Worksheet - Graphs: linear and quadratic

Year: Year 9 · 20

Show your working.

Question 1

Question 1 – A table of values for a line *(Section A · Skills practice)*

Complete the table of values for $y = 2x + 1$, then answer the questions about the straight line.

x	-2	-1	0	1	2	3
$y = 2x + 1$	?	?	?	?	?	?

a. Work out each missing value of y.
b. Write down the coordinates of the point where the line crosses the y-axis.
c. Write down the gradient. How does the table show it?
d. Find y when $x = 10$.

Question 2

Question 2 – Gradient and intercept *(Section A · Skills practice)*

A straight line has equation $y = mx + c$, where m is the gradient and c is the y-intercept. Write down m and c for each line. Rearrange first if you need to.

a. $y = 3x - 4$
b. $y = -x + 5$
c. $y = \frac{1}{2}x + 2$
d. $2y = 4x + 6$

Question 3

Question 3 – Find the equation from two points *(Section A · Skills practice)*

Find the equation of the straight line through each pair of points. First find the gradient using $m = \frac{\text{change in } y}{\text{change in } x}$.

a. $(0, 3)$ and $(2, 7)$
b. $(0, 5)$ and $(5, 0)$
c. $(1, 3)$ and $(3, 7)$
d. $(0, -1)$ and $(4, 7)$

Question 4

Question 4 – Does the point lie on the line? *(Section A · Skills practice)*

The line $y = 3x - 2$ is drawn. A point lies on a line if its coordinates fit the equation.

a. Does $(4, 10)$ lie on the line?
b. Does $(-1, -5)$ lie on the line?
c. Does $(2, 5)$ lie on the line?
d. Which of these lines are parallel to $y = 3x - 2$: $y = 3x + 7$, $y = -3x - 2$, $y = 2x - 2$, $2y = 6x + 1$?

Question 5

Question 5 – A table for a quadratic *(Section A · Skills practice)*

A quadratic graph is a curve called a parabola. Complete the table for $y = x^2 - 4$ and answer the questions.

x	-3	-2	-1	0	1	2	3
$y = x^2 - 4$	?	?	?	?	?	?	?

a. Complete the table.
b. Write down the coordinates of the lowest point (the turning point).
c. Write down the x-values where the curve crosses the x-axis.
d. Write down the equation of the line of symmetry.

Question 6

Question 6 – Reading values from a quadratic *(Section A · Skills practice)*

Here is the table for $y = x^2 + 2x - 3$.

x	-4	-3	-2	-1	0	1	2
y	5	0	-3	-4	-3	0	5

a. Check the value at $x = -2$ using the equation.
b. Write down the roots (where $y = 0$).
c. Write down the minimum value of y and the x-value where it happens.
d. Use the table to solve $x^2 + 2x - 3 = 5$.

Question 7

Question 7 – Taxi fares *(Section B · Real-life practice)*

A taxi firm charges a fixed fee of £3 plus £2 for every mile. The fare £y for a journey of x miles is $y = 2x + 3$.

Miles x	0	2	4	6	8
Fare £y	?	?	?	?	?

a. Complete the table.
b. Explain what the gradient 2 and the intercept 3 mean in this situation.
c. Find the fare for a 7-mile journey.
d. Sunita has £25. How far can she travel?
e. Another firm charges £1 per mile with no fixed fee. For what distance is it cheaper?

Question 8

Question 8 – Joining the gym *(Section B · Real-life practice)*

A gym charges a joining fee of £20 and £15 per month. The total cost £y after x months is $y = 15x + 20$.

a. Find the cost after 6 months.
b. Find the number of months if the total is £200.
c. Draw (or describe) the graph. Where does it cross the y-axis and what does that mean?
d. Another gym has no joining fee and charges £25 per month. Write its equation and find when the two gyms cost the same.

Question 9

Question 9 – The birthday candle *(Section B · Real-life practice)*

A birthday candle is 20 cm tall when lit. It burns down at a steady rate. Its height h cm after x hours is $h = 20 - 2.5x$.

a. Find the height after 3 hours.
b. What does the gradient -2.5 tell you?
c. How long does the candle last?
d. Draw the line from $x = 0$ to $x = 8$ and write down its two end points.

Question 10

Question 10 – Two sunflowers *(Section B · Real-life practice)*

Two sunflowers are measured every week. Sunflower A has height $y = 5 + 1.5x$ cm and sunflower B has height $y = 8 + 1.5x$ cm, where x is the number of weeks.

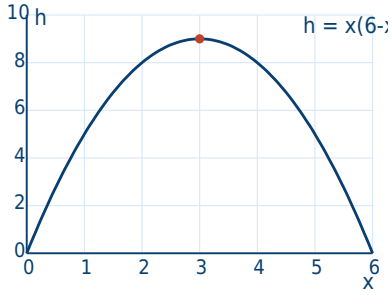
a. Find the heights of both plants after 4 weeks.
b. Are the lines parallel? Explain what that means for the plants.
c. After how many weeks is plant A 29 cm tall?
d. Plant C has height $y = 2x + 5$. After how many weeks is it the same height as plant A?

Question 11

Question 11 – The basketball shot *(Section B · Real-life practice)*

A pupil shoots a basketball. Its height h metres at a horizontal distance x metres from the shooter is $h = x(6 - x)$. Complete the table and answer the questions.

x	0	1	2	3	4	5	6
$h = x(6-x)$	?	?	?	?	?	?	?



a. Complete the table.
b. What is the greatest height and at which distance does it happen?
c. At what distances is the ball exactly 5 m high?
d. How far from the shooter does the ball land?

Question 12

Question 12 – Stopping distances *(Section B · Real-life practice)*

A road-safety leaflet uses the model $d = \dfrac{v^2}{20}$ for the braking distance d metres of a car at speed v mph.

v (mph)	20	30	40	60
d (m)	?	?	?	?

a. Complete the table.
b. Does doubling the speed double the braking distance? Use the table to explain.
c. At what speed is the braking distance 125 m?
d. A pupil says the graph is a straight line. Is she right? Explain.

Question 13

Question 13 – Which phone plan? *(Section B · Real-life practice)*

Plan A costs £10 per month plus 5p per minute of calls: $y = 0.05x + 10$. Plan B has no monthly charge but costs 10p per minute: $y = 0.1x$. The cost is £y for x minutes.

Minutes x	0	100	200	300
Plan A (£)	10	15	20	25

Minutes x	0	100	200	300
Plan B (£)	0	10	20	30

a. Show how the values for $x = 200$ were found.
b. Draw the graphs and find where they cross.
c. Which plan is cheaper for 150 minutes?
d. Which plan is cheaper for 300 minutes? Use algebra to confirm the crossing point.

Question 14

Question 14 – The fence line on the plan *(Section B · Real-life practice)*

On a plan of the school field, a fence runs along the line $y = \frac{1}{2}x + 2$, where distances are in metres from the corner of the field.

a. Does a tree at $(6, 5)$ stand on the fence line?
b. A pond is at $(4, 3)$. Is it on the fence line?
c. Where does the fence line cross the x-axis?
d. A path runs parallel to the fence through $(0, -1)$. Write its equation.

Question 15

Question 15 – Intercepts of lines *(Section C · Problem solving)*

A table shows four lines. Complete the table. The x-intercept is where $y = 0$.

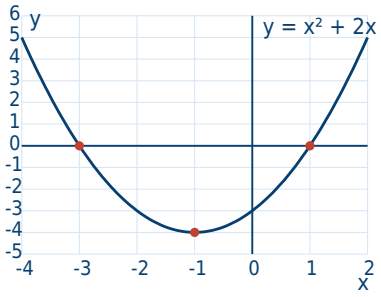
Equation	Gradient	y-intercept	x-intercept
$y = 2x + 4$	?	?	?
$y = -3x + 6$	?	?	?
$y = \frac{1}{2}x - 1$	?	?	?
$y = 4x$	?	?	?

a. Complete the table.
b. Which line passes through the origin?
c. Which two lines have x-intercepts that are the same? What is that value?
d. Write the equation of the line with gradient 2 that passes through the x-intercept of the second line.

Question 16

Question 16 – Roots of a parabola *(Section C · Problem solving)*

The curve $y = x^2 + 2x - 3$ is drawn below. Answer the questions using the graph.

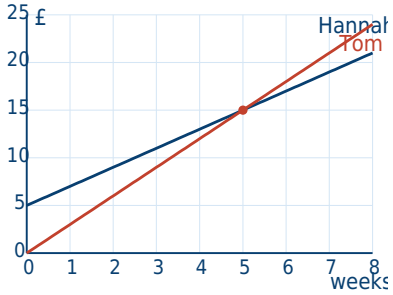


a. Read the roots and the coordinates of the turning point.
b. Write down the line of symmetry. What is the mean of the two roots?
c. Use the graph to solve $x^2 + 2x - 3 = -3$.
d. Use the graph to estimate y when $x = 0.5$, and check with the equation.
e. Explain why the curve is a smooth U-shape and not a straight line.

Question 17

Question 17 – Two savers *(Section C · Problem solving)*

Hannah has £5 in her purse and saves £2 each week: $y = 2x + 5$. Tom has nothing and saves £3 each week: $y = 3x$. Both graphs are drawn with x as the number of weeks.



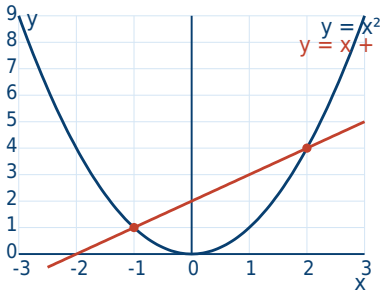
Weeks	0	2	4	6	8
Hannah (£)	5	9	13	17	21
Tom (£)	0	6	12	18	24

a. Read the point where the graphs cross and explain what it means.
b. Use algebra to confirm this.
c. Who has more money after 3 weeks?
d. Who has more after 8 weeks, and by how much?

Question 18

Question 18 – A line and a curve *(Section C · Problem solving)*

The line $y = x + 2$ and the curve $y = x^2$ are drawn on the same axes.



x	-2	-1	0	1	2	3
$y = x^2$	4	1	0	1	4	9
$y = x + 2$	0	1	2	3	4	5

a. Use the table to find the x-values where the line and curve meet.
b. Write down the coordinates of the points of intersection.
c. Show that $x^2 = x + 2$ at these two x-values.
d. The solutions of $x^2 - x - 2 = 0$ are the x-values of these points. Explain why.

Question 19

Question 19 – The skate-park ramp *(Section C · Problem solving)*

The cross-section of a skate-park ramp is modelled by $y = x^2 - 6x + 8$, where x is the distance in metres from the left edge and y is the height in metres above the ground level of the park.

x	0	1	2	3	4	5	6
y	?	?	?	?	?	?	?

a. Complete the table.
b. Find the lowest point of the ramp and its depth below ground level.
c. Between which two x-values is the ramp below ground level?
d. Write down the line of symmetry. Check it using the table.
e. The ramp is 6 m long. The same ramp is built in two halves. Why do the halves look like mirror images?

Question 20

Question 20 – Challenge: where do the line and the parabola meet? *(Section D · Challenge)*

A straight line passes through $(1, 5)$ and $(4, 11)$.

a. Find the gradient of the line.
b. Find the equation of the line in the form $y = mx + c$.
c. The curve $y = x^2$ is drawn on the same axes. Complete a table of values for the line for $x = -2$ to 3.
d. The line and the curve meet at two points. Use your table and a table for $y = x^2$

to find them.

e. Show that $x^2 - 2x - 3 = 0$ at these points and check by factorising $(x - 3)(x + 1)$.