Section 1: Points and straight lines

Solutions to Exercise level 1

1. (a) (i) Gradient of AB $= \dfrac{y_1 - y_2}{x_1 - x_2} = \dfrac{1-4}{3-7} = \dfrac{-3}{-4} = \dfrac{3}{4}$.

(ii) Gradient m of perpendicular line satisfies $m \times \frac{3}{4} = -1$

so gradient of perpendicular line $= -\dfrac{4}{3}$.

(iii) Midpoint of AB $= \left(\dfrac{3+7}{2}, \dfrac{1+4}{2}\right) = (5, 2.5)$

(iv) Distance AB $= \sqrt{(3-7)^2 + (1-4)^2}$

$= \sqrt{16+9}$

$= \sqrt{25}$

$= 5$

(b) (i) Gradient of AB $= \dfrac{y_1 - y_2}{x_1 - x_2} = \dfrac{9-(-1)}{-2-3} = \dfrac{10}{-5} = -2$.

(ii) Gradient m of perpendicular line satisfies $m \times -2 = -1$

so gradient of perpendicular line $= \dfrac{1}{2}$.

(iii) Midpoint of AB $= \left(\dfrac{-2+3}{2}, \dfrac{9+(-1)}{2}\right) = (0.5, 4)$

(iv) Distance AB $= \sqrt{(-2-3)^2 + (9-(-1))^2}$

$= \sqrt{25+100}$

$= \sqrt{125}$

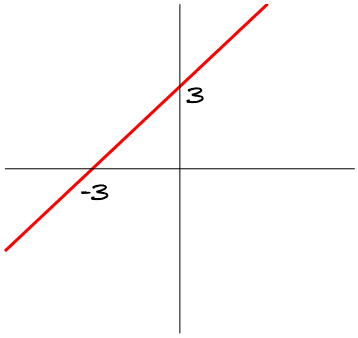
$= 5\sqrt{5}$

2. (i) $y = x + 3$

Gradient $= 1$

When $x = 0$, $y = 3$

When $y = 0$, $x + 3 = 0 \Rightarrow x = -3$



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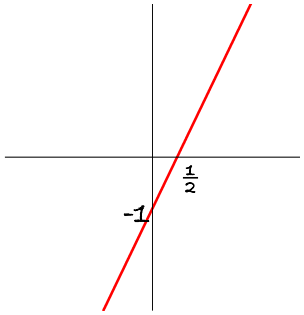
(ii) $y = 2x - 1$

Gradient = 2

When $x = 0$, $y = -1$

When $y = 0$, $2x - 1 = 0 \Rightarrow x = \frac{1}{2}$



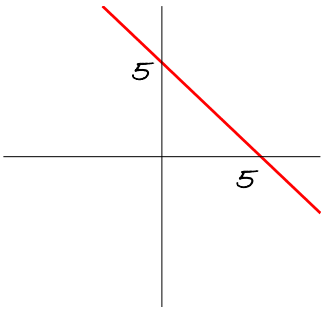
(iii) $x + y = 5$

$y = -x + 5$

Gradient = -1

When $x = 0$, $y = 5$

When $y = 0$, $x = 5$



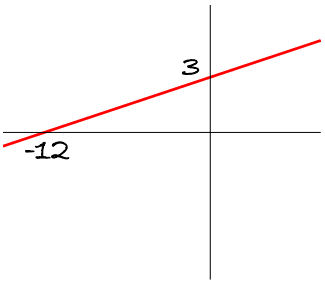
(iv) $4y = x + 12$

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

Gradient = $\frac{1}{4}$

When $x = 0$, $y = 3$

When $y = 0$, $x + 12 = 0 \Rightarrow x = -12$



(v) $3y + x + 6 = 0$

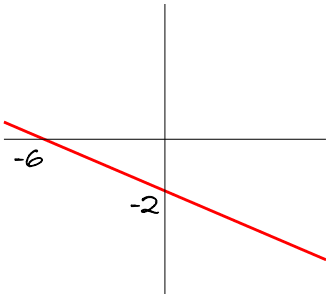
$3y = -x - 6$

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

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

When $x = 0$, $y = -2$

When $y = 0$, $x + 6 = 0 \Rightarrow x = -6$



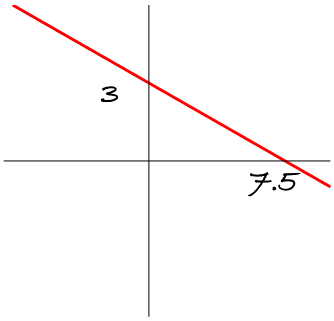
(vi) $5y = 15 - 2x$

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

Gradient = $-\frac{2}{5}$

When $x = 0$, $5y = 15 \Rightarrow y = 3$

When $y = 0$, $15 - 2x = 0 \Rightarrow x = 7.5$



3. (a) Gradient = 1, y-intercept = 2

Equation of line is $y = x + 2$

(b) Gradient = $\frac{1}{2}$, y-intercept = -1

Equation of line is $y = \frac{1}{2}x - 1$

or $2y = x - 2$

(c) Gradient $= -\frac{1}{2}$, y-intercept = -2
Equation of line is $y = -\frac{1}{2}x - 2$
or $2y + x + 4 = 0$

(d) Gradient $= -\frac{1}{4}$, y- intercept $= 3$
Equation of line is $y = -\frac{1}{4}x + 3$
or $4y + x = 12$

(e) Gradient $= -\frac{8}{3}$, passes through (-1, 4)
Equation of line is $y - 4 = -\frac{8}{3}(x - (-1))$

$$3(y - 4) = -8(x + 1)$$
$$3y - 12 = -8x - 8$$
$$3y + 8x = 4$$

4. Gradient of AB $= \frac{7 - 5}{9 - 3} = \frac{2}{6} = \frac{1}{3}$

Gradient of BC $= \frac{4 - 7}{10 - 9} = \frac{-3}{1} = -3$

Gradient of CD $= \frac{2 - 4}{4 - 10} = \frac{-2}{-6} = \frac{1}{3}$

Gradient of AD $= \frac{2 - 5}{4 - 3} = \frac{-3}{1} = -3$

AB and CD are parallel, and BC and AD are parallel.
The gradients of AB and CD are $\frac{1}{3}$,
and the gradients of BC and AD are -3.
Since $\frac{1}{3} \times -3 = -1$, AB and CD are perpendicular to BC and AD
so ABCD is a rectangle.

5. (i) $|AE| = \sqrt{4^2 + 3^2} = 5$

$|AB| = \sqrt{1^2 + (-1)^2} = \sqrt{2}$

(ii) gradient AB $= \frac{-1}{1} = -1$ gradient AC $= \frac{2}{2} = 1$
gradient AE $= \frac{-3}{4} = -\frac{3}{4}$ gradient DE $= \frac{-6}{1} = -6$
gradient CD $= \frac{1}{1} = 1$

(iii) AC and CD are parallel to each other
AB is perpendicular to AC and to CD

(iv) gradient BF $= \frac{-4}{4} = -1$
so the angle between AC and BF is 90°.