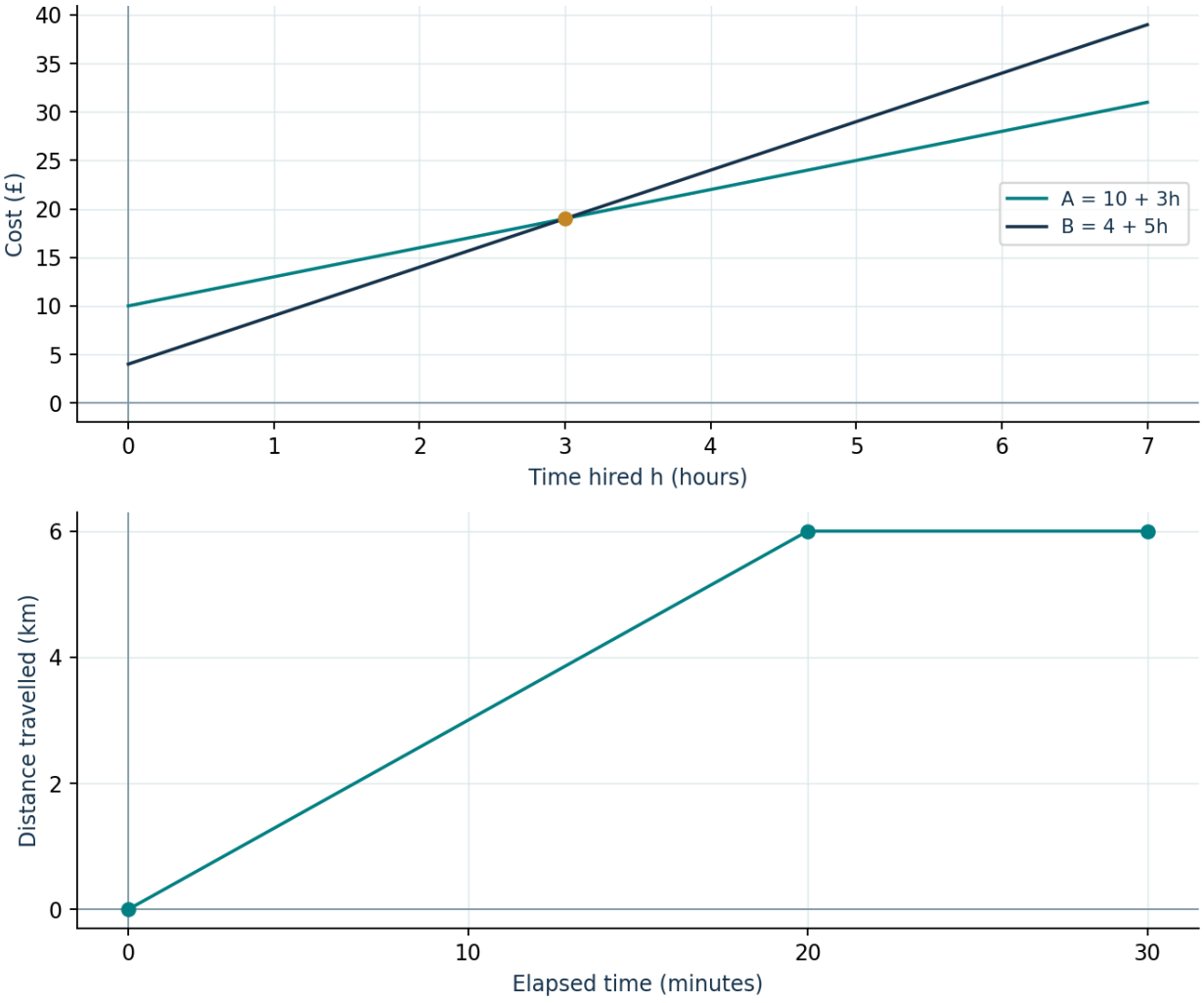
Check before turning to the answers: is the size sensible, is the notation clear, and have you included any required units?

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VISUAL EXPLAINER / CONNECT THE RULE TO THE GRAPH

Read the mathematics

Read quantities and units before interpreting a graph



WHAT THE FIGURE SHOWS

Top: both plans cost £19 at 3 hours; compare the lines on either side. Bottom: the traveller covers 6 km in 20 minutes, then rests for 10 minutes. Moving speed is 18 km/h, while the average over the whole 30 minutes is 12 km/h.

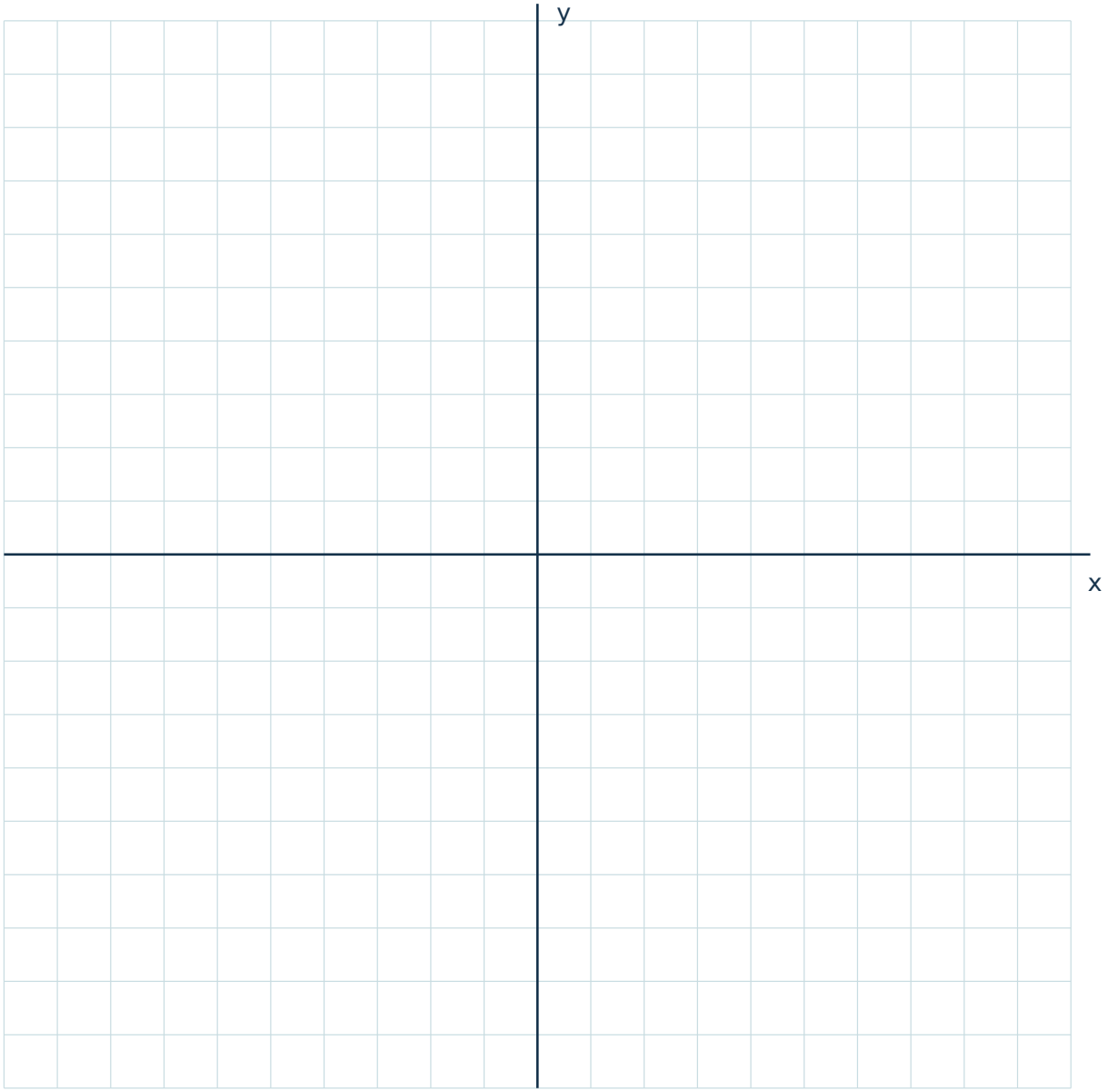
Explain how the labelled features follow from the equations. Check a point by substitution or recalculate a gradient or area before relying on the picture.

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GRAPH WORKSPACE / RECREATE AND EXPLAIN

Build the picture yourself

Choose one graph from the preceding visual explainer and reconstruct it on this grid. Choose and label a suitable scale on each axis; one square need not represent one unit. Include the displayed domain, key points and units. For a real-life graph, relabel x and y with the measured quantities.



SELF-CHECK

Compare with the preceding plotted figure and its explanation. Check at least three points, any intercepts and the direction or shape of the graph. Explain how the equation or context produces those features.

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MIXED REVIEW / ORIGINAL EXAM-STYLE PRACTICE

Apply your learning • 1

These questions are independently authored, not taken or adapted from past papers. Marks are suggested for self-assessment. Show your method and explain decisions. Use a calculator only where the arithmetic requires it.

R1. Use D = 1.3P to convert £60. [2 marks]

R2. Use F = 1.8C + 32 to find C when F = 50. [3 marks]

R3. Find equal cost for A = 18 + 2h and B = 6 + 5h. [3 marks]

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MIXED REVIEW / ORIGINAL EXAM-STYLE PRACTICE

Apply your learning • 2

These questions are independently authored, not taken or adapted from past papers. Marks are suggested for self-assessment. Show your method and explain decisions. Use a calculator only where the arithmetic requires it.

R4. Interpret the gradient and intercept in C = 9 + 4n. [2 marks]

R5. A 15 km trip takes 45 minutes including a stop. Find average speed. [3 marks]

R6. A distance-from-home graph drops from 18 km to 6 km in 30 minutes along a direct road. Describe direction and speed. [3 marks]

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SOLUTIONS / LESSON PRACTICE

Check the reasoning

Your layout may differ. Compare the mathematical reasoning as well as the final answer. Correct any error, then reattempt the question without looking.

Lesson 1 • Reading scales, interpolating and converting

1.1 At E = 1.2P, convert £35 to euros.

E = 42 euros under the fixed-rate model.

1.2 At E = 1.2P, convert 72 euros to pounds.

P = 72/1.2 = £60.

1.3 Use F = 1.8C + 32 for C = −10.

F = −18 + 32 = 14°F.

1.4 A graph is based on measurements from 2 to 10 minutes. Classify a reading at 6 minutes and a prediction at 14 minutes.

6 minutes is interpolation; 14 minutes is extrapolation.

Lesson 2 • Pricing graphs and comparing models

2.1 Find cost C = 6 + 4h at h = 5.

£26.

2.2 Find equal cost for C = 12 + 2h and C = 4 + 4h.

8 = 2h, so h = 4 and cost £20.

2.3 Which of those plans is cheaper at h = 6?

12 + 12 = £24 versus 4 + 24 = £28. The first is cheaper.

2.4 Interpret a cost graph with intercept 15 and gradient 7.

A fixed cost of 15 money units plus 7 per input unit.

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SOLUTIONS / LESSON PRACTICE

Check the reasoning • continued

Lesson 3 • Distance–time graphs and journeys

3.1 A distance–time section rises 8 km in 0.5 hours. Find speed.

16 km/h.

3.2 What does a horizontal section mean?

The distance is unchanged; the object is stationary over that interval.

3.3 A cyclist travels 12 km out and 12 km back in 2 hours total. Find average speed.

Total distance 24 km; average speed 12 km/h.

3.4 A traveller is 9 km from home at 10:00 and 3 km away at 10:20 on a direct return. Find speed.

6 km in 1/3 hour gives 18 km/h.

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SOLUTIONS / MIXED REVIEW

Answers and marking guidance

Award the suggested method marks for valid working, even where a later arithmetic slip occurs. Do not count the same step twice. These are independent teaching allocations, not official exam-board mark schemes.

R1. Use D = 1.3P to convert £60. [2 marks]

D = 78 dollars. [1 for multiplication; 1 for result.]

R2. Use F = 1.8C + 32 to find C when F = 50. [3 marks]

C = (50 − 32)/1.8 = 10°C. [1 for subtracting 32; 1 for division; 1 for answer/unit.]

R3. Find equal cost for A = 18 + 2h and B = 6 + 5h. [3 marks]

12 = 3h gives h = 4; both cost £26. [1 for equation; 1 for h; 1 for cost.]

R4. Interpret the gradient and intercept in C = 9 + 4n. [2 marks]

Fixed cost 9; cost per unit n is 4. [1 each.]

R5. A 15 km trip takes 45 minutes including a stop. Find average speed. [3 marks]

45 minutes = 0.75 h; 15/0.75 = 20 km/h. [1 for conversion; 1 for division; 1 for result/unit.]

R6. A distance-from-home graph drops from 18 km to 6 km in 30 minutes along a direct road. Describe direction and speed. [3 marks]

Towards home; 12 km in 0.5 h gives 24 km/h. [1 for direction; 1 for changes; 1 for speed.]

Reflect, repair and revisit

Record one secure method, one mistake you corrected and one question to retry. Reattempt the questions you missed in a few days. Explain why your new method works before you compare your answer.

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