Maths Autumn Term 1 - Graphs

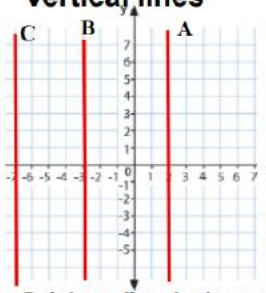
LEES BROOK COMMUNITY SCHOOL

Section A: Vocabulary

Vocabulary	Definition
Straight line	A line that does not curve.
Parallel	Always the same distance apart and never touching.
Equation	A statement that two mathematical expressions are equal
Graph	A diagram showing a relationship between two variables
Intercept	Where a line cuts across a axis
Linear	A straight line graph is linear
Gradient	How steep a line is. Found by dividing the change in y by the change in x, represented by m in the equation y = mx + c
Y-intercept	The value of the y-coordinate when a graph crosses the y-axis
Coordinates	A point on a 2d plane (x, y)
Substitute	Replacement of letter with a numerical value
Solutions	A value, or values, we can put in place of a variable (such as x) that makes the equation true.
Simultaneous	A set of two or more equations, each involving two or more variables. The solutions to simultaneous equations satisfy both/all of the equations
Reciprocal	The reciprocal of a number is: 1 divided by the number. Eg. the reciprocal of 2 is $\frac{1}{2}$.
Perpendicular	Two or more lines which meet at right angles
Product	The answer when two or more values are multiplied together.
Quadratic	Where the highest exponent of the variable (usually "x") is a square (^{2}).
Roots	A root is a value for which a given function equals zero. When that function is plotted on a graph, the roots are points where the function crosses the x-axis.

Section B:

Vertical lines



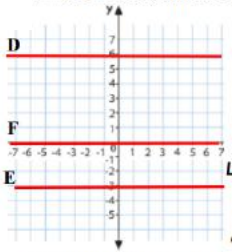
Line A: x = 2

Line B: x = -3

What is line C?

Points on line A always have an x coordinate of 2
e.g. (2,-3), (2,0), (2,5)
so the line is x = 2

Horizontal lines



Line D: y = 6

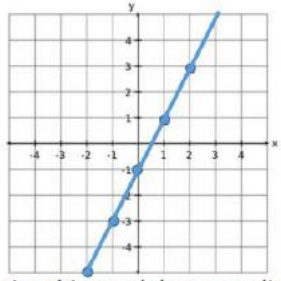
Line E: y = -3

Line F is the x axis. What is its equation?

Points on line D always have a y coordinate of 6
e.g. (-5,6), (0,6), (2,6)
so the line is y = 6

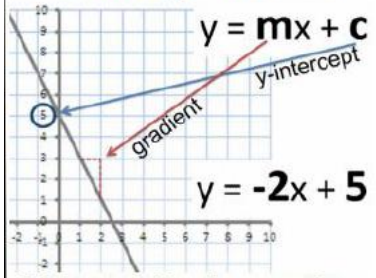
Draw the graph of y = 2x - 1

X	-2	-1	0	1	2
Y	-5	-3	-1	1	3



Notice this graph has a gradient of 2 and a y-intercept of -1.

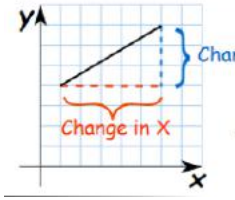
Linear graphs in the format y = mx + c



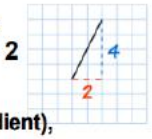
What would be the equation of a line with gradient 3 and y intercept -4?

Calculating gradient

Gradient = $\frac{\text{Change in y}}{\text{Change in x}}$



In this example:
Gradient = $\frac{4}{2} = 2$



The higher the number (gradient), the steeper the line

The gradient is how steep a line is. The larger the gradient the steeper the slope. A gradient of zero is a horizontal line. A negative gradient slopes the opposite direction.

Section C:

Find the equation of a line given a point and a gradient.

Substitute in the gradient (m) and point (x, y) in to the equation $y = x + c$ and solve for c.

Find the equation of the line with gradient 4 passing through (2,7).

$$y = mx + c$$
$$7 = 4 \times 2 + c$$
$$c = -1$$
$$y = 4x - 1$$

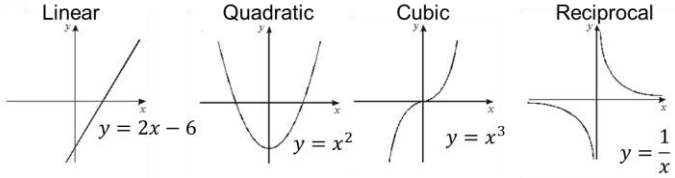
Find the equation of a line given two points.

Use the two points to calculate the gradient. Then repeat the method to the left using the gradient and either of the two points.

Find the equation of the line passing through (6,11) and (2,3)

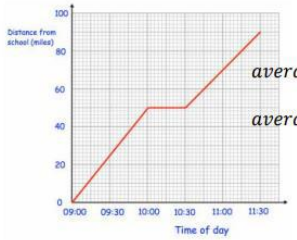
$$m = \frac{11 - 3}{6 - 2} = 2$$
$$y = mx + c$$
$$11 = 2 \times 6 + c$$
$$c = -1$$
$$y = 2x - 1$$

Types of Graphs



Distance time graphs

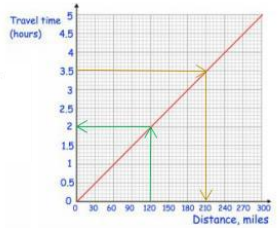
Graphs which describe a journey, straight line equals constant speed.
Horizontal line mean stationary (no speed)



$$speed = \frac{distance}{time}$$
$$average\ speed = \frac{total\ distance}{total\ time}$$
$$average\ speed = \frac{90}{2.5} = 36mph$$

Conversion graphs

Graphs which help us convert one unit of measure to another
To plot simply take the given information and join with a straight line



To use the conversion graph simply use your ruler
1) 120 miles is 2 hours
2) 3.5 hours is 210 miles

Maths Autumn Term 2 – Expanding and Factorising, Changing the Subject and Functions

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Section A: Vocabulary

Vocabulary	Definition
Expression	A collection of terms which can contain variables (letters) and numbers. E.g. $4 + 3x$
Equation	Two expressions which have the same value, separated by an = sign. E.g. $7x=1$
Identity	An equation that is true for variables of any value. E.g. $a(b + c) \equiv ab + ac$
Formula	An equation used to describe a relationship between two or more variables. E.g. $A = \pi r^2$
Inequality	A mathematical equation expressing inequality. E.g $x < 3$ *or* $2x \geq x - 1$
Binomial	An expression with two terms joined by an add or subtract sign. E.g. $5x + 3y$
Expanding	To multiply out brackets in an expression. E.g. $2(x - 3) = 2x - 6$
Factorising	To put an expression into brackets by taking out a common factor.
Solving	To find the missing value/s in an equation.
Substitution	Swapping numbers for variables (letters) to find solutions.
Iteration	The repetition of a formula applied to the result of a previous application, to get closer to a solution.
Change the subject	Rearrange the equation so that a certain variable is the subject like a formula.
Inverse	The opposite. The inverse of ^{2} is $\sqrt{}$
Function	A special relationship where each input has a single output.
Composite Function	a function whose values are found from substituting a value into one function and then a second function to get a result

Section B: Key Facts and Processes

1. Expand $(x - 1)^2$. FOIL= First Outside Inside Last

$(x - 1)(x - 1) = x^2 - \boldsymbol{x} - \boldsymbol{x} + 1 = x^2 - \mathbf{2}\boldsymbol{x} + 1$

2. Factorise $x^2 + 8x + 12$

Find two numbers that add to make 8 and multiplies to make 12. List out the factors of 12 to help with this.

$2 \times 6 = 12 \quad and \quad 2 + 6 = 8$

Therefore $x^2 + 8x + 12 = (x + 2)(x + 6)$

3. Solve $4x + 1 = 2x - 3$

$2x + 1 = -3$ Subtract $2x$ to both sides

$2x = -4$ Subtract 1 to both sides

$x = -2$ Divide by 2 to both sides

4. Solve $x^2 + 5x - 14 = 0$.

$(x + 7)(x - 2) = 0$ Firstly factorise

$x + 7 = 0 \quad x - 2 = 0$ Solve each equation

$x = -7 \ and \ x = 2$

5. The quadratic formula: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

This is used to solve quadratic equations in the form $ax^2 + bx + c = 0$. It is helpful if we cannot solve by factorising.

6. Rearrange $A = \pi r^2$ to make r the subject.

$\frac{A}{\pi} = r^2$ divide by π

$\sqrt{\frac{A}{\pi}} = r$ square root

7. Solve $2x - 3 < 9$

$2x < 12$ add 3

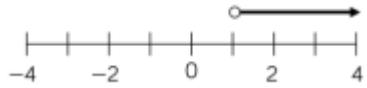
$x < 6$ divide by 2

8. Solve $-x \leq 2$ (What could x be? What else?...)

$x \geq -2$ notice the sign changes when multiplied by -1.

9. Draw $x > 1$ on a number line.

The direction of the arrow shows possible values for the variable. The circle is filled for $\leq$ *or* $\geq$

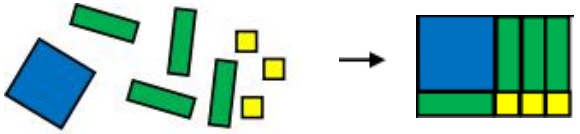


Section C: Support

1. Factorise $x^2 + 4x + 3$

Use algebra tiles to make a rectangle with the pieces.

The blue piece is x^2, green is x and yellow is 1.



What are the dimensions of the rectangle?

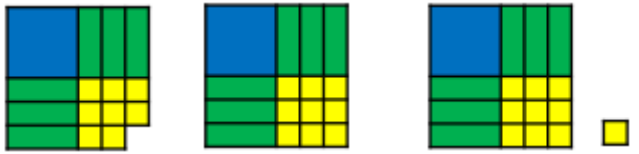
The width is $x + 3$ and the height is $x + 1$.

Therefore $x^2 + 4x + 3 = (x + 1)(x + 3)$

2. We can use algebra tiles to visualise making a square.

Complete the square:

$\boldsymbol{x^2 + 6x + 8}$ $\boldsymbol{x^2 + 6x + 9}$ $\boldsymbol{x^2 + 6x + 10}$

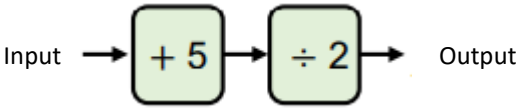


$\boldsymbol{(x + 3)^2 - 1}$ $\boldsymbol{(x + 3)^2}$ $\boldsymbol{(x + 3)^2 + 1}$

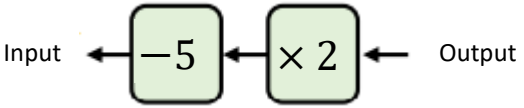
Missing 1 perfect square 1 extra

3. Functions. If the input is 3 what is the output?

$3 + 5 = 8 \quad 8 \div 2 = 4$ the output is 4



If the output is 12, what is the input? Let's do the inverse:



$12 \times 2 = 24 \quad 24 - 5 = 19$

Check your working: $19 + 5 = 25 \quad 24 \div 2 = 12$