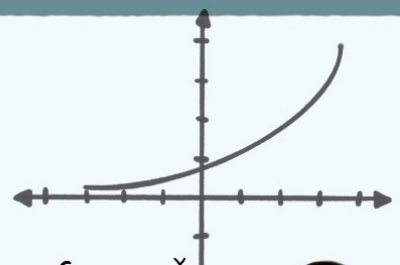
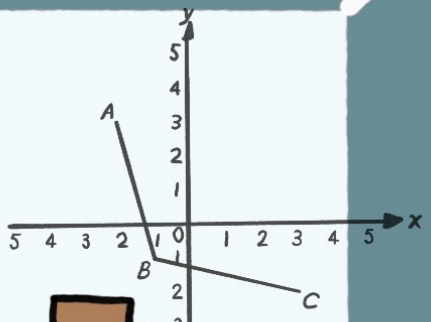
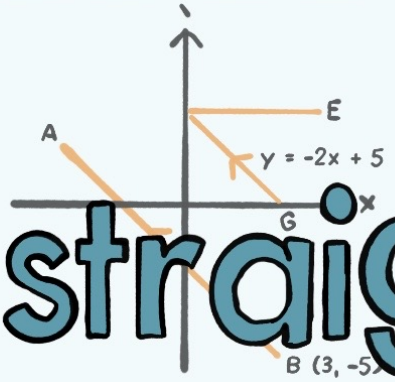
The Maths Society







straight line

$y = mx + c$

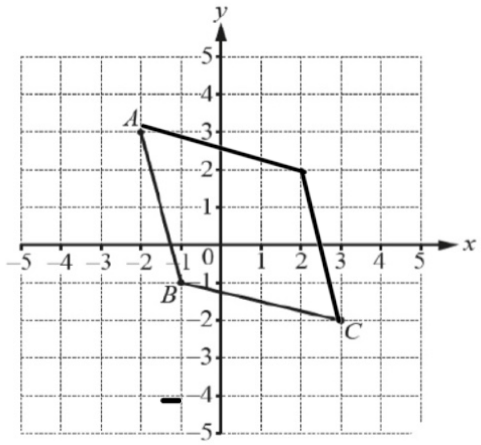
$y = -2x + 1$

Climbing

$F(X) =$

$F'(X) =$

Question 1



The diagram shows two sides of a rhombus $ABCD$.

(a) Write down the co-ordinates of A. [1]

$(-2, 3)$

(b) Complete the rhombus $ABCD$ on the grid. [1]

Question 2

$y = mx + c$

Find the value of y when $m = -2$, $x = -7$ and $c = -3$. [2]

$y = (-2)(-7) - 3$

$= +14 - 3$

$= 11$

Question 3

The point A has co-ordinates $(-4, 6)$ and the point B has co-ordinates $(7, -2)$. [3]

Calculate the length of the line AB.

$\text{length} = \sqrt{(-2-6)^2 + (7+(1))^2}$

$= \sqrt{185} = 13.6$

Question 4

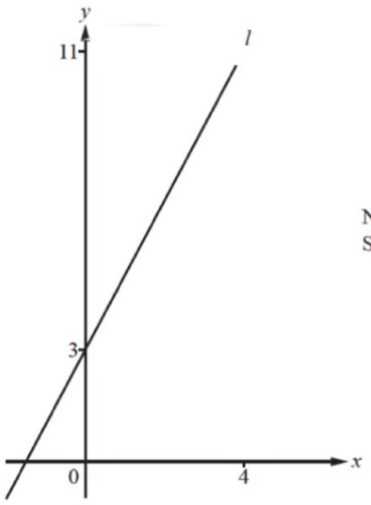
Find the equation of the line passing through the points with co-ordinates $(5, 9)$ and $(-3, 13)$. [3]

$m = \frac{13-9}{-3-5} = -\frac{1}{2}$

$y - 13 = \frac{-1}{2}(x + 3)$

$y = -\frac{1}{2}x + \frac{23}{2}$

Question 5



NOT TO SCALE

The diagram shows the straight line, l, which passes through the points (0, 3) and (4, 11).

(a) Find the equation of line l in the form $y = mx + c$.

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{11-3}{4-0} = 2$

$y - 3 = (2x)$

$y = 2x + 3$ [3]

(b) Line p is perpendicular to line l.

Write down the gradient of line p. [1]

$m \times m_\perp = -1$

$m_\perp = -\frac{1}{2}$

Question 6

A (5, 23) and B (–2, 2) are two points.

(a) Find the co-ordinates of the midpoint of the line AB. [2]

$\text{midpoint} = \left(\frac{5-2}{2}, \frac{23+2}{2}\right)$

$= \left(\frac{3}{2}, \frac{25}{2}\right)$

(b) Find the equation of the line AB. [3]

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

$= \frac{2-23}{-2-5} = \frac{-21}{-7} = 3$

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

$y = 3x + 6 + 2$

$y = 3x + 8$

(c) Show that the point (3, 17) lies on the line AB. [1]

$y = 3(3) + 8$

$= 17$ $\therefore$ (3, 17) lies on AB.

Question 7

Find the equation of the line passing through the points (0, –1) and (3, 5). [3]

$m = \frac{5+1}{3-0} = 2$

$y + 1 = 2x$

$y = 2x - 1$

Question 8

(a) The two lines $y = 2x + 8$ and $y = 2x - 12$ intersect the x-axis at P and Q.

Work out the distance PQ.

$y = 0$

$2x + 8 = 0$ | $2x - 12 = 0$

$x = -4$ | $x = 6$

$y = 0$ | $y = 0$

$\longrightarrow$ Distance $= 6 - (-4)$

$= 10$ [2]

(b) Write down the equation of the line with gradient -4 passing through (0, 5).

$m = -4$

$y - 5 = -4x$

$y = -4x + 5$ [2]

(c) Find the equation of the line parallel to the line in **part (b)** passing through (5, 4).

$\rightarrow$ same gradient

$y - 4 = -4(x - 5)$

$= -4x + 20 + 4 = -4x + 24$

$\therefore y = -4x + 24$

Question 9

(a) Find the co-ordinates of the midpoint of the line joining $A(-8, 3)$ and $B(-2, -3)$.

midpoint $= \left(\frac{-8-2}{2}, \frac{3-3}{2}\right)$ [2]

$= (-5, 0)$

(b) The line $y = 4x + c$ passes through (2, 6).

Find the value of c.

$6 = 4(2) + c$ [1]

$6 = 8 + c$

$-2 = c$

$\therefore c = -2$

$y = 4x - 2$

(c) The lines $5x = 4y + 10$ and $2y = kx - 4$ are parallel.

Find the value of k.

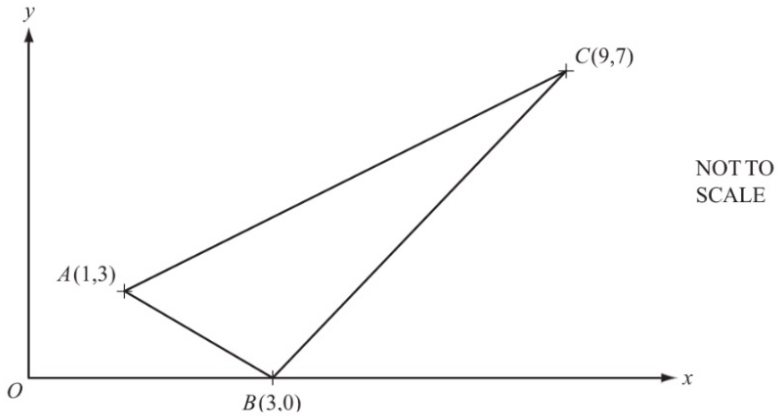
$y = \frac{5x}{4} - \frac{10}{4}$

$y = \frac{kx}{2} - \frac{4}{2}$ [2]

$\frac{k}{2} = \frac{5}{4}$

$k = \frac{10}{4} = 2.5$

Question 1



The co-ordinates of A, B and C are shown on the diagram, which is not to scale.

(a) Find the length of the line AB. [3]

$\text{length}_{AB} = \sqrt{(0-3)^2 + (3-1)^2}$

$= \sqrt{13} = 3.61$

(b) Find the equation of the line AC. [3]

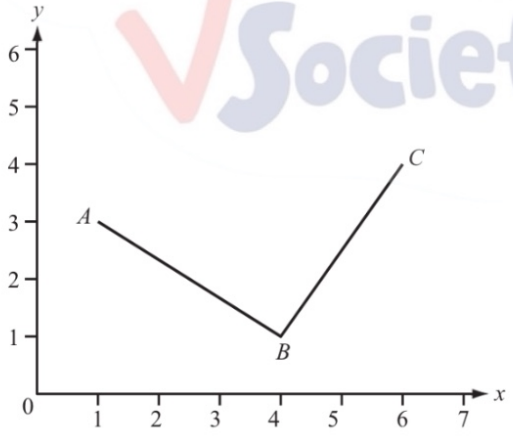
$m = \frac{7-3}{9-1} = \frac{4}{8} = \frac{1}{2}$

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

$y = \frac{1}{2}x - \frac{1}{2} + 3$

$y = \frac{1}{2}x + \frac{5}{2}$

Question 2



$A(1, 3)$, $B(4, 1)$ and $C(6, 4)$ are shown on the diagram.

(b) Work out the equation of the line BC. [3]

$m = \frac{4-1}{6-4} = \frac{3}{2}$

$y - 1 = \frac{3}{2}(x-4)$

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

(c) ABC forms a right-angled isosceles triangle of area 6.5 cm^2.

Calculate the length of AB. [2]

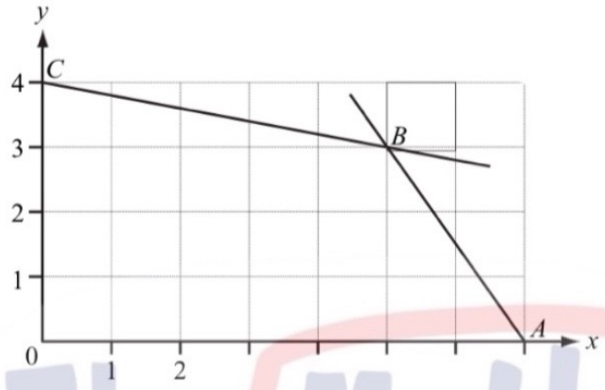
$\text{length}_{AB} = \sqrt{(1-3)^2 + (4-1)^2} = \sqrt{13} = 3.61$

Question 3

Find the length of the straight line from Q (−8, 1) to R (4 , 6). [3]

$$\text{length} = \sqrt{(6-1)^2 + (4+8)^2}$$
$$= 13$$

Question 4



$A = (7, 0)$
$B = (5, 3)$
$C = (0, 4)$

The lines AB and CB intersect at B.

(a) Find the co-ordinates of the midpoint of AB. [1]

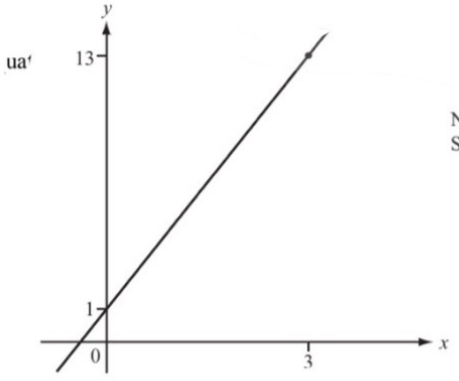
$$\text{midpoint}_{AB} = \left(\frac{7+5}{2}, \frac{3}{2}\right)$$
$$= (6, 1.5)$$

(b) Find the equation of the line CB. [3]

$$m = \frac{4-3}{-5}$$
$$= \frac{1}{-5}$$

$$y - 4 = -\frac{1}{5}x$$
$$y = -\frac{1}{5}x + 4$$

Question 5



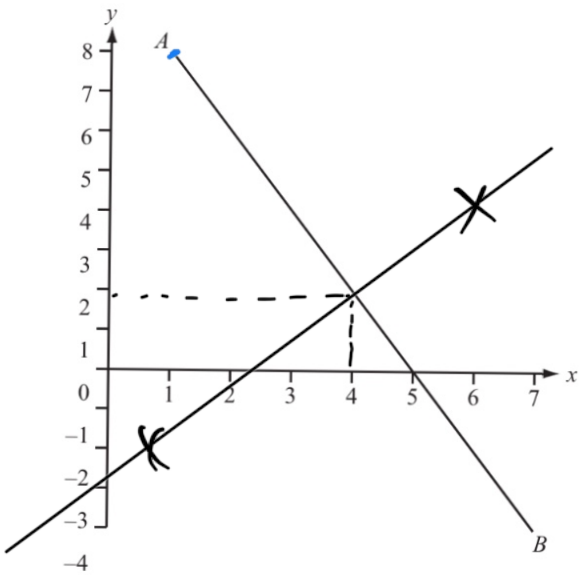
The diagram shows the straight line which passes through the points (0, 1) and (3, 13).

Find the equation of the straight line. [3]

$$m = \frac{13-1}{3} = \frac{12}{3} = 4$$

$$y - 1 = 4x$$
$$y = 4x + 1$$

Question 6



(a) **Using a straight edge and compasses only**, construct the perpendicular bisector of AB on the diagram above. [2]

(b) Write down the co-ordinates of the midpoint of the line segment joining $A(1, 8)$ to $B(7, -4)$.

(4, 2) [1]

(c) Find the equation of the line AB.

$\sqrt{(4-8)^2+(7-1)^2}$ [3]

$= 6\sqrt{5} = 13.42$

Question 7

(a) The line $y = 2x + 7$ meets the y-axis at A.

$4x = 0$

Write down the co-ordinates of A.

$y = 7 \quad (0, 7)$ [1]

(b) A line parallel to $y = 2x + 7$ passes through $B(0, 3)$. 1

(i) Find the equation of this line.

$m_{//} = 2$

$y - 3 = 2x \quad , y = 2x + 3$ [2]

(ii) C is the point on the line $y = 2x + 1$ where $x = 2$.

Find the co-ordinates of the midpoint of BC.

$y = 4 + 1 = 5 \quad (2, 5)$ [3]

midpoint $= \left(\frac{2}{2}, \frac{3+5}{2}\right) = (1, 4)$

Question 8

Find the equation of the straight line which passes through the points (0, 8) and (3, 2).

$m = \frac{2-8}{3-0} = \frac{-6}{3} = -2$ $\quad y - 8 = -2x$ $\quad y = -2x + 8$ [3]

Question 1

The points (2, 5), (3, 3) and (k, 1) all lie in a straight line.

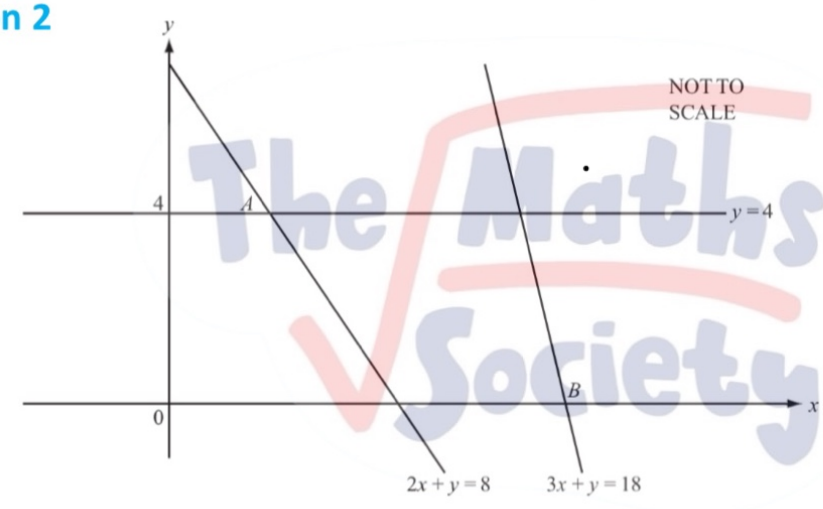
(a) Find the value of k. [1]

$k = 4$

(b) Find the equation of the line. [3]

$m = \frac{3-5}{3-2} = -2$ $\quad y - 3 = -2(x - 3)$ $\quad y = -2x + 9$

Question 2



(a) The line $y = 4$ meets the line $2x + y = 8$ at the point A. [1]
Find the co-ordinates of A.

$2x + 4 = 8$ $\quad x = 2$ $\quad (2, 4)$

(b) The line $3x + y = 18$ meets the x axis at the point B. [1]
Find the co-ordinates of B. $y = 0$

$3x = 18$ $\quad x = 6$ $\quad (6, 0)$

(c) (i) Find the co-ordinates of the mid-point M of the line joining A to B. [1]

$\left(\frac{2+6}{2}, \frac{4}{2}\right) = (4, 2)$

(ii) Find the equation of the line through M parallel to $3x + y = 18$. [2]

$y = -3x + 18$

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

$y = -3x + 14$

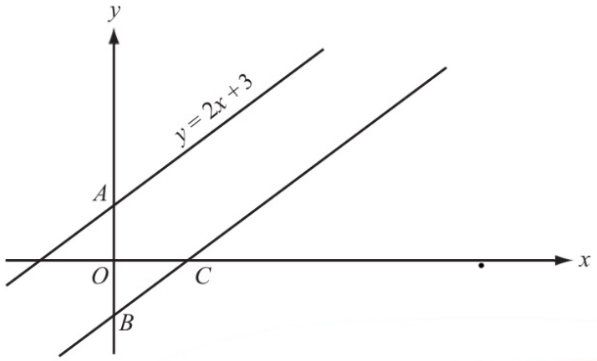
Question 3

Find the length of the line joining the points $A(-4, 8)$ and $B(-1, 4)$. [2]

length $= \sqrt{(4-8)^2 + (-1+4)^2}$

$= 5$

Question 4



NOT TO SCALE

The distance AB is 7 units.

(a) Write down the equation of the line through B which is parallel to $y = 2x + 3$. [2]

$B = 3 - 7 = -4$

$(0, -4)$

$y = 2x - 4$

(b) Find the co-ordinates of the point C where this line crosses the x axis. [1]

$0 = 2x - 4$

$\frac{4}{2} = x$

$x = 2 \quad (2, 0)$

Question 5

The equation of a straight line can be written in the form $3x + 2y - 8 = 0$.

(a) Rearrange this equation to make y the subject. [2]

$2y = -3x + 8$

$y = \frac{-3x + 8}{2}$

(b) Write down the gradient of the line. [1]

$-\frac{3}{2}$

(c) Write down the co-ordinates of the point where the line crosses the y axis. [1]

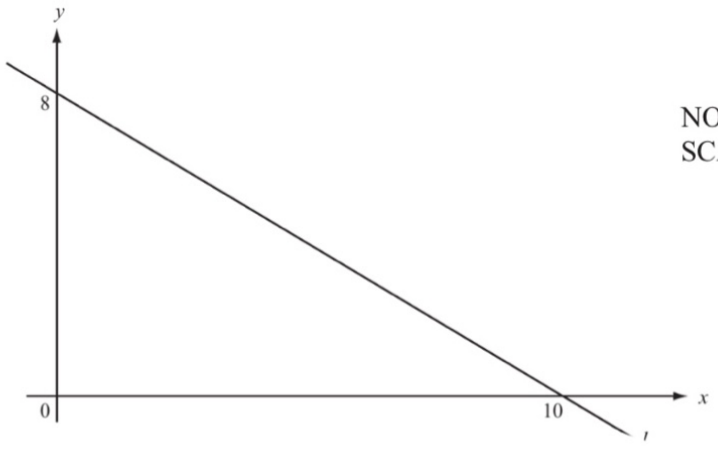
$-3x + 8 = 0$

$-3x = -8$

$x = \frac{8}{3}$

$(\frac{8}{3}, 0)$

Question 6



NOT TO SCALE

The line l passes through the points (10, 0) and (0, 8) as shown in the diagram.

(a) Find the gradient of the line as a fraction in its simplest form. [1]

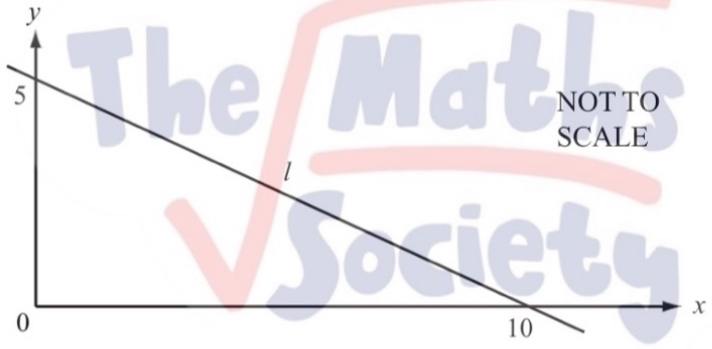
$m = \frac{8}{-10} = \frac{4}{-5}$

(b) **Write down** the equation of the line parallel to l which passes through the origin. [1]

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

(c) Find the equation of the line parallel to l which passes through the point (3, 1). [2]

Question 7



NOT TO SCALE

(a) Calculate the gradient of the line l. [2]

$m = \frac{5}{-10} = -\frac{1}{2}$

(b) Write down the equation of the line l. [2]

$y - 5 = -\frac{1}{2}x$

$y = -\frac{1}{2}x + 5$

Question 8

The straight line graph of $y = 3x - 6$ cuts the x-axis at A and the y-axis at B.

$y = 0$ $x = 0$

(a) Find the coordinates of A and the coordinates of B. [2]

$3x - 6 = 0$ $y = 3(0) - 6 = -6$

$x = 2$ $B(0, -6)$

$A(2, 0)$

(b) Calculate the length of AB. [2]

$\text{length} = \sqrt{(-6)^2 + (2)^2} = 6.32$

(c) M is the mid-point of AB.
Find the coordinates of M. [1]

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$\text{midpoint} = \left(\frac{2}{2}, \frac{-6}{2}\right) = (1, -3)$

Question 1

A line has gradient 5.
M and N are two points on this line.
M is the point $(x, 8)$ and N is the point $(k, 23)$.

Find an expression for x in terms of k. [3]

$m = 5$

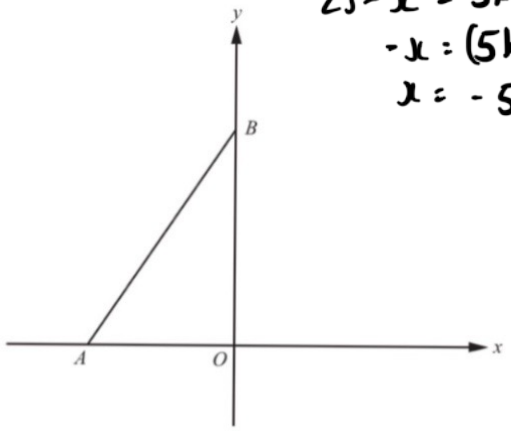
$\frac{23-x}{k-8} = 5$

$23 - x = 5k - 40$

$-x = (5k - 40 - 23)$

$x = -5k + 63$

Question 2



NOT TO SCALE

A is the point $(-2, 0)$ and B is the point $(0, 4)$.

(a) Find the equation of the straight line joining A and B. [3]

$m = \frac{4}{+2} = 2$ $\quad y - 0 = +2(x+2)$

$y = x + 4$

(b) Find the equation of the perpendicular bisector of AB. [4]

$m_{\perp} = -\frac{1}{2}$ $\quad mid = \left(\frac{-2}{2}, \frac{4}{2}\right) = (-1, 2)$

$y - 2 = -\frac{1}{2}(x+1)$

$y = -\frac{1}{2}x + \frac{3}{2}$

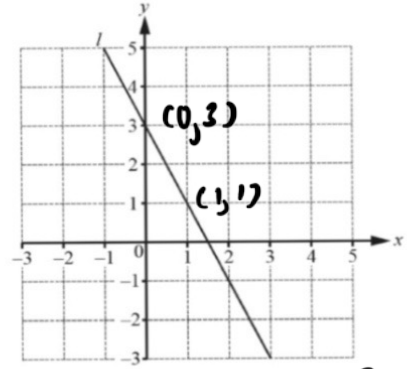
Question 3

A is the point (8, 3) and B is the point (12, 1).

Find the equation of the line, perpendicular to the line AB, which passes through the point (0, 0). [3]

$m = \left(\frac{1-3}{12-8}\right) = \frac{-2}{4} = -\frac{1}{2}$ $\quad m_{\perp} = 2$ $\quad y = 2x$

Question 4



(a) Find the equation of the line l.
Give your answer in the form $y = mx + c$. [3]

$m = \frac{1-3}{3-0} = -2$

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

(b) A line perpendicular to the line l passes through the point $(3, -1)$.

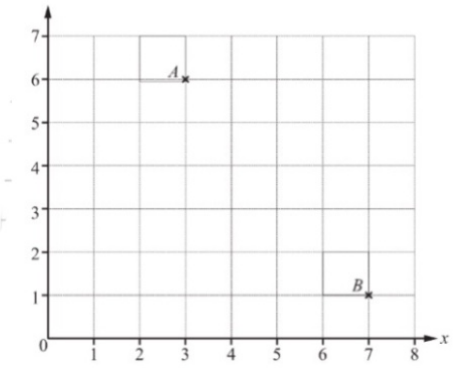
Find the equation of this line. [3]

$m = \frac{1}{2}$

$y + 1 = \frac{1}{2}x - (3 \times \frac{1}{2})$

$y = \frac{1}{2}x - \frac{5}{2}$

Question 5



Point A has co-ordinates (3, 6). [1]

(a) Write down the co-ordinates of point B.

(7, 1)

[2]

(b) Find the gradient of the line AB.

$m = \frac{1-6}{7-3} = \frac{-5}{4}$

(c) Find the equation of the line that [3]

- is perpendicular to the line AB

and

- passes through the point (0, 2).

$m_1 = \frac{4}{5}$

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

$y = \frac{4}{5}x + 2$

Question 1

A is the point (4, 1) and B is the point (10, 15). [6]

Find the equation of the perpendicular bisector of the line AB.

$\text{mid} = \left(\frac{4+10}{2}, \frac{1+15}{2}\right) = (7, 8)$

$m = \frac{15-1}{10-4} = \frac{14}{6} = \frac{7}{3}$

$m_1 = -\frac{3}{7}$

$y - 8 = -\frac{3}{7}(x - 7)$

$y = -\frac{3}{7}x + 3 + 8$

$y = -\frac{3}{7}x + 11$

Question 2

Find the equation of the line that

- is perpendicular to the line $y = 3x - 1$

and

- passes through the point (7, 4). [3]

$m_1 = -\frac{1}{3}$

$y - 4 = \frac{1}{3}(x - 7)$

$y = -\frac{1}{3}x + \frac{19}{3}$

Question 3

Find the co-ordinates of the mid-point of the line joining the points $A(2, -5)$ and $B(6, 9)$. [2]

$\text{mid}_{AB} = \left(\frac{2+6}{2}, -\frac{5+9}{2}\right)$

$= (4, 2)$

Question 4

A straight line passes through two points with co-ordinates (6, 8) and (0, 5).
Work out the equation of the line. [3]

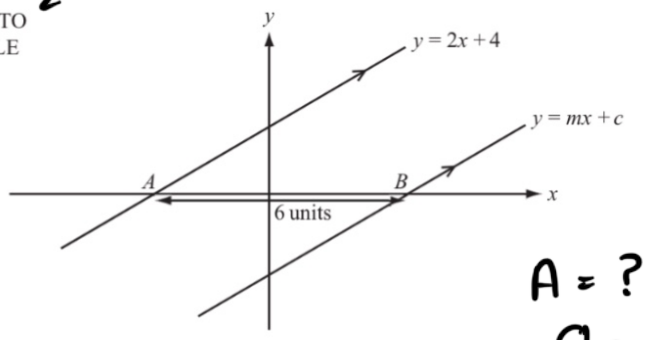
$m = \frac{5-8}{0-6} = \frac{-3}{-6} = \frac{1}{2}$

$y - 5 = \frac{1}{2}x$

$y = \frac{1}{2}x + 5$

Question 5

NOT TO SCALE



The line $y = mx + c$ is parallel to the line $y = 2x + 4$.
The distance AB is 6 units.

Find the value of m and the value of c. [4]

$m = 2$

$A = ?$

$0 = 2x + 4$

$x = -2$

$B = -2 + 6$

$= 4$

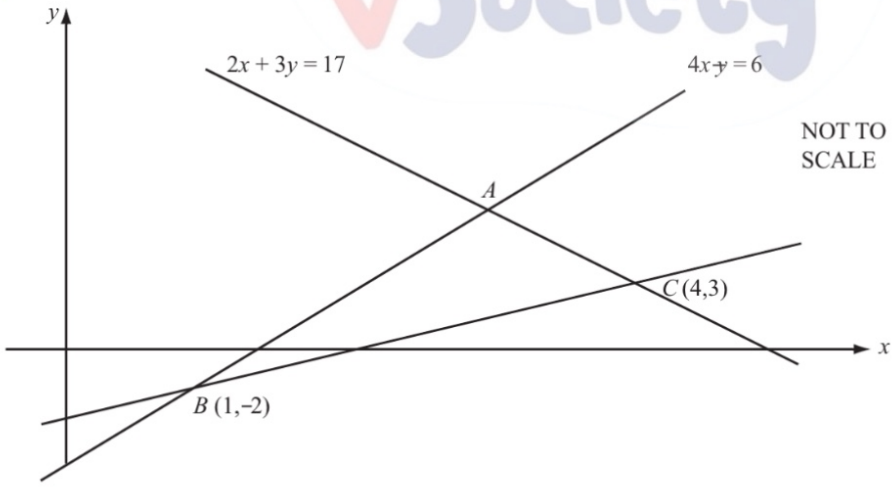
$(4, 0)$

$y = 2(x - 4)$

$y = 2x - 8$

$c = -8$

Question 6



In the diagram, the line AC has equation $2x + 3y = 17$ and the line AB has equation $4x - y = 6$.
The lines BC and AB intersect at $B(1, -2)$.
The lines AC and BC intersect at $C(4, 3)$.

(a) Use algebra to find the coordinates of the point A. [3]

$3y = 17 - 2x$

$y = \frac{17 - 2x}{3}$

$-y = 6 - 4x$

$y = 4x - 6$

$4x - 6 = \frac{17 - 2x}{3}$

$12x - 18 = 17 - 2x$

$14x = 35$

$x = 2.5$

$y = 4(\frac{5}{2}) - 6$

$= 4$

$(\frac{5}{2}, 4)$

(b) Find the equation of the line BC. [3]

$m = \frac{3+2}{4-1} = \frac{5}{3}$

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

$y = \frac{5}{3}x - \frac{11}{3}$

Question 7

The points $A(6,2)$ and $B(8,5)$ lie on a straight line.

(a) Work out the gradient of this line. [1]

$$m = \frac{5-2}{8-6} = \frac{3}{2}$$

(b) Work out the equation of the line, giving your answer in the form $y = mx + c$. [2]

$$y - 2 = \frac{3}{2}(x - 6)$$
$$y = \frac{3}{2}x - 9 + 2$$
$$y = \frac{3}{2}x - 7$$

Question 1

A line joins the points $A(-3, 8)$ and $B(2, -2)$.

(a) Find the co-ordinates of the midpoint of AB. [2]

$$\left(\frac{-3+2}{2}, \frac{8-2}{2}\right) = \left(\frac{1}{2}, 3\right)$$

(b) Find the equation of the line through A and B.
Give your answer in the form $y = mx + c$. [3]

$$m = \frac{-2-8}{2+3} = \frac{-10}{5} = -2$$

$$y - 8 = -2(x + 3)$$
$$y = -2x - 6 + 8$$
$$y = -2x + 2$$

(c) Another line is parallel to AB and passes through the point (0, 7).

Write down the equation of this line. [2]

$$m = -2$$
$$y - 7 = -2x$$
$$y = -2x + 7$$

(d) Find the equation of the line perpendicular to AB which passes through the point (1, 5).
Give your answer in the form $ax + by + c = 0$ where a, b and c are integers. [4]

$$m_1 = \frac{1}{2}$$
$$y - 5 = \frac{1}{2}(x - 1)$$
$$y = \frac{1}{2}x - \frac{1}{2} + 5$$
$$y = \frac{1}{2}x + \frac{9}{2}$$
$$-\frac{1}{2}x + y - \frac{9}{2} = 0 \rightarrow \frac{1}{2}x - y + \frac{9}{2} = 0$$

$x - 2y + 9 = 0$

Question 2

A line joins the points A (–2, –5) and B (4, 13).

(a) Calculate the length AB. [3]

$\sqrt{(13+5)^2+(4+2)^2} = 6\sqrt{10} = 18.97$
≈ 19 unit

(b) Find the equation of the line through A and B.
Give your answer in the form $y = mx + c$. [3]

$m = \frac{13+5}{4+2} = \frac{18}{6} = 3$

$y + 5 = 3(x+2)$
$= 3x + 6 - 5$
$= 3x + 1$

(c) Another line is parallel to AB and passes through the point (0, –5).

Write down the equation of this line. [2]

$y + 5 = 3(x)$ $\quad y = 3x - 5$

(d) Find the equation of the perpendicular bisector of AB. [5]

$m_{\perp} = \frac{-1}{3}$, $\text{mid} = \left(\frac{-2+4}{2}, \frac{13-5}{2}\right) = (1, 4)$

$y - 4 = \frac{-1}{3}x + \frac{1}{3}$

$y = \frac{-1}{3}x + \frac{13}{3}$

Question 3

A line AB joins the points A (3, 4) and B (5, 8).

(a) Write down the co-ordinates of the midpoint of the line AB. [2]

$\text{mid} = \left(\frac{3+5}{2}, \frac{4+8}{2}\right) = (4, 6)$

(b) Calculate the distance AB. [3]

$\sqrt{(8-4)^2+(5-3)^2} = 2\sqrt{5}$ unit

(c) Find the equation of the line AB. [3]

$m = \frac{8-4}{5-3} = \frac{4}{2} = 2$

$y - 8 = 2(x-5)$
$y = 2x - 2$

(d) A line perpendicular to AB passes through the origin and through the point $(6, r)$.

Find the value of r. [3]

$m_{\perp} = -\frac{1}{2}$ $\quad \overline{(0,0)}$

$y = -\frac{1}{2}x$

$y = -\frac{1}{2}(6) = -3$

Question 4

(a) A straight line joins the points (–1, –4) and (3, 8).

(i) Find the midpoint of this line. [2]

$\text{mid}_{AB} \Rightarrow \left(\frac{-1+3}{2}, \frac{-4+8}{2}\right) = (1, 2)$

(ii) Find the equation of this line.
Give your answer in the form $y = mx + c$. [3]

$m = \frac{8+4}{3+1} = \frac{12}{4} = 3$

$y + 4 = 3(x+1)$
$y = 3x - 1$