WJEC MATHEMATICS
INTERMEDIATE
GRAPHS

STRAIGHT LINE GRAPHS
(PLOTTING)
Contents

Some Simple Straight Lines
\[ y = mx + c \]
Parallel Lines
Perpendicular Lines
Plotting Equations
Shaded Regions

Credits

WJEC Question bank
http://www.wjec.co.uk/question-bank/question-search.html
Some Simple Straight Lines
There are some basic straight lines that you should be able to draw.

\[ y = x \]
The line of \( y = x \) is a diagonal line that does through (0,0).

\[ y = -x \]
The line \( y = -x \) goes is a diagonal line, opposite to \( y = x \).
\( y = \, ? \)
If you need to plot a graph of \( y = \, ? \) (For example, \( y = 3 \) as seen below), you need to find the number on the \( y \) axis and draw a **horizontal line**.

\( x = \, ? \)
If you need to plot a graph of \( x = \, ? \) (For example, \( x = -3 \) as seen below), you need to find the number on the \( x \) axis and draw a **vertical line**.

**Common Confusion!**
Yes, the \( y \) axis is the **vertical** axis, but the line \( y = 4 \) is a **horizontal** line.
And yes, the \( x \) axis is the **horizontal** axis, but the line \( x = 4 \) is a **vertical** line.
Exercise G2

1. Plot, and label, the following lines of the graph paper below

   a. \( y = 4 \)
   
   b. \( y = 2 \)
   
   c. \( y = 1 \)
   
   d. \( y = -5 \)
   
   e. \( y = -2 \)
   
   f. \( y = -1 \)

2. Plot, and label, the following lines of the graph paper below

   a. \( x = 2 \)
   
   b. \( x = 5 \)
   
   c. \( x = 3 \)
   
   d. \( x = -4 \)
   
   e. \( x = -1 \)
   
   f. \( x = 0 \)
\[ y = mx + c \]
You may be shown a straight line and asked to write the equation of that line. The formula we use is:

\[ y = mx + c \]

where:
- \( m \) is the gradient of the line
- \( c \) is where the line crosses the \( y \) axis

Example
Write the equation of the following line in the form \( y = mx + c \)

So for the above line
- The gradient of the line is \( \frac{\text{length of vertical}}{\text{length of horizontal}} = \frac{1}{2} \)
- The line passes through the \( y \) axis at 1
The equation is \( y = \frac{1}{2}x + 1 \)

For this line,
- The gradient is \( \frac{\text{length of vertical}}{\text{length of horizontal}} = \frac{2}{1} = 2 \)
- The line passes through the \( y \) axis at -3
The equation is \( y = -2x - 3 \)
Exercise G3
Write the equations of the following lines

Parallel Lines
Parallel lines have the **SAME GRADIENT**.

\[
y = \frac{1}{2}x + 2 \\
y = \frac{1}{2}x + 0.5 \\
y = \frac{1}{2}x - 1
\]
Perpendicular Lines
The gradients of two lines that are perpendicular (meet at a right angle) **MULTIPLY TO GIVE -1**

![Graph showing perpendicular lines]

**Example Question**
*Write the equation of a line that is parallel to* \( y = 3x + 2 \) *and a line that is perpendicular to* \( y = 3x + 2 \)

**Note:** You only need to change the gradient, the value of \( c \) does not affect whether lines are parallel or perpendicular.

Parallel line: \( y = 3x + 1 \)
Perpendicular line: \( y = -\frac{1}{3}x + 1 \)

**Exercise G4**
Write the equation of a line that is perpendicular and a line that is parallel to the following equations:

a. \( y = 2x + 1 \)  
b. \( y = -4x - 2 \)  
c. \( y = 12x - 4 \)  
d. \( y = \frac{1}{2}x + 4 \)  
e. \( y = -\frac{1}{3}x + 3 \)  
f. \( y = -\frac{1}{5}x - \frac{2}{3} \)
Plotting Straight Lines

You may be given an equation and be asked to draw the line. To do this, you will need to create a table of points.

Example

Plot the line \( y = 2x - 3 \) on the graph paper below.

**Step one**

Draw your table of points

\[
\begin{array}{c|c|c|c}
  x & 1 & 2 & 3 \\
  \hline
  y & \quad & \quad & \quad \\
\end{array}
\]

Substitute the \( x \) values into the equation to find the \( y \) value that goes with it.

- \( 2(1) - 3 = 2 - 3 = -1 \)
- \( 2(2) - 3 = 4 - 3 = 1 \)
- \( 2(3) - 3 = 6 - 3 = 3 \)

We now have three coordinate points \((1, -1)\), \((2, 1)\) and \((3, 3)\). If using 1, 2, 3 isn't easy use three different values of \( x \) instead.

Once you have these points, plot them and the connect them with a line.
To complete the question, plot the points and join them up with a line.

Make sure your line uses the entire space of the graph

Exercise G5
Plot the following lines

1. \( y = x + 2 \)

2. \( y = -2x + 1 \)

3. \( y = 3x - 5 \)

4. \( y = \frac{1}{2}x + 1 \)
Exam Questions G8

1. (a) Use the grid below to draw graphs to represent each of the following equations.

(i) \[ y = \frac{1}{2}x + 6 \]

(ii) \[ x + y = 8 \]

Label your lines (i) and (ii) as appropriate.

(b) Using your answer to (a), are the lines \( y = \frac{1}{2}x + 6 \) and \( x + y = 8 \) perpendicular to each other? Give a reason for your answer.
2. In a game, the rule for plotting points is \((x, 2x)\).

On the graph below, plot the points when \(x = 1\), \(x = 4\) and when \(x = -2\). [3]

3. | Line | Equation   |
    |------|-----------|
    | A    | \(y = 3x + 4\) |
    | B    | \(y = -3x + 3\) |
    | C    | \(y = -2x - 4\) |
    | D    | \(y = 3x - 5\) |
    | E    | \(y = 4x + 4\) |

\((a)\) Which two of the above lines are parallel?
You must give a clear reason for your answer.

\((b)\) Which two of the above lines intersect each other on the \(y\)-axis?
Shaded Regions (Inequalities)
Common questions will give you multiple straight line equations. Once all the equations have been plotted there will be a region (part of the graph) that is contained within all the lines.

Example
Using the axes below, find the region defined by the following inequalities

\[
\begin{align*}
    x & \geq -2 \\
    y & \geq 1 \\
    x + 2y & \leq 4
\end{align*}
\]

Don't be worried by the inequalities. For now, assume they are all '=' signs, rearrange them to the correct form, and plot them.
Exam Questions G9

1. On the grid below, draw the region which satisfies all of the following inequalities.

\[ x \geq -5 \]
\[ y \leq 3 \]
\[ y - x + 2 \geq 0 \]

You must clearly indicate the region that represents your answer. [4]

2. On the squared paper below, draw the region which satisfies all of the following inequalities.

\[ x \leq 7 \]
\[ x + y \geq 6 \]
\[ y \leq \frac{x}{2} \]

Make sure that you clearly indicate the region that represents your answer. [3]
3. On the squared paper provided, draw the region which satisfies all of the following inequalities.

\[
\begin{align*}
  y &\leq 8 \\
  x + y &\geq 2 \\
  y &\geq 2x - 4
\end{align*}
\]

Make sure that you clearly indicate the region that represents your answer.

4. (a) Rafi has been asked to paint a region on a coordinate grid. He is given the following criteria.

The region must be such that

- \( y \leq x \)
- \( x \leq 1 \)
- \( y \geq -2 \)

Use the grid below to show the region that Rafi needs to paint.