

Equation of the line.

Log Tables pg 18

$$\left. \begin{aligned} y &= mx + c \\ y - y_1 &= m(x - x_1) \end{aligned} \right\} \text{given formula.}$$

$m$  = slope (coefficient of  $x$ ).  
 $c$  = cuts the  $y$  axis ( $y$  intercept)

Eg 1) Find the slope and  $y$  intercept of the following.

①  $x + y - 4 = 0$       ②  $3x - 4y + 6 = 0$

Rearrange in the form  $y = mx + c$   
 get  $y$  on its own.

$$\begin{array}{l|l} -x & x + y - 4 = 0 \\ +4 & y - 4 = -x \\ & y = -x + 4 \end{array}$$

$m$  = slope = 1  
 $y$  intercept = 4  
 (0, 4)

$$\begin{array}{l|l} +4y & 3x - 4y + 6 = 0 \\ & 3x + 6 = 4y \\ & \frac{3x + 6}{4} = y \end{array}$$

Slope =  $\frac{3}{4}$        $c = \frac{6}{4} = \frac{3}{2}$

$(0, \frac{3}{2})$  cuts  $y$  axis.

Equation of a line

$y - y_1 = m(x - x_1)$  : You need a point  $(x_1, y_1)$   
 you need a slope ( $m$ ).  
 Sub values into the formula.

Eg 1) Find the equation of the line which contains the point  $(3, 4)$  and has a slope of 2

$(3, 4)$  slope = 2 ( $m$ )  $\Rightarrow$  sub into formula

$$y - y_1 = m(x - x_1)$$

$$y - 4 = 2(x - 3)$$

$$y - 4 = 2x - 6$$

$$\begin{array}{l|l} -y & y - 4 = 2x - 6 \\ +4 & -4 = 2x - y - 6 \\ & 0 = 2x - y - 2 \end{array}$$

form  
 $ax + by + c = 0$   
 $2x - y + 2 = 0$

form  
 $y = mx + c$   
 $y = 2x - 2$

$$\begin{array}{l|l} & y - 4 = 2x - 6 \\ +4 & y = 2x - 2 \end{array}$$

Classwork pg 61 Q 1 part (ii)  $\rightarrow$  (v)



**Coordinate Geometry - The Line** chapter 3

*Key words*

Cartesian plane	origin	axis	quadrant	vertex	horizontal
vertical	slope	parallel	perpendicular	positive	negative
linear equation	area	translation	intersection	collinear	

Section 3.5 The equation of a line

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### Example 1

Find the equation of the line containing the point  $(-3, 2)$  and whose slope is  $\frac{2}{3}$ .

The equation of the line through  $(x_1, y_1)$  with slope  $m$  is found by using  
 $y - y_1 = m(x - x_1)$

$$m = \frac{2}{3}$$

$$(x_1, y_1) = (-3, 2)$$

Equation of the line is:  $y - y_1 = m(x - x_1)$

$$y - 2 = \frac{2}{3}(x + 3)$$

$$y - 2 = \frac{2x}{3} + \frac{6}{3}$$

Multiply each term by 3:

$$3y - 6 = 2x + 6$$

Bring all terms to right-hand side.

$$2x - 3y + 12 = 0$$

$\therefore$  the equation of the line is:  $2x - 3y + 12 = 0$

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### Example 2

Find the equation of the line containing the points  $(-2, 3)$  and  $(3, 1)$ .

The equation of the line through  $(x_1, y_1)$  with slope  $m$  is found by using  
 $y - y_1 = m(x - x_1)$

$$\begin{matrix} (-2, 3) & (3, 1) \\ \downarrow & \downarrow \\ (x_1, y_1) & (x_2, y_2) \end{matrix}$$

Slope of line:  $m = \frac{y_2 - y_1}{x_2 - x_1}$

$$= \frac{1 - 3}{3 - (-2)} = \frac{-2}{5}$$

We now use the slope  $-\frac{2}{5}$  and the point  $(-2, 3)$ ... you may use either of the 2 points

Equation of line:  $y - y_1 = m(x - x_1)$

$$y - 3 = -\frac{2}{5}(x + 2)$$

$$y - 3 = -\frac{2x}{5} - \frac{4}{5}$$

$$5y - 15 = -2x - 4 \dots \text{ multiply each term by 5.}$$

$\Rightarrow 2x + 5y - 11 = 0$  is the equation of the line.

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### Exercise 3.5

The equation of the line through  $(x_1, y_1)$  with slope  $m$  is found by using  
 $y - y_1 = m(x - x_1)$

1. Find the equations of the following lines, given the slope and a point on the line in each case:

- (i) slope = 2; point =  $(3, 4)$       (ii) slope = 4; point =  $(1, 5)$   
 (iii) slope = 5; point =  $(-2, 3)$       (iv) slope =  $-\frac{3}{5}$ ; point =  $(-2, 0)$   
 (v) slope = -5; point =  $(-3, -2)$       (vi) slope =  $\frac{2}{3}$ ; point =  $(3, -1)$ .

ii)  $y - 5 = 4(x - 1)$   
 $y - 5 = 4x - 4$   
 $[y = mx + c]$   
 $y = 4x + 1$   
 $ax + by + c = 0$   
 $4x - y + 1 = 0$

ii)  $y - 3 = 5(x + 2)$   
 $y - 3 = 5x + 10$   
 $-y \quad -3 = 5x - y + 10 \quad -y$   
 $+3 \quad 0 = 5x - y + 13 \quad +3$   
 $[y = mx + c]$   
 $y = 5x + 13$

vi)  $y + 1 = \frac{2}{3}(x - 3)$   
 $3y + 3 = 2x - 6$   
 $0 = 2x - 3y - 9$

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### Exercise 3.5

The equation of the line through  $(x_1, y_1)$  with slope  $m$  is found by using  
 $y - y_1 = m(x - x_1)$

H/W

2. Find the equations of the following lines, given the slope and a point on the line in each case:

- (i) slope =  $\frac{3}{2}$ ; point =  $(1, -4)$       (ii) slope =  $\frac{3}{5}$ ; point =  $(-4, 2)$ .

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### Exercise 3.5

The equation of the line through  $(x_1, y_1)$  with slope  $m$  is found by using  
 $y - y_1 = m(x - x_1)$

3. Find the equation of the line through  $(-2, 3)$  with slope

- (i) 4      (ii) -2      (iii)  $\frac{3}{4}$       (iv)  $-\frac{2}{3}$

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### Exercise 3.5

The equation of the line through  $(x_1, y_1)$  with slope  $m$  is found by using  
 $y - y_1 = m(x - x_1)$

4. Find the equation of the line through  $(0, 0)$  and whose slope is -3.

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### Exercise 3.5

The equation of the line through  $(x_1, y_1)$  with slope  $m$  is found by using  
 $y - y_1 = m(x - x_1)$

5. Find the equation of the line through  $(0, 0)$  and whose slope is

- (i) 3      (ii) -5      (iii)  $\frac{1}{3}$       (iv)  $-\frac{3}{2}$

What do you notice about the equation of each of these lines?

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The equation of the line through  $(x_1, y_1)$  with slope  $m$  is found by using  
 $y - y_1 = m(x - x_1)$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

6. Find the slope of the line through  $A(3, -4)$  and  $B(1, 2)$ .  
 Hence find the equation of the line  $AB$ .

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The equation of the line through  $(x_1, y_1)$  with slope  $m$  is found by using  
 $y - y_1 = m(x - x_1)$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

7. Find the equations of the lines through the following pairs of points:  
 (i)  $(2, 3)$  and  $(4, 6)$                       (ii)  $(-1, 2)$  and  $(2, -4)$   
 (iii)  $(-5, 1)$  and  $(1, 0)$                   (iv)  $(-2, 3)$  and  $(3, -1)$   
 (v)  $(2, 7)$  and  $(0, 5)$                       (vi)  $(-3, -5)$  and  $(-1, -1)$ .

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The equation of the line through  $(x_1, y_1)$  with slope  $m$  is found by using  
 $y - y_1 = m(x - x_1)$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

The midpoint of the line segment joining  $A(x_1, y_1)$  and  $B(x_2, y_2)$  is  
 $\left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$

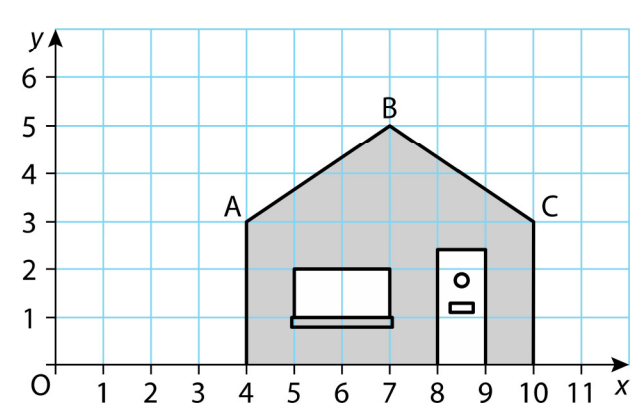
8. Find the equation of the line through  $(-2, 3)$  and the midpoint of the line segment joining  $(1, -3)$  and  $(3, -1)$ .

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The equation of the line through  $(x_1, y_1)$  with slope  $m$  is found by using  
 $y - y_1 = m(x - x_1)$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

9. The given diagram shows the gable-end of a house.



Use the grid to write down

- (i) the coordinates of the points marked  $A$ ,  $B$  and  $C$ .  
 (ii) the slope of  $AB$   
 (iii) the equation of  $AB$ .

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#### Exercise 3.5 Answers

1. (i)  $2x - y - 2 = 0$     (ii)  $4x - y + 1 = 0$   
 (iii)  $5x - y + 13 = 0$     (iv)  $3x + y + 6 = 0$   
 (v)  $5x + y + 17 = 0$     (vi)  $2x - 3y - 9 = 0$
2. (i)  $3x - 4y - 19 = 0$     (ii)  $3x - 5y + 22 = 0$
3. (i)  $4x - y + 11 = 0$     (ii)  $2x + y + 1 = 0$   
 (iii)  $3x - 4y + 18 = 0$     (iv)  $2x + 3y - 5 = 0$
4.  $3x + y = 0$
5. (i)  $3x - y = 0$                       (ii)  $5x + y = 0$   
 (iii)  $x - 3y = 0$                       (iv)  $3x + 2y = 0$
6.  $-3$ ;  $3x + y - 5 = 0$
7. (i)  $3x - 2y = 0$                       (ii)  $2x + y = 0$   
 (iii)  $x + 6y - 1 = 0$                   (iv)  $4x + 5y - 7 = 0$   
 (v)  $x - y + 5 = 0$                       (vi)  $2x - y + 1 = 0$
8.  $5x + 4y - 2 = 0$
9. (i)  $A(4, 3)$ ,  $B(7, 5)$ ,  $C(10, 3)$   
 (ii)  $\frac{2}{3}$                                       (iii)  $2x - 3y + 1 = 0$

Answers