

# Linear Sketching



Did you know?



Where is the steepest street in the world?

Gradients can be represented in different ways, but what do the measurements mean?

A gradient of 1:5 means for every 5m you travel horizontally you travel 1m vertically.



A gradient of 16% means for every 100m across you go 16m up.



Can you find out:

- Where the street is?
- What the gradient of the street is?
- Why there is controversy over the winners?

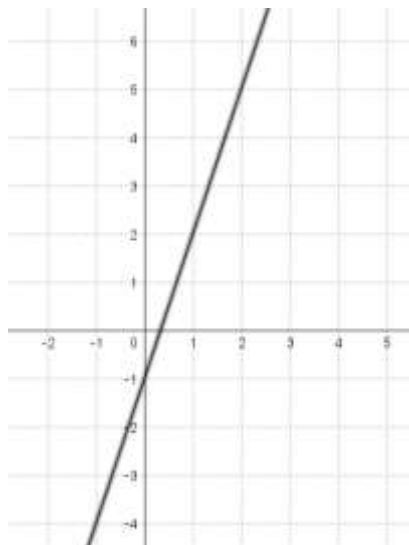
Clue: They hold a Jaffa rolling contest down the street every year!



## Linear Graphs 1



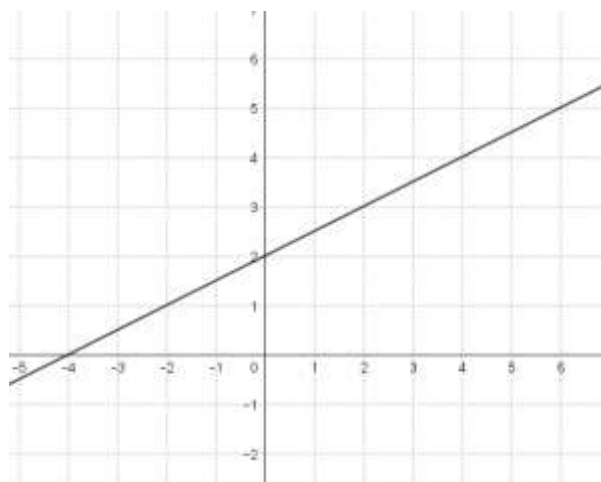
1. What are the gradient and intercept of the line  $y = 3x - 5$ ?
2. Find the gradient of the line connecting (3,10) and (1,6)
3. Find the midpoint between the points (3,-8) and (-1,4)
4. Find the distance between points (1,10) and (4,18)
5. What is the equation of the line with gradient 3 that passes through (5,8)?
6. Does the line  $y = 2x - 3$  pass through (1,-1)? Explain how you know.
7. Find the equation of a line that is parallel to  $y = 5x - 2$  that passes through (2,19)
8. What is the equation of this graph?



## Linear Graphs 2



1. What are the gradient and y intercept of the line  $y = 2x - 7$ ?
2. Find the gradient of the line connecting (1,4) and (-1,0)
3. Find the midpoint between the points (-2,10) and (6,4)
4. Find the distance between the points (4,11) and (-1,15)
5. What is the equation of the line with gradient 2 that passes through (1,4)?
6. Does the line  $y = -2x + 5$  pass through (3,1)? Explain how you know.
7. Find the equation of a line that is parallel to  $y = -\frac{3}{2}x - 1$  that passes through (6,4)
8. What's the equation of this graph?





## Do they cross?

Line A passes through the points  $(-3,1)$  and  $(3,5)$   
Line B passes through the points  $(0,-4)$  and  $(6,4)$

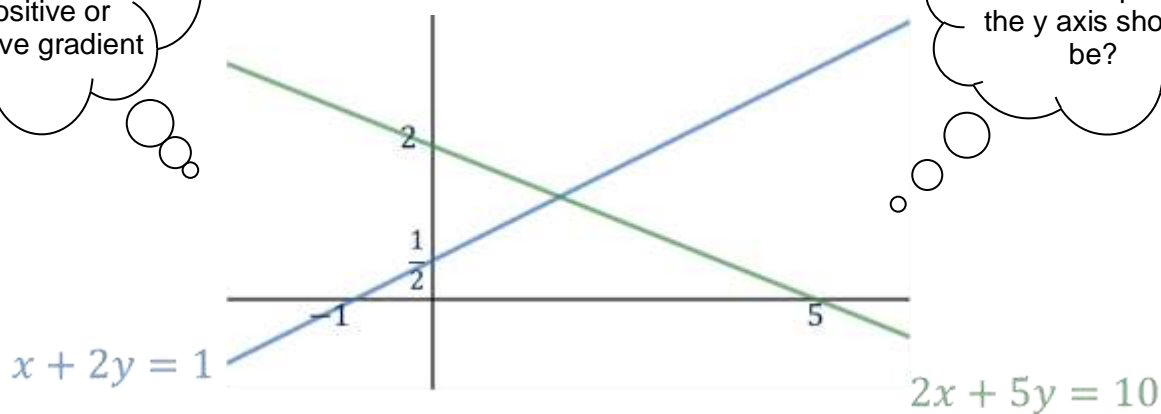
- By sketching can you tell if the lines will meet?
- If they do meet what are the points of intersection?
- Challenge! Can you find where the lines will meet using algebra



Think about whether the equation suggests a positive or negative gradient

## Picture this

Is this an accurate sketch of these two lines?



What does the equation suggest the intercept with the y axis should be?



## The plot thickens....

Complete the information in the table for each equation below:

- Find the co-ordinates of the  $x$  and  $y$  intercepts
- Decide if the gradient of the graph would be positive or negative

Name	Equation	$x$ intercept	$y$ intercept	Positive/negative gradient
A	$y - 2x - 1 = 0$			
B	$y = 3$			
C	$3x + 4y = 2$			
D	$2x - y + 6 = 0$			
E	$2y + x = 4$			
F	$2x + y - 3 = 0$			

Using the information from the table, sketch all the graphs on one set of axes to find:

- A pair of lines that are parallel
- A pair of lines that are perpendicular
- A pair of lines that intersect at  $(-2, 2)$



## Two geometry problems

DEF is an isosceles right angled triangle  
 The line passing through D and F has the equation  
 $x + 3y = 15$   
 D is the co-ordinate  $(6,3)$   
 E is the co-ordinate  $(5,0)$   
 The angle EDF is the right angle

Can you find:

- The equation of line DE?
- The possible coordinates of F?
- The equation of line EF?

ABCD is a parallelogram. The line passing through  
 C and D has the equation  $y = 7$   
 The line CD is 5 units long  
 D has coordinate  $(2,7)$   
 C has both positive  $x$  and  $y$  co-ordinates  
 The line through AC has equation  $3x + 2y = 35$   
 A has coordinate  $(9,4)$

Can you find:

- The coordinate of C?
- The equation of line AB?
- The equation of line BD?
- The area of the parallelogram?



## Sketching Linear Inequalities

Sketch and shade the following inequalities.

- |               |            |                    |                      |
|---------------|------------|--------------------|----------------------|
| 1. $y \leq 6$ | 2. $x < 6$ | 3. $x + 2y \geq 8$ | 4. $3x + 2y \geq 12$ |
|---------------|------------|--------------------|----------------------|

- Shade out the side of the line that doesn't satisfy the inequality.
- Label the correct region R



## Geometry from equations

The following equations enclose a square:

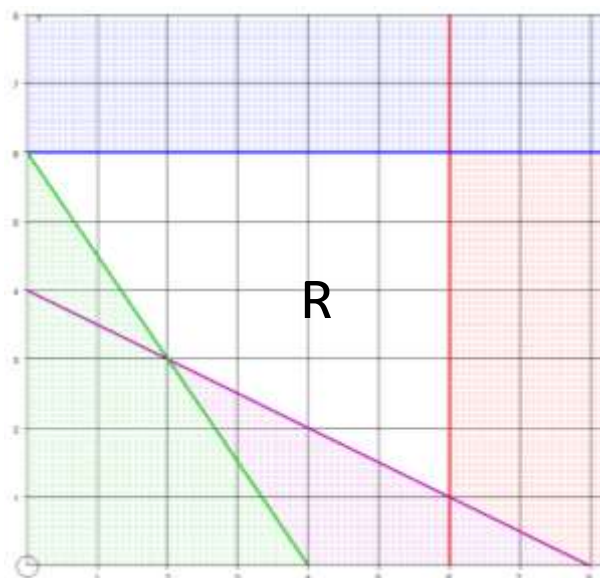
$$\begin{aligned}y - 2 &= x \\ y + x &= 6 \\ y &= x - 1 \\ y + x - 3 &= 0\end{aligned}$$

- Which are the two pairs of parallel sides?
- What are the coordinates of all 4 vertices
- How can you convince yourself this is a square?



## Linear Programming

Here is a graph that shows the feasible region R satisfied by the all inequalities from the previous question.



In Linear Programming linear inequalities are used to find solutions to real life problems.

The 'optimal' or best solution for is found for a particular objective.

R, the unshaded region is called the **FEASIBLE REGION**. Points in this region satisfy all of the inequalities.

The feasible region has four vertices  
What are the coordinates?

- Use the diagram to have a go at this question

Maximise the value of  $x + y$  within the region satisfied by the inequalities:

$$x + 2y \geq 8, \quad 3x + 2y \geq 12, \quad y \leq 6, \quad x \leq 6$$



## Catching Stars

Go to [Student.Desmos.com](https://student.desmos.com) (use classroom code: **3VJUM2**) to try a Linear Marbleslides Challenge.

You will be investigating the features of linear graphs whilst trying to catch as many stars as possible.

You can join the activity without signing in or entering your real name.