

## Gradients of straight lines

### Starter

1. **(Review of last lesson)** Imani is a phenomenal rugby player in 8 games she scored 17 tries. Given that each try is worth 5 points, calculate her average points per game.

**Working:** Total points =  $17 \times 5 = 85$   
Points per game =  $\frac{85}{8} = 10.625 = 10\frac{5}{8}$

### E.g. 1 Copy and complete:

- (a) A gradient of 4 means that for every...  
(b) A gradient of  $-5$  means that for every...  
(c) A gradient of  $-m$  means that for every...  
(d) A gradient of  $\frac{b}{a}$  means that for every...

- Working:** (a) ...unit across to the right, the line goes 4 units up.  
(b) ...unit across to the right, the line goes 5 units down.  
(c) ...unit across to the right, the line goes  $m$  units down.  
(d) ... $a$  units across to the right, the line goes  $b$  units up.

### E.g. 2 State the gradient for the following lines.

- (a) For every unit it goes across to the right, the line goes 6 units up  
(b) For every unit it goes across to the right, the line goes 3 units down.  
(c) For every 2 units it goes across to the right, the line goes down 1 unit.  
(d) For every 4 units it goes across to the right, the line goes up 1 unit.  
(e) For every 3 units it goes across to the right, the line goes 7 units up.  
(f) The line goes down 8 units for every 5 units it goes across to the right.

- Working:** (a) 6  
(b)  $-3$   
(c)  $-\frac{1}{2}$   
(d)  $\frac{1}{4}$   
(e)  $\frac{7}{3}$   
(f)  $-\frac{8}{5}$

**E.g. 3** Write a statement for each of these gradients.

- (a)  $-10$     (b)  $\frac{4}{9}$     (c)  $-\frac{12}{5}$

**Working:** (a) For every unit across to the right, the line goes 10 units down.  
(b) For every 9 units across to the right, the line goes 4 units up.  
(c) For every 5 units across to the right, the line goes 12 units down.

**E.g. 4** Decide whether these statements are true or false:

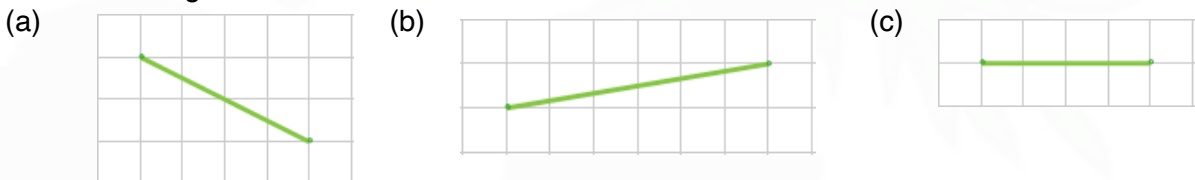
- (a) A line with gradient 2 is steeper than a line with gradient 3.  
(b) A line with gradient  $-6$  is steeper than a line with gradient  $-5$ .  
(c) A line with gradient 7 is steeper than a line with gradient  $-8$ .

**Working:** (a) False.  
(b) True.  
(c) False.

**E.g. 5** State the gradient of the line which moves across *run* units for every *rise* units it moves up.

**Working:** Gradient =  $\frac{\text{rise}}{\text{run}}$

**E.g. 6** Calculate the gradient of these lines:



**Working:** (a) Gradient =  $\frac{\text{rise}}{\text{run}} = \frac{-2}{4} = -\frac{1}{2}$

(b) Gradient =  $\frac{\text{rise}}{\text{run}} = \frac{1}{6}$

(c) Gradient =  $\frac{\text{rise}}{\text{run}} = \frac{0}{4} = 0$

**N.B.** Horizontal lines have a gradient of zero.

### Exercise

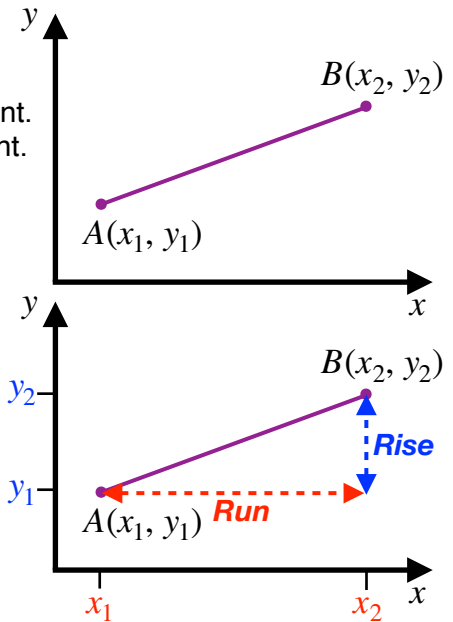
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**E.g. 7** Consider the line segment between the points  $A(x_1, y_1)$  and  $B(x_2, y_2)$

- State an expression for the rise of the line segment.
- State an expression for the run of the line segment.
- Hence state an expression for the gradient of the line.

**Working:**

- Rise =  $y_2 - y_1$
- Run =  $x_2 - x_1$
- Gradient =  $\frac{y_2 - y_1}{x_2 - x_1}$



**E.g. 8** Find the gradient of the line passing through the following pairs of points:

- (2, 4) and (5, 19)
- (-3, 2) and (5, 4)

**Working:**

- Label the points:** (2, 4) (5, 19)  
 $(x_1, y_1)$   $(x_2, y_2)$

**Sub. into formula:** Gradient =  $\frac{y_2 - y_1}{x_2 - x_1} = \frac{19 - 4}{5 - 2} = \frac{15}{3} = 5$
- Label the points:** (-3, 2) (5, 4)  
 $(x_1, y_1)$   $(x_2, y_2)$

**Sub. into formula:** Gradient =  $\frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 2}{5 - -2} = \frac{2}{8} = \frac{1}{4}$

**E.g. 9\*** The gradient of a line passing through the point (-3, 9) and (p, 4) is 6. Find the value of p.

**Working:**

**Label the points:** (-3, 9) (p, 4)  
 $(x_1, y_1)$   $(x_2, y_2)$

**Sub. into formula:** Gradient =  $\frac{y_2 - y_1}{x_2 - x_1}$ :  $6 = \frac{4 - 9}{p - -3}$

$$6 = \frac{-5}{p + 3}$$

**Multiply by (p + 3):**  $6(p + 3) = -5$

**Expand the brackets:**  $6p + 18 = -5$

**Subtract 18 from both sides:**  $6p = -23$

$$p = -\frac{23}{6}$$

**Video:** [Gradient of a line Gradient between two points](#)

[Solutions to Starter and E.g.s](#)

**Exercise**

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Worksheet: Describing Steepness Gradient