2.4 Answers

A-Level Pure Mathematics, Year 1
Additional Mathematics
GCSE
Coordinate Geometry

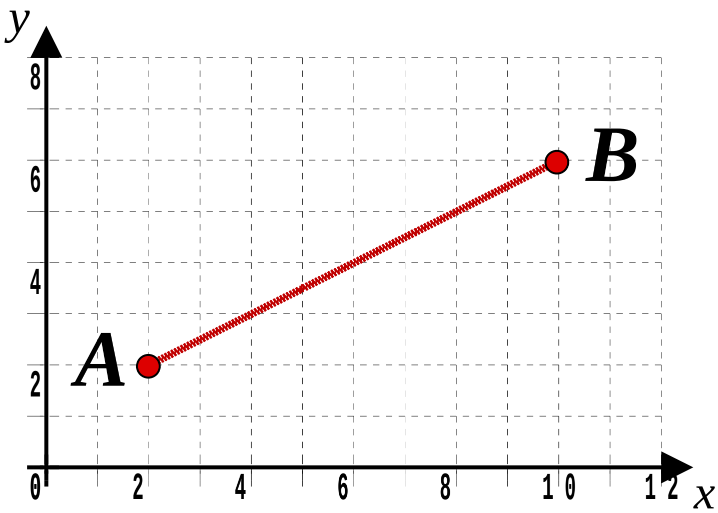
2.4.1 Solution to 2.2 Example (Teaching Video)

$$f(x) = \frac{1}{2}x + 1, \quad x \in \mathbb{R}, \; 2 \leqslant x \leqslant 10$$

Endpoints are,

$$f(2) = \frac{1}{2} \times 2 + 1 = 2 \Rightarrow A(2, 2)$$

$$f(10) = \frac{1}{2} \times 10 + 1 = 6 \Rightarrow B(10, 6)$$



[3 marks]

$$|AB| = \sqrt{(\Delta X)^2 + (\Delta Y)^2}$$

$$= \sqrt{(10 - 2)^2 + (6 - 2)^2}$$

$$= \sqrt{8^2 + 4^2}$$

$$= \sqrt{80}$$

$$= 4\sqrt{5}$$ is the length of the line segment

[2 marks]

$$Midpoint\ AB = \left(\frac{x_B + x_A}{2}, \frac{y_B + y_A}{2} \right)$$

$$= \left(\frac{10 + 2}{2}, \frac{6 + 2}{2} \right)$$

$$= (6, 4)$$

[2 marks]

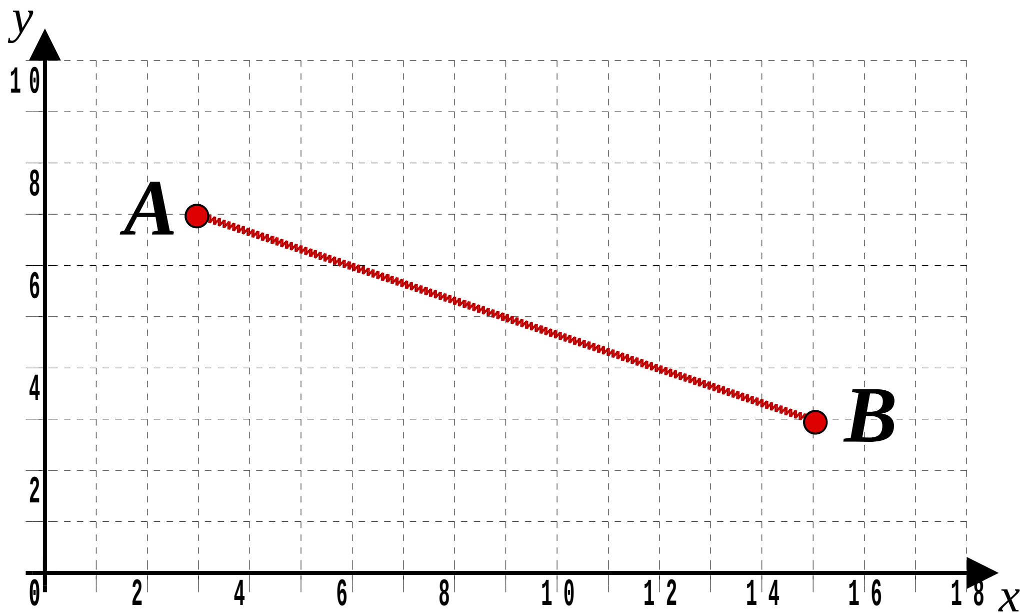
2.4.2 Solutions to 2.3 Exercise

Answer 1

(i) $$g(x) = -\frac{1}{3}x + 8, \quad x \in \mathbb{R}, \ 3 \leqslant x \leqslant 15$$

$$\text{Endpoint } A \ : \ g(3) = -\frac{1}{3} \times 3 + 8 = 7 \Rightarrow A(3, \ 7)$$

$$\text{Endpoint } B \ : \ g(15) = -\frac{1}{3} \times 15 + 8 = 3 \Rightarrow B(15, \ 3)$$



[3 marks]

(ii) $$|AB| = \sqrt{(\Delta X)^2 + (\Delta Y)^2}$$
$$= \sqrt{(15 - 3)^2 + (3 - 7)^2}$$
$$= \sqrt{12^2 + 4^2} = \sqrt{160} = 4\sqrt{10}$$

[2 marks]

(iii) $$\text{Midpoint } AB = \left(\frac{x_B + x_A}{2}, \ \frac{y_B + y_A}{2} \right)$$
$$= \left(\frac{15 + 3}{2}, \ \frac{3 + 7}{2} \right)$$
$$= (9, \ 5)$$

[2 marks]

Answer 2

$$|AB| = \sqrt{(\Delta X)^2 + (\Delta Y)^2}$$
$$= \sqrt{(9 - (-15))^2 + (5 - (-2))^2}$$
$$= \sqrt{24^2 + 7^2} = 25$$

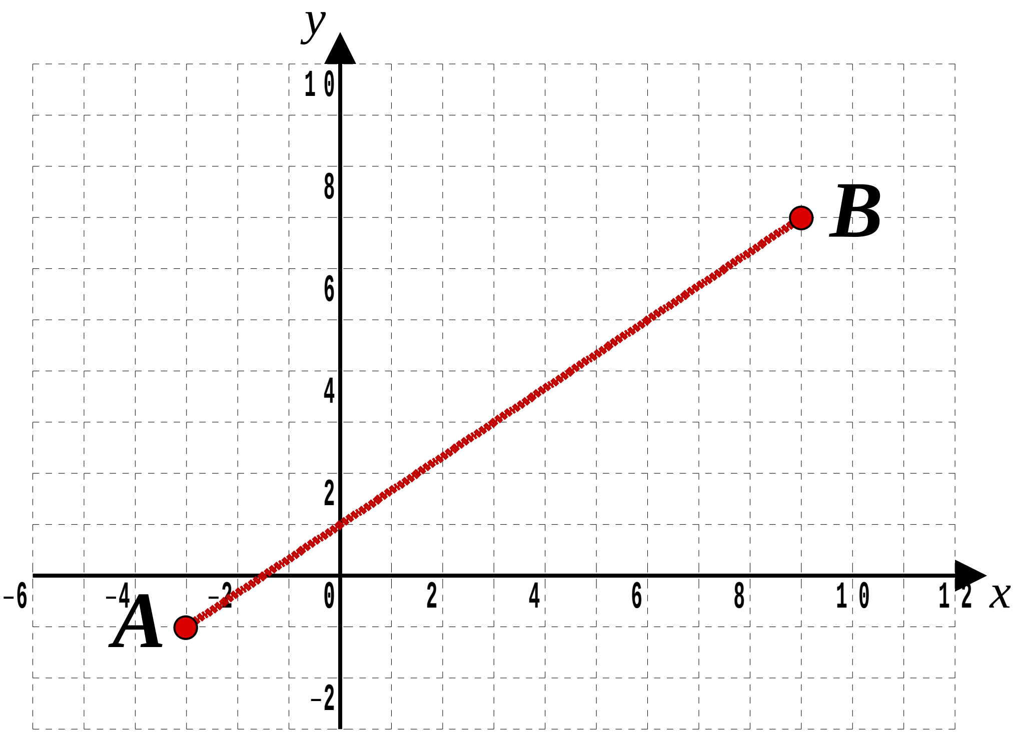
[3 marks]

Answer 3

(i) $$h(x) = \frac{2}{3}x + 1, \quad x \in \mathbb{R}, \quad -3 \leqslant x \leqslant 9$$

$$\text{Endpoint } A : h(-3) = \frac{2}{3} \times (-3) + 1 = 7 \Rightarrow A(-3, \ -1)$$

$$\text{Endpoint } B : h(9) = \frac{2}{3} \times 9 + 1 = 3 \Rightarrow B(9, \ 7)$$



[3 marks]

(ii)

$$|AB| = \sqrt{(\Delta X)^2 + (\Delta Y)^2}$$
$$= \sqrt{(9 - (-3))^2 + (7 - (-1))^2}$$
$$= \sqrt{12^2 + 8^2} = \sqrt{208} = 4\sqrt{13}$$

[2 marks]

(iii)

$$\mathit{Midpoint}\ AB = \left(\frac{x_B + x_A}{2}, \ \frac{y_B + y_A}{2} \right)$$
$$= \left(\frac{9 + (-3)}{2}, \ \frac{7 + (-1)}{2} \right)$$
$$= (3, \ 3)$$

[2 marks]

Answer 4

$$4y - 12x + 3 = 0 \Rightarrow y = 3x - \frac{3}{4}$$

[2 marks]

Answer 5

(a) $$Midpoint\ AB = \left(\frac{x_B + x_A}{2},\ \frac{y_B + y_A}{2} \right)$$
$$= \left(\frac{13 + 5}{2},\ \frac{1 + (-4)}{2} \right)$$
$$= \left(9, -\frac{3}{2} \right)$$

[2 marks]

(b) Gradient is $-\ 3$

[1 mark]

(c) Put $x = 100$ into $y = 2 - 3x \Rightarrow y = -298$

$\therefore$ As the answer was not $-\ 302$, the point $(100, -302)$ is not on L

[1 mark]

Answer 6

$$2y + 8x = 5 \Rightarrow y = -4x + \frac{5}{2} \text{ which has gradient of } -\ 4$$
$$y = mx + c$$
$$3 = -4 \times 2 + c$$
$$c = 11$$
$$\therefore\ L \text{ has equation } y = -4x + 11$$

[3 marks]

Answer 7

(i) $$\left| AB \right| = \sqrt{(\Delta X)^2 + (\Delta Y)^2}$$
$$= \sqrt{(\ (-3) - 1\ )^2 + (\ 7 - 5\ )^2}$$
$$= \sqrt{4^2 + 2^2}$$
$$= \sqrt{20}$$
$$= 2\sqrt{5} \quad \text{is the length of the line segment}$$

[2 marks]

(ii) $$Midpoint\ AB = \left(\frac{x_B + x_A}{2},\ \frac{y_B + y_A}{2} \right)$$
$$= \left(\frac{(-3) + 1}{2},\ \frac{7 + 5}{2} \right)$$
$$= (-1,\ 6)$$

[1 mark]

Answer 8

(i) $2x + 5y = 7 \Rightarrow y = -\frac{2}{5}x + \frac{7}{5}$ which has gradient of $-\frac{2}{5}$

$$y = mx + c$$

$$5 = -\frac{2}{5} \times 1 + c$$

$$c = \frac{27}{5}$$

$\therefore$ The line through A has equation $y = -\frac{2}{5}x + \frac{27}{5}$

[2 marks]

(ii)

$$y = -\frac{2}{5}x + \frac{27}{5}$$

$$p = -\frac{2}{5} \times 3 + \frac{27}{5}$$

$$= \frac{21}{5}$$

[2 marks]

Answer 9

(a) Putting all of the lines into the $y = mx + c$ format;

Line **A** $y = 2x + 3$

Line **B** $2y = 6 - 3x \Rightarrow y = -\frac{3}{2}x + 3$

Line **C** $4x - 2y = 3 \Rightarrow y = 2x - \frac{3}{2}$

Line **D** $y = 3 - 2x$

$\therefore$ Line **A** and Line **C** are parallel, both with a gradient of 2

[2 marks]

(b)

$$y = mx + c$$

$$3 = -\frac{5}{2} \times 1 + c$$

$$c = \frac{11}{2}$$

The line is thus, $y = -\frac{5}{2}x + \frac{11}{2}$

$$2y = -5x + 11$$

$5x + 2y = 11$ is the requested format

[3 marks]

Answer 10

(a)

$$m = \frac{\Delta Y}{\Delta X} \qquad\qquad y = mx + c$$

$$= \frac{-3 - 4}{8 - (-6)} \qquad\qquad 4 = -\frac{1}{2} \times (-6) + c$$

$$= -\frac{7}{14} \qquad\qquad c = 1$$

$= -\dfrac{1}{2}$ The line is thus, $y = -\dfrac{1}{2}x + 1$

That is $x + 2y - 2 = 0$

[4 marks]

(b)

$$|AB| = \sqrt{(\Delta X)^2 + (\Delta Y)^2}$$

$$= \sqrt{(8 - (-6))^2 + (-3 - 4)^2}$$

$$= \sqrt{14^2 + 7^2}$$

$$= \sqrt{245}$$

$= 7\sqrt{5}$ is the length of the line segment

[3 marks]

Answer 11

(a)

$$m = \frac{\Delta Y}{\Delta X} \qquad\qquad y = mx + c$$

$$= \frac{0 - 4}{2 - 7} \qquad\qquad 0 = \frac{4}{5} \times 2 + c$$

$$= \frac{4}{5} \qquad\qquad c = -\frac{8}{5}$$

The line is thus, $y = \frac{4}{5}x - \frac{8}{5}$

That is, $4x - 5y - 8 = 0$

[3 marks]

(b)

$$|AB| = \sqrt{(\Delta X)^2 + (\Delta Y)^2}$$

$$= \sqrt{(2 - 7)^2 + (0 - 4)^2}$$

$$= \sqrt{5^2 + 4^2}$$

$$= \sqrt{41}$$

[3 marks]

(c) $t = 8$

[1 mark]

(d)

$$Area\,\Delta = \frac{1}{2}bh$$

$$= \frac{1}{2} \times 8 \times (7 - 2)$$

$$= 20$$

[2 marks]

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