1 Find the gradient of the straight line with equation $5x + 2y = 7$

Equation of straight line : $y = mx + c$

where m = gradient
c = y-intercept

Rearrange equation to $y = mx + c$

$5x + 2y = 7$

$2y = -5x + 7$

$y = \boxed{-\frac{5}{2}}x + \frac{7}{2}$ (1)

↖ gradient, m

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

.....

(Total for Question 1 is 2 marks)

2 P and Q are two points.

The coordinates of P are $(-1, 6)$

The coordinates of Q are $(5, -4)$

Find an equation of the perpendicular bisector of PQ.
Give your answer in the form $ax + by + c = 0$ where a, b and c are integers.

Midpoint of PQ

Finding midpoint of PQ :

$\left(\frac{-1+5}{2}, \frac{6+(-4)}{2}\right) = (2, 1)$ (1)

Finding gradient of line PQ :

$m = \frac{(-4-6)}{(5-(-1))} = \frac{-10}{6} = \frac{-5}{3}$ (1)

Finding gradient of perpendicular bisector :

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

Finding equation of perpendicular bisector :

known value : point $(2,1)$ and gradient $= \frac{3}{5}$

$y = mx + c$

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

$c = 1 - \frac{6}{5}$

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

Equation : $y = \frac{3}{5}x - \frac{1}{5}$ (1)

$5y = 3x - 1$

$\therefore 3x - 5y - 1 = 0$

$3x - 5y - 1 = 0$ (1)

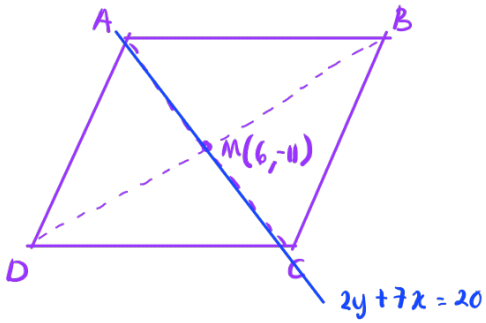
(Total for Question 2 is 6 marks)

3 *ABCD* is a rhombus.

The diagonals, *AC* and *BD*, intersect at the point *M*.
The coordinates of *M* are (6, −11)

The points *A* and *C* both lie on the line with equation $2y + 7x = 20$

Find the exact coordinates of the point where the line through *B* and *D* intersects the *y*-axis.



Equation of straight line AC :

$2y + 7x = 20$

$2y = 20 - 7x$

$y = \frac{-7x + 20}{2}$

$\therefore \quad y = -\frac{7}{2}x + 10$ where gradient $= -\frac{7}{2}$ (1)

Gradient of line BD $= \frac{-1}{m_{AC}} = \frac{2}{7}$ (1)

Equation of line BD :

$y = mx + c$

at M(6, -11) : $-11 = \frac{2}{7}(6) + c$

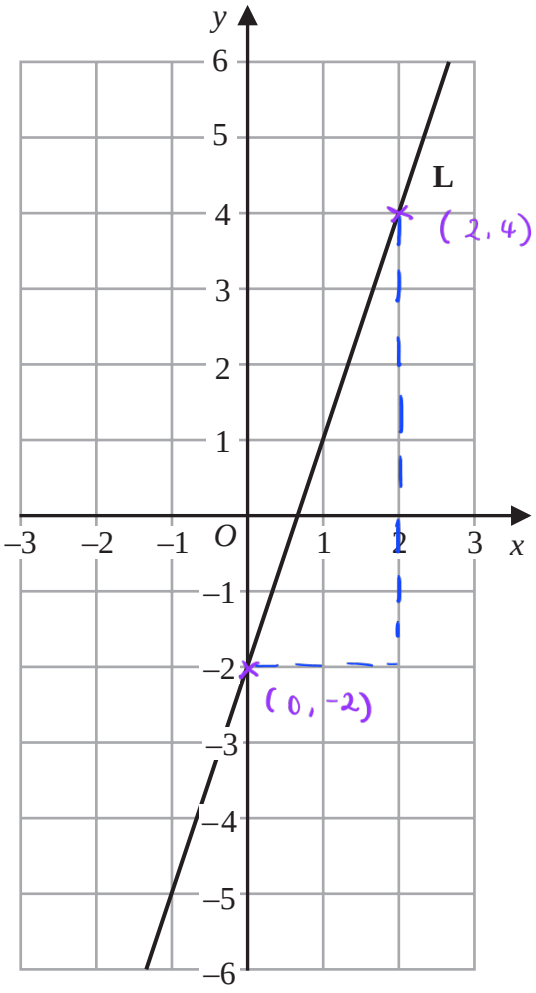
$c = -\frac{89}{7}$ (1)

$\therefore$ Line BD intersect y-axis at $(0, -\frac{89}{7})$ (1)

(0 , $-\frac{89}{7}$)

(Total for Question 3 is 4 marks)

4 The line **L** is shown on the grid.



Find an equation for **L**.

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

y-intercept = −2

$m = \frac{4 - (-2)}{2 - 0} = \frac{6}{2} = 3$ (1)

$y = mx + c$

$y = 3x - 2$ (1)

$y = 3x - 2$

(Total for Question 4 is 2 marks)

5 (a) Write down an equation of a line that is parallel to the line with equation $y = 7 - 4x$

$y = -4x$ (1)

.....

(1)

(Total for Question 5 is 1 marks)

6 The straight line **L** passes through the points (4, −1) and (6, 4)

The straight line **M** is perpendicular to **L** and intersects the *y*-axis at the point (0, 8)

Find the coordinates of the point where **M** intersects the *x*-axis.

gradient of line L : $\frac{4-(-1)}{6-4}$

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

gradient of line M = $\frac{-1}{m_L}$

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

Equation of line M : $y = -\frac{2}{5}x + 8$ ← intersects at y-axis (0,8)

when M intersects x-axis, $y = 0$

$0 = -\frac{2}{5}x + 8$

$\frac{2}{5}x = 8$

$x = \frac{8 \times 5}{2}$

$= 20$ (1)

∴ M intersects x-axis at (20, 0) (1)

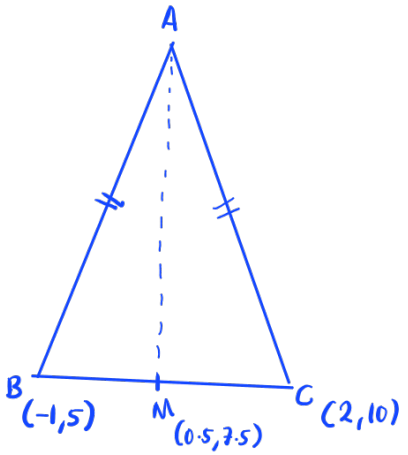
(20 , 0)

(Total for Question 6 is 4 marks)

7 *ABC* is an isosceles triangle with *AB* = *AC*.

B is the point with coordinates (–1, 5)
C is the point with coordinates (2, 10)
M is the midpoint of *BC*.

Find an equation of the line through the points *A* and *M*.
Give your answer in the form $py + qx = r$ where *p*, *q* and *r* are integers.



midpoint of BC = $\left(\frac{2+(-1)}{2}, \frac{10+5}{2}\right)$

$= (0.5, 7.5)$ (1)

gradient of line Bc : $\frac{10-5}{2-(-1)}$

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

gradient of line MA = $\frac{-1}{m_{BC}}$

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

Equation of line MA = $7.5 = -\frac{3}{5}(0.5) + c$

$c = 7.5 + 0.3$

$= \frac{39}{5}$ (1)

$y = -\frac{3}{5}x + \frac{39}{5}$

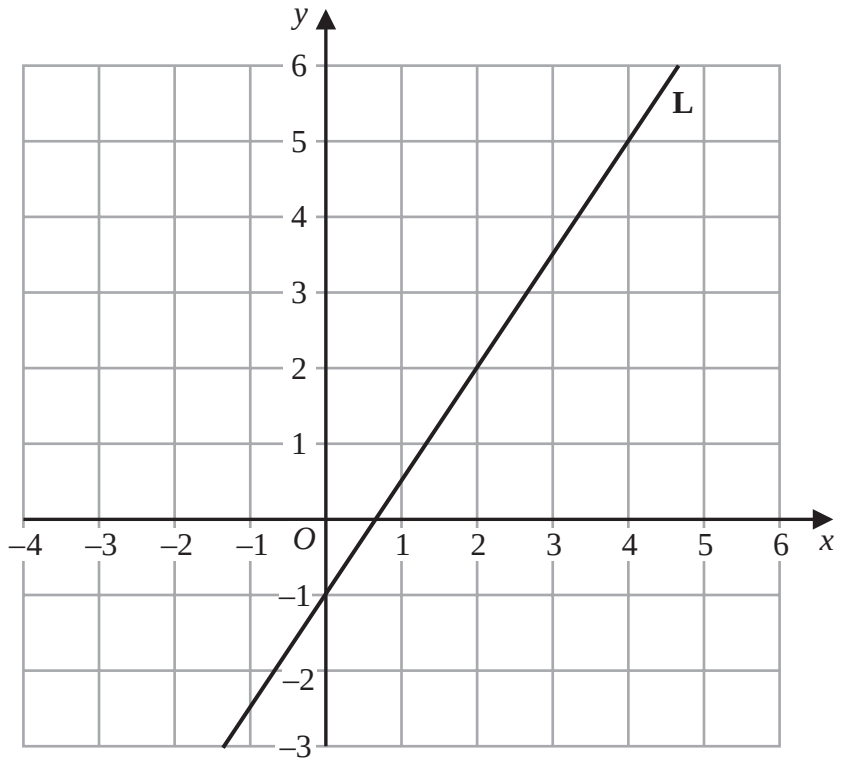
$5y = -3x + 39$

$5y + 3x = 39$ (1)

$5y + 3x = 39$

(Total for Question 7 is 5 marks)

8 Line **L** is drawn on the grid.



Find an equation for **L**
Give your answer in the form $y = mx + c$

c = y-intercept = -1 (1)

gradient : $\frac{5-(-1)}{4-0}$

$= \frac{6}{4} = \frac{3}{2}$ (1)

$y = \frac{3}{2}x - 1$ (1) – $y = mx + c$

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

(Total for Question 8 is 3 marks)

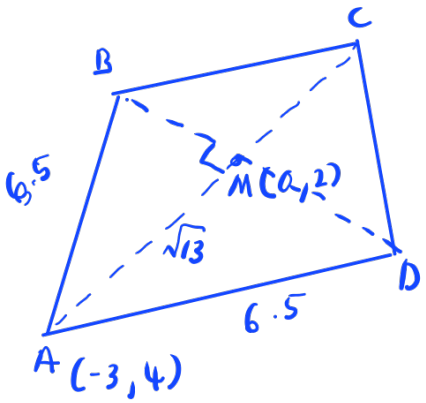
9 *ABCD* is a kite, with diagonals *AC* and *BD*, drawn on a centimetre square grid, with a scale of 1 cm for 1 unit on each axis.

A is the point with coordinates (−3, 4)

The diagonals of the kite intersect at the point *M* with coordinates (0, 2)

Given that *AB* = *AD* = 6.5 cm and the *x* coordinate of *B* is positive,

find the coordinates of the points *B* and *D*.



$m_{AM} = \frac{4-2}{-3} = -\frac{2}{3}$ (1)

$m_{BD} = \frac{3}{2}$

Equation of line BD : $y - 2 = \frac{3}{2}x$

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

$AM = \sqrt{(-3-0)^2 + (4-2)^2} = \sqrt{13}$

$BM = \sqrt{(x-0)^2 + (y-2)^2} = \sqrt{x^2 + (y-2)^2}$ (1)

$AB^2 = AM^2 + BM^2$

$(6.5)^2 = 13 + x^2 + (y-2)^2$ (1)

$\frac{117}{4} = x^2 + (y-2)^2$

$\frac{117}{4} = x^2 + (\frac{3}{2}x)^2$ (1)

$\frac{117}{4} = \frac{13}{4}x^2$ (1)

$x^2 = \frac{117}{13} = 9$

$x = \pm 3$

$x = 3, \ y = 6.5$

$x = -3, \ y = -2.5$

(1)

(3 , 6.5)

(-3 , -2.5)

(Total for Question 9 is 7 marks)

10 (a) Write down an equation of the straight line with gradient -3 and which passes through the point with coordinates (0, 5)

$y = mx + c$

$5 = -3(0) + c$

$c = 5$

$\therefore \quad y = -3x + 5$ (2)

$y = -3x + 5$

(2)

(Total for Question 10 is 2 marks)

11 G is the point on the curve with equation $y = 8x^2 - 14x - 6$ where the gradient is 10
The straight line **Q** passes through the point G and is perpendicular to the tangent at G

Find an equation for **Q**
Give your answer in the form $ax + by + c = 0$ where a, b and c are integers.

gradient, $\frac{dy}{dx} = 16x - 14$ (1)

$16x - 14 = 10$ (1)

$x = \frac{24}{16} = 1.5$

$y = 8(1.5)^2 - 14(1.5) - 6$

$= -9$ (1)

$G(1.5, -9)$

$m_Q = -\frac{1}{10}$

$-9 = -\frac{1}{10}\left(\frac{3}{2}\right) + c$

$-9 + \frac{3}{20} = c$

$-\frac{177}{20} = c$ (1)

$y = -\frac{1}{10}x - \frac{177}{20}$

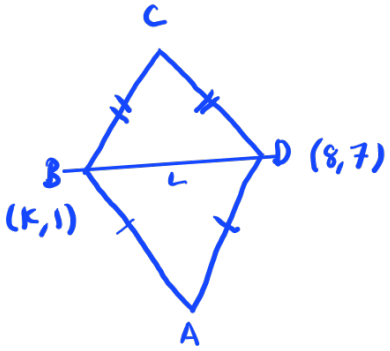
$20y = -2x - 177$

$2x + 20y + 177 = 0$ (1)

$2x + 20y + 177 = 0$

(Total for Question 11 is 5 marks)

12 *ABCD* is a kite.



AB = *AD* and *CB* = *CD*

The point *B* has coordinates (*k*, 1) where *k* is a negative constant.
The point *D* has coordinates (8, 7)

The straight line **L** passes through the points *B* and *D*

The straight line **L** is parallel to the line with equation $5y - 3x = 6$

Find an equation of *AC*
Give your answer in the form $px + qy = r$ where *p*, *q* and *r* are integers.
Show your working clearly.

gradient of L : $5y = 3x + 6$

$y = \frac{3}{5}x + \frac{6}{5}$ (1)

$m_L = \frac{3}{5}$

$\frac{3}{5} = \frac{7-1}{8-k}$

$24 - 3k = 35 - 5$

$3k = 24 - 30$

$3k = -6$

$k = -2$ (1)

midpoint of BD : $\left(\frac{8+(-2)}{2}, \frac{7+1}{2}\right)$

$= (3, 4)$ (1)

gradient of AC : $-\frac{5}{3}$ (1)

Equation of AC : $y - 4 = -\frac{5}{3}(x - 3)$ (1)

$3y - 12 = -5x + 15$

$3y = -5x + 27$

$5x + 3y = 27$ (1)

$5x + 3y = 27$

(Total for Question 12 is 6 marks)

13 (d) Write down an equation of the line.

$m = \frac{4-0}{0-2}$ (1)

$= -2$

$y = -2x + 4$ (1)

$y = -2x + 4$

.....

(2)

(Total for Question 13 is 2 marks)

14 *A* is the point with coordinates (–5, 12)

B is the point with coordinates (19, –48)

Find an equation of the straight line that passes through the points *A* and *B*

gradient $= \frac{12-(-48)}{-5-19} = \frac{60}{-24} = -2.5$ (1)

equation : $12 = -2.5(-5) + c$

$12 = 12.5 + c$

$c = -0.5$ (1)

$y = -2.5x - 0.5$ (1)

$y = -2.5x - 0.5$

(Total for Question 14 is 3 marks)

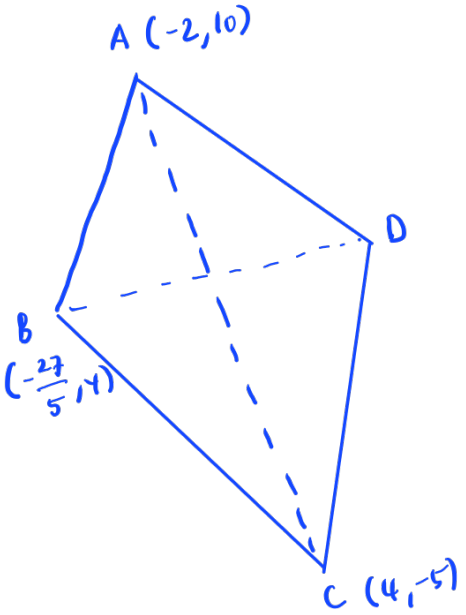
15 *ABCD* is a kite with $AB = AD$ and $CB = CD$

A is the point with coordinates $(-2, 10)$

B is the point with coordinates $\left(-\frac{27}{5}, 4\right)$

C is the point with coordinates $(4, -5)$

Work out the coordinates of D



gradient AC : $\frac{-5-10}{4-(-2)} = \frac{-15}{6} = -\frac{5}{2}$ (1)

equation of AC : $10 = -\frac{5}{2}(-2) + c$

$c = 10 - 5 = 5$

$\therefore \quad y = -\frac{5}{2}x + 5$ (1)

gradient BD : $\frac{2}{5}$

equation of BD : $4 = \frac{2}{5}\left(-\frac{27}{5}\right) + c$

$4 = -\frac{54}{25} + c$

$c = \frac{154}{25}$

$\therefore \quad y = \frac{2}{5}x + \frac{154}{25}$ (1)

$-\frac{5}{2}x + 5 = \frac{2}{5}x + \frac{154}{25}$ (1)

$\frac{2}{5}x + \frac{5}{2}x = 5 - \frac{154}{25}$

$2.9x = -\frac{29}{25}$ (1)

$x = -\frac{10}{25} = -\frac{2}{5}$, $y = -\frac{5}{2}\left(-\frac{2}{5}\right) + 5 = 6$

intersection between AC and BD is $(-\frac{2}{5}, 6)$

$$(-\frac{2}{5}, 6) = \left(\frac{-\frac{27}{5} + x_D}{2}, \frac{4 + y_D}{2}\right)$$

x_D : $-\frac{4}{5} + \frac{27}{5} = \frac{23}{5}$ (1)

y_D : $12 - 4 = 8$

($\frac{23}{5}$, 8)

(Total for Question 15 is 6 marks)