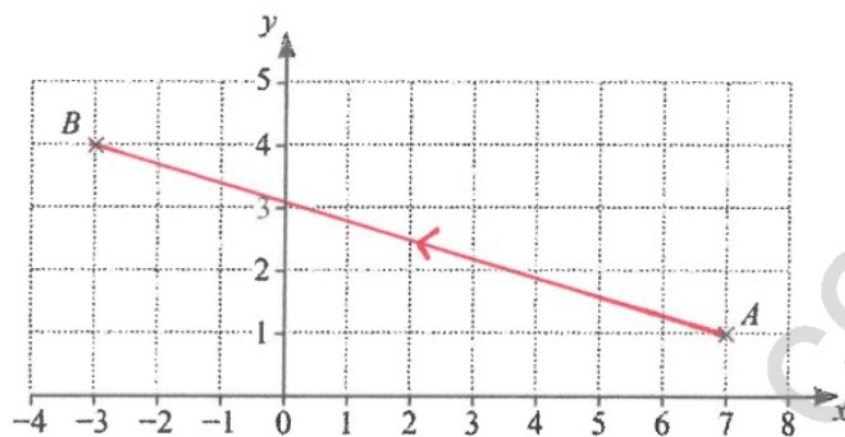


6



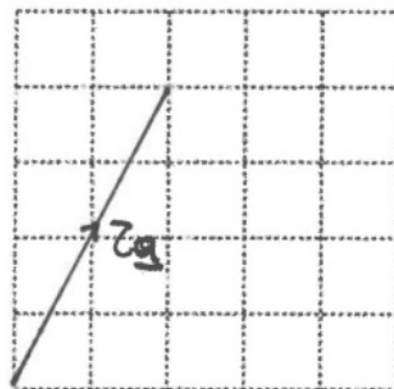
Write $\vec{AB}$ as a column vector.

$$\vec{AB} = \begin{pmatrix} -10 \\ 3 \end{pmatrix} [1]$$

10 (a) $\mathbf{a} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} -3 \\ 5 \end{pmatrix}$

(i) On the grid, draw and label vector $2\mathbf{a}$.

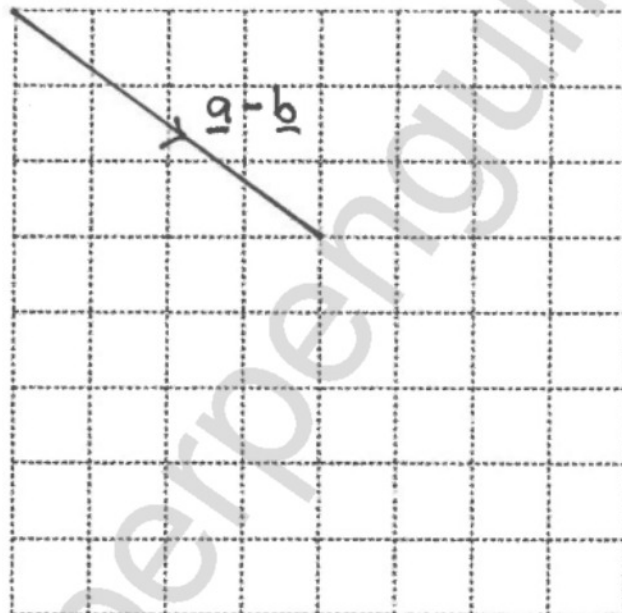
$$2\begin{pmatrix} 1 \\ 2 \end{pmatrix} = \begin{pmatrix} 2 \\ 4 \end{pmatrix}$$



[1]

(ii) On the grid, draw and label vector $(\mathbf{a} - \mathbf{b})$.

$$\begin{pmatrix} 1 \\ 2 \end{pmatrix} - \begin{pmatrix} -3 \\ 5 \end{pmatrix} = \begin{pmatrix} 4 \\ -3 \end{pmatrix}$$



[2]

2 Work out $4 \times \begin{pmatrix} 6 \\ -2 \end{pmatrix} = \begin{pmatrix} 24 \\ -8 \end{pmatrix}$

$$\begin{pmatrix} 24 \\ -8 \end{pmatrix} \quad [1]$$

5 Work out.

(a) $\begin{pmatrix} 6 \\ -5 \end{pmatrix} + \begin{pmatrix} 8 \\ -1 \end{pmatrix} = \begin{pmatrix} 14 \\ -6 \end{pmatrix}$

$$\begin{pmatrix} 14 \\ -6 \end{pmatrix} \quad [1]$$

(b) $3 \begin{pmatrix} -4 \\ 7 \end{pmatrix} = \begin{pmatrix} -12 \\ 21 \end{pmatrix}$

$$\begin{pmatrix} -12 \\ 21 \end{pmatrix} \quad [1]$$

2 $\mathbf{v} = \begin{pmatrix} -1 \\ 3 \end{pmatrix} \quad \mathbf{y} = \begin{pmatrix} 2 \\ 5 \end{pmatrix}$

Find

(a) $\mathbf{v} - \mathbf{y} \quad \begin{pmatrix} -1 \\ 3 \end{pmatrix} - \begin{pmatrix} 2 \\ 5 \end{pmatrix} = \begin{pmatrix} -3 \\ -2 \end{pmatrix}$

$$\begin{pmatrix} -3 \\ -2 \end{pmatrix} \quad [1]$$

(b) $2\mathbf{v} \quad 2 \begin{pmatrix} -1 \\ 3 \end{pmatrix} = \begin{pmatrix} -2 \\ 6 \end{pmatrix}$

$$\begin{pmatrix} -2 \\ 6 \end{pmatrix} \quad [1]$$

3 Point A has coordinates (6, 4) and point B has coordinates (2, 7).

Write $\overrightarrow{AB}$ as a column vector.

$$\begin{aligned} \overrightarrow{AB} &= \underline{b} - \underline{a} \\ &= \begin{pmatrix} 2 \\ 7 \end{pmatrix} - \begin{pmatrix} 6 \\ 4 \end{pmatrix} = \begin{pmatrix} -4 \\ 3 \end{pmatrix} \end{aligned}$$

$$\overrightarrow{AB} = \begin{pmatrix} -4 \\ 3 \end{pmatrix} \quad [1]$$

2 Point A (7, 5) is translated to point B (2, 2).

Find the vector that represents this translation.

$$\begin{aligned} \overrightarrow{AB} &= \underline{b} - \underline{a} = \begin{pmatrix} 2 \\ 2 \end{pmatrix} - \begin{pmatrix} 7 \\ 5 \end{pmatrix} \\ &= \begin{pmatrix} -5 \\ -3 \end{pmatrix} \end{aligned}$$

$$\begin{pmatrix} -5 \\ -3 \end{pmatrix} \quad [2]$$

2 $p = \begin{pmatrix} 3 \\ -1 \end{pmatrix}$ $q = \begin{pmatrix} 1 \\ -2 \end{pmatrix}$

(a) Find $p + q$.

$$\begin{pmatrix} 3 \\ -1 \end{pmatrix} + \begin{pmatrix} 1 \\ -2 \end{pmatrix} = \begin{pmatrix} 4 \\ -3 \end{pmatrix}$$

$$\begin{pmatrix} 4 \\ -3 \end{pmatrix} \quad [1]$$

(b) A is the point $(2, 7)$.

The point A is translated to the point B by the vector $p + q$.

Find the coordinates of B .

$\vec{AB} = b - a$
 $\begin{pmatrix} 4 \\ -3 \end{pmatrix} = b - \begin{pmatrix} 2 \\ 7 \end{pmatrix}$
 $b = \begin{pmatrix} 4 \\ -3 \end{pmatrix} + \begin{pmatrix} 2 \\ 7 \end{pmatrix} = \begin{pmatrix} 6 \\ 4 \end{pmatrix}$ (..... 6, 4) [2]

3 (a) Work out $\begin{pmatrix} 1 \\ 2 \end{pmatrix} - \begin{pmatrix} -5 \\ 3 \end{pmatrix}$.

$$\begin{pmatrix} 1 \\ 2 \end{pmatrix} - \begin{pmatrix} -5 \\ 3 \end{pmatrix} = \begin{pmatrix} 6 \\ -1 \end{pmatrix}$$

$$\begin{pmatrix} 6 \\ -1 \end{pmatrix} \quad [1]$$

(b) P is the point $(-3, 6)$.

Q is the point $(0, 2)$.

Find the translation vector that maps the point P onto the point Q .

$$\begin{aligned} \vec{PQ} &= q - p \\ &= \begin{pmatrix} 0 \\ 2 \end{pmatrix} - \begin{pmatrix} -3 \\ 6 \end{pmatrix} \\ &= \begin{pmatrix} 3 \\ -4 \end{pmatrix} \end{aligned}$$

$$\begin{pmatrix} 3 \\ -4 \end{pmatrix} \quad [2]$$

4 (a) Work out $2\begin{pmatrix} 2 \\ 3 \end{pmatrix} - \begin{pmatrix} -3 \\ 5 \end{pmatrix}$.

$$= \begin{pmatrix} 4 \\ 6 \end{pmatrix} - \begin{pmatrix} -3 \\ 5 \end{pmatrix}$$

$$= \begin{pmatrix} 7 \\ 1 \end{pmatrix}$$

$$\begin{pmatrix} 7 \\ 1 \end{pmatrix} \quad [2]$$

(b) F is the point $(5, 7)$.

The vector that maps F onto the point G is $\begin{pmatrix} -1 \\ 3 \end{pmatrix}$.

Find the coordinates of G .

$$\vec{FG} = g - f$$

$$\begin{pmatrix} -1 \\ 3 \end{pmatrix} = g - \begin{pmatrix} 5 \\ 7 \end{pmatrix}$$

$$g = \begin{pmatrix} -1 \\ 3 \end{pmatrix} + \begin{pmatrix} 5 \\ 7 \end{pmatrix}$$

$$= \begin{pmatrix} 4 \\ 10 \end{pmatrix}$$

$$(\dots\dots\dots 4, \dots\dots\dots 10 \dots\dots\dots) \quad [1]$$

10 Find the magnitude of the vector $\begin{pmatrix} 2 \\ 6 \end{pmatrix}$.

Give your answer in simplest surd form.

$$\sqrt{2^2 + 6^2}$$

$$= \sqrt{4 + 36}$$

$$= \sqrt{40}$$

$$= \sqrt{4} \times \sqrt{10}$$

$$= 2\sqrt{10}$$

$$2\sqrt{10}$$

[2]

7 Find the magnitude of $\begin{pmatrix} 9 \\ -3 \end{pmatrix}$.

Give your answer in its simplest surd form.

$$\sqrt{9^2 + (-3)^2}$$

$$= \sqrt{81 + 9}$$

$$= \sqrt{90}$$

$$= \sqrt{9} \times \sqrt{10}$$

$$= 3\sqrt{10}$$

$$3\sqrt{10}$$

[2]

8 (a) Work out $\begin{pmatrix} 12 \\ -5 \end{pmatrix} - 5\begin{pmatrix} 4 \\ -1 \end{pmatrix}$.

$$\begin{pmatrix} 12 \\ -5 \end{pmatrix} - \begin{pmatrix} 20 \\ -5 \end{pmatrix} = \begin{pmatrix} -8 \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} -8 \\ 0 \end{pmatrix} \quad [2]$$

(b) Work out the magnitude of $\begin{pmatrix} 3 \\ -4 \end{pmatrix}$.

$$\begin{aligned} & \sqrt{3^2 + (-4)^2} \\ &= \sqrt{9 + 16} \end{aligned} \quad \begin{aligned} &= \sqrt{25} \\ &= 5 \end{aligned}$$

$$5 \quad [2]$$

8 $\mathbf{a} = \begin{pmatrix} -4 \\ -3 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} 2 \\ -1 \end{pmatrix}$

(a) Find $\mathbf{a} - 3\mathbf{b}$.

$$\begin{aligned} & \begin{pmatrix} -4 \\ -3 \end{pmatrix} - 3\begin{pmatrix} 2 \\ -1 \end{pmatrix} \\ &= \begin{pmatrix} -4 \\ -3 \end{pmatrix} - \begin{pmatrix} 6 \\ -3 \end{pmatrix} = \begin{pmatrix} -10 \\ 0 \end{pmatrix} \end{aligned}$$

$$\begin{pmatrix} -10 \\ 0 \end{pmatrix} \quad [2]$$

(b) Find the magnitude of $\begin{pmatrix} -4 \\ -3 \end{pmatrix}$.

$$\begin{aligned} & \sqrt{(-4)^2 + (-3)^2} \\ &= \sqrt{16 + 9} \\ &= \sqrt{25} = 5 \end{aligned}$$

$$5 \quad [2]$$

7 $u = \begin{pmatrix} 3 \\ -2 \end{pmatrix} \quad v = \begin{pmatrix} -12 \\ 5 \end{pmatrix}$

(a) Find $u - 2v$.

$$\begin{pmatrix} 3 \\ -2 \end{pmatrix} - 2 \begin{pmatrix} -12 \\ 5 \end{pmatrix}$$

$$= \begin{pmatrix} 3 \\ -2 \end{pmatrix} - \begin{pmatrix} -24 \\ 10 \end{pmatrix} = \begin{pmatrix} 27 \\ -12 \end{pmatrix} \quad [2]$$

(b) Find $|v|$. *← "magnitude" of v*

$$\sqrt{(-12)^2 + 5^2}$$

$$= \sqrt{144 + 25}$$

$$= \sqrt{169} = 13$$

..... 13 [2]

12 $a = \begin{pmatrix} 4 \\ -10 \end{pmatrix} \quad b = \begin{pmatrix} -4 \\ 2 \end{pmatrix}$

Find the magnitude of the vector $a - b$.
Give your answer in its simplest surd form.

$$\underline{a} - \underline{b} = \begin{pmatrix} 4 \\ -10 \end{pmatrix} - \begin{pmatrix} -4 \\ 2 \end{pmatrix}$$

$$= \begin{pmatrix} 8 \\ -12 \end{pmatrix}$$

$$|\underline{a} - \underline{b}| = \sqrt{8^2 + (-12)^2}$$

$$= \sqrt{64 + 144}$$

$$= \sqrt{208}$$

$$= \sqrt{16} \times \sqrt{13}$$

$$= 4\sqrt{13}$$

..... $4\sqrt{13}$ [4]

7 (a) $\mathbf{p} = \begin{pmatrix} 8 \\ -5 \end{pmatrix}$ $\mathbf{q} = \begin{pmatrix} -4 \\ 5 \end{pmatrix}$

(i) Find $3\mathbf{q}$.

$$3 \begin{pmatrix} -4 \\ 5 \end{pmatrix} = \begin{pmatrix} -12 \\ 15 \end{pmatrix}$$

$$\begin{pmatrix} -12 \\ 15 \end{pmatrix}$$

[1]

(ii) (a) Find $\mathbf{p} - \mathbf{q}$.

$$\begin{pmatrix} 8 \\ -5 \end{pmatrix} - \begin{pmatrix} -4 \\ 5 \end{pmatrix} = \begin{pmatrix} 12 \\ -10 \end{pmatrix}$$

$$\begin{pmatrix} 12 \\ -10 \end{pmatrix}$$

[1]

(b) Find $|\mathbf{p} - \mathbf{q}|$.

$$\begin{aligned} & \sqrt{12^2 + (-10)^2} \\ &= \sqrt{144 + 100} \end{aligned}$$

$$= \sqrt{244}$$

$$= 2\sqrt{61}$$

$$2\sqrt{61}$$

[2]

10 $\overrightarrow{AB} = \begin{pmatrix} 7 \\ -3 \end{pmatrix}$

(a) Find $3\overrightarrow{AB}$.

$$3 \begin{pmatrix} 7 \\ -3 \end{pmatrix} = \begin{pmatrix} 21 \\ -9 \end{pmatrix}$$

$$\begin{pmatrix} 21 \\ -9 \end{pmatrix}$$

[1]

(b) Find $|\overrightarrow{AB}|$.

$$\sqrt{7^2 + (-3)^2}$$

$$= \sqrt{49 + 9}$$

$$= \sqrt{58}$$

$$|\overrightarrow{AB}| = \sqrt{58}$$

[2]

(b) Ahmed finds the magnitude of the vector $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$.

From this list, put a ring around the correct calculation.

$\sqrt{2^2 + -3^2}$

$2^2 - 3^2$

$\sqrt{2^2 - 3^2}$

$2^2 + (-3)^2$

$\sqrt{2^2 + (-3)^2}$

→ because of BIDMAS,
 $-3^2 = -9$
(indices first)

[1]

14 The magnitude of the vector $\begin{pmatrix} 20 \\ k \end{pmatrix}$ is 29.

Find the value of k .

$$\sqrt{20^2 + k^2} = 29$$

square

square

$$20^2 + k^2 = 841$$

$$400 + k^2 = 841$$

-400

-400

$$k^2 = 441$$

$$k = \sqrt{441}$$

$$= 21$$

$$k = \dots\dots\dots 21 \dots\dots\dots [3]$$

- 9 F is the point $(1, -4)$, $\overrightarrow{FG} = \begin{pmatrix} 8 \\ -3 \end{pmatrix}$ and $\overrightarrow{GH} = \begin{pmatrix} -12 \\ 35 \end{pmatrix}$.

Find

- (a) $3\overrightarrow{FG}$

$$3 \begin{pmatrix} 8 \\ -3 \end{pmatrix} = \begin{pmatrix} 24 \\ -9 \end{pmatrix}$$

$$\begin{pmatrix} 24 \\ -9 \end{pmatrix} [1]$$

- (b) $\overrightarrow{FG} + \overrightarrow{GH}$

$$\begin{pmatrix} 8 \\ -3 \end{pmatrix} + \begin{pmatrix} -12 \\ 35 \end{pmatrix} = \begin{pmatrix} -4 \\ 32 \end{pmatrix}$$

$$\begin{pmatrix} -4 \\ 32 \end{pmatrix} [1]$$

- (c) the coordinates of the point G

$$\begin{aligned} \overrightarrow{FG} &= G - F \\ \begin{pmatrix} 8 \\ -3 \end{pmatrix} &= G - \begin{pmatrix} 1 \\ -4 \end{pmatrix} \end{aligned} \quad \begin{aligned} G &= \begin{pmatrix} 8 \\ -3 \end{pmatrix} + \begin{pmatrix} 1 \\ -4 \end{pmatrix} \\ &= \begin{pmatrix} 9 \\ -7 \end{pmatrix} \quad (\dots 9 \dots, \dots -7 \dots) [1] \end{aligned}$$

- (d) the magnitude of vector $\overrightarrow{GH}$.

$$\sqrt{(-12)^2 + 35^2}$$

$$= \sqrt{144 + 1225}$$

$$= \sqrt{1369}$$

$$= 37$$

37

..... [2]

10 (a) ABC is a triangle.

B is the point $(1, -10)$, A is the point $(4, 14)$ and $\vec{CA} = \begin{pmatrix} -11 \\ 8 \end{pmatrix}$.

(i) Find the coordinates of C .

$$\vec{CA} = a - c$$

$$\begin{pmatrix} -11 \\ 8 \end{pmatrix} = \begin{pmatrix} 4 \\ 14 \end{pmatrix} - c$$

$$\rightarrow c = \begin{pmatrix} -11 \\ 8 \end{pmatrix} - \begin{pmatrix} 4 \\ 14 \end{pmatrix}$$

$$-c = \begin{pmatrix} -15 \\ -6 \end{pmatrix}$$

$$c = \begin{pmatrix} 15 \\ 6 \end{pmatrix}$$

(.....15.....6.....) [2]

(ii) Find $\vec{BA}$.

$$\vec{BA} = a - b$$

$$= \begin{pmatrix} 4 \\ 14 \end{pmatrix} - \begin{pmatrix} 1 \\ -10 \end{pmatrix} = \begin{pmatrix} 3 \\ 24 \end{pmatrix}$$

$$\vec{BA} = \begin{pmatrix} 3 \\ 24 \end{pmatrix} \quad [1]$$

(iii) Find $|\vec{CA}|$.

$$\sqrt{(-11)^2 + 8^2}$$

$$= \sqrt{121 + 64}$$

$$= \sqrt{185}$$

$$\sqrt{185}$$

..... [2]

- (b) D is the point $(22, 34)$ and E is the point $(23, 39)$.
 D is the point on CE such that $2CE = 5DE$.

Find the coordinates of C .

$$\begin{aligned}\vec{DE} &= \underline{e} - \underline{d} \\ &= \begin{pmatrix} 23 \\ 39 \end{pmatrix} - \begin{pmatrix} 22 \\ 34 \end{pmatrix} \\ &= \begin{pmatrix} 1 \\ 5 \end{pmatrix}\end{aligned}$$

$$\begin{aligned}2\vec{CE} &= 5\vec{DE} \\ \div 2 &\quad \div 2 \\ \vec{CE} &= \frac{5}{2}\vec{DE}\end{aligned}$$

$$\begin{aligned}\vec{CE} &= \frac{5}{2} \begin{pmatrix} 1 \\ 5 \end{pmatrix} \\ &= \begin{pmatrix} 2.5 \\ 12.5 \end{pmatrix}\end{aligned}$$

$$\begin{aligned}\vec{CE} &= \underline{e} - \underline{c} \\ \begin{pmatrix} 2.5 \\ 12.5 \end{pmatrix} &= \begin{pmatrix} 23 \\ 39 \end{pmatrix} - \underline{c}\end{aligned}$$

$$-\underline{c} = \begin{pmatrix} 2.5 \\ 12.5 \end{pmatrix} - \begin{pmatrix} 23 \\ 39 \end{pmatrix}$$

$$-\underline{c} = \begin{pmatrix} -20.5 \\ -26.5 \end{pmatrix}$$

$$\underline{c} = \begin{pmatrix} 20.5 \\ 26.5 \end{pmatrix}$$

(20.5, 26.5) [3]

15 Point A has coordinates $(-4, 1)$ and $\vec{BA} = \begin{pmatrix} -5 \\ -12 \end{pmatrix}$.

(a) Find the coordinates of point B.

$$\vec{BA} = \underline{a} - \underline{b}$$

$$\begin{pmatrix} -5 \\ -12 \end{pmatrix} = \begin{pmatrix} -4 \\ 1 \end{pmatrix} - \underline{b}$$

$$-\underline{b} = \begin{pmatrix} -5 \\ -12 \end{pmatrix} - \begin{pmatrix} -4 \\ 1 \end{pmatrix}$$

$$-\underline{b} = \begin{pmatrix} -1 \\ -13 \end{pmatrix}$$

$$\underline{b} = \begin{pmatrix} 1 \\ 13 \end{pmatrix}$$

$$(\dots\dots\dots 1 \dots\dots\dots, \dots\dots\dots 13 \dots\dots\dots) [2]$$

(b) Point C has coordinates $(5, -2)$.

Find the vector $\vec{CA}$.

$$\vec{CA} = \underline{a} - \underline{c}$$

$$= \begin{pmatrix} -4 \\ 1 \end{pmatrix} - \begin{pmatrix} 5 \\ -2 \end{pmatrix} = \begin{pmatrix} -9 \\ 3 \end{pmatrix}$$

$$\vec{CA} = \begin{pmatrix} -9 \\ 3 \end{pmatrix} [2]$$

(c) $\vec{EF} = 3\vec{BA}$

Find $|\vec{EF}|$.

$$|\vec{EF}| = 3|\vec{BA}|$$

$|\vec{BA}|$:

$$|\vec{BA}| = \sqrt{(-5)^2 + (-12)^2}$$

$$= \sqrt{25 + 144}$$

$$= \sqrt{169}$$

$$= 13$$

$|\vec{EF}|$:

$$|\vec{EF}| = 3 \times |\vec{BA}|$$

$$= 3 \times 13$$

$$= 39$$

$$39$$

$$\dots\dots\dots [3]$$

12 (a) $v = \begin{pmatrix} 2 \\ -3 \end{pmatrix}$

Find $5v$.

$$5 \begin{pmatrix} 2 \\ -3 \end{pmatrix} = \begin{pmatrix} 10 \\ -15 \end{pmatrix}$$

$$\begin{pmatrix} 10 \\ -15 \end{pmatrix} [1]$$

(b) H is the point $(-3, 8)$ and K is the point $(-4, 0)$.

$$\vec{HJ} = \begin{pmatrix} 7 \\ -2 \end{pmatrix}$$

Find $|\vec{JK}|$.

Find J :

$$\vec{HJ} = \underline{j} - \underline{h}$$

$$\begin{pmatrix} 7 \\ -2 \end{pmatrix} = \underline{j} - \begin{pmatrix} -3 \\ 8 \end{pmatrix}$$

$$\begin{aligned} \underline{j} &= \begin{pmatrix} 7 \\ -2 \end{pmatrix} + \begin{pmatrix} -3 \\ 8 \end{pmatrix} \\ &= \begin{pmatrix} 4 \\ 6 \end{pmatrix} \end{aligned}$$

$$\vec{JK} = \underline{k} - \underline{j}$$

$$= \begin{pmatrix} -4 \\ 0 \end{pmatrix} - \begin{pmatrix} 4 \\ 6 \end{pmatrix}$$

$$= \begin{pmatrix} -8 \\ -6 \end{pmatrix}$$

$$|\vec{JK}| = \sqrt{(-8)^2 + (-6)^2}$$

$$= \sqrt{64 + 36}$$

$$= \sqrt{100}$$

$$= \underline{\underline{10}}$$

5 (a) $\mathbf{a} = \begin{pmatrix} -3 \\ 8 \end{pmatrix}$ $\mathbf{b} = \begin{pmatrix} 2 \\ -5 \end{pmatrix}$

(i) Find

(a) $\mathbf{b} - \mathbf{a}$, $\begin{pmatrix} 2 \\ -5 \end{pmatrix} - \begin{pmatrix} -3 \\ 8 \end{pmatrix} = \begin{pmatrix} 5 \\ -13 \end{pmatrix}$ [1]

(b) $2\mathbf{a} + \mathbf{b}$, $2\begin{pmatrix} -3 \\ 8 \end{pmatrix} + \begin{pmatrix} 2 \\ -5 \end{pmatrix} = \begin{pmatrix} -6 \\ 16 \end{pmatrix} + \begin{pmatrix} 2 \\ -5 \end{pmatrix} = \begin{pmatrix} -4 \\ 11 \end{pmatrix}$ [2]

(c) $|\mathbf{b}|$, $\sqrt{2^2 + (-5)^2}$
 $= \sqrt{4 + 25}$
 $= \sqrt{29}$ [2]

(ii) $\mathbf{a} + k\mathbf{b} = \begin{pmatrix} 13 \\ m \end{pmatrix}$, where k and m are integers.

Find the value of k and the value of m .

$$\begin{pmatrix} -3 \\ 8 \end{pmatrix} + k \begin{pmatrix} 2 \\ -5 \end{pmatrix} = \begin{pmatrix} 13 \\ m \end{pmatrix}$$

x components:

$$\begin{array}{rcl} -3 + 2k & = & 13 \\ +3 & & +3 \end{array}$$

$$\begin{array}{rcl} 2k & = & 16 \\ \div 2 & & \div 2 \end{array}$$

$$\underline{k = 8}$$

y components:

$$8 - 5k = m$$

$$8 - 5(8) = m$$

$$8 - 40 = m$$

$$\underline{-32 = m}$$

$$k = \underline{8}$$

$$m = \underline{-32}$$
 [3]

- 9 A is the point $(3, -1)$.

$$\overrightarrow{AB} = \begin{pmatrix} 2 \\ -4 \end{pmatrix}$$

(a) $\overrightarrow{AC} = 2\overrightarrow{AB}$

Find the coordinates of the point C .

$$\begin{aligned}\overrightarrow{AC} &= 2\begin{pmatrix} 2 \\ -4 \end{pmatrix} \\ &= \begin{pmatrix} 4 \\ -8 \end{pmatrix}\end{aligned}$$

$$\overrightarrow{AC} = \underline{c} - \underline{a}$$

$$\begin{pmatrix} 4 \\ -8 \end{pmatrix} = \underline{c} - \begin{pmatrix} 3 \\ -1 \end{pmatrix}$$

$$\underline{c} = \begin{pmatrix} 4 \\ -8 \end{pmatrix} + \begin{pmatrix} 3 \\ -1 \end{pmatrix}$$

$$\underline{c} = \begin{pmatrix} 7 \\ -9 \end{pmatrix}$$

$$(\underline{\hspace{1cm}}7\underline{\hspace{1cm}}, \underline{\hspace{1cm}}-9\underline{\hspace{1cm}}) \quad [2]$$

- (b) The length of AB is $k\sqrt{5}$.

Find the value of k .

$$\begin{aligned}&\sqrt{2^2 + (-4)^2} \\ &= \sqrt{4 + 16} \\ &= \sqrt{20}\end{aligned}$$

$$\begin{aligned}&= \sqrt{4} \times \sqrt{5} \\ &= \underline{2\sqrt{5}}\end{aligned}$$

$$k = \underline{\hspace{1cm}}2\underline{\hspace{1cm}} \quad [2]$$

(c) P is a point on AB .

$$AP : PB = 1 : 3$$



Find the position vector of P .

$$\vec{AP} = \frac{1}{4} \vec{AB}$$

$$\begin{aligned} \vec{AP} &= \frac{1}{4} \begin{pmatrix} 2 \\ -4 \end{pmatrix} \\ &= \begin{pmatrix} 0.5 \\ -1 \end{pmatrix} \end{aligned}$$

$$\vec{AP} = \mathbf{p} - \mathbf{a}$$

$$\begin{pmatrix} 0.5 \\ -1 \end{pmatrix} = \mathbf{p} - \begin{pmatrix} 3 \\ -1 \end{pmatrix}$$

$$\begin{aligned} \mathbf{p} &= \begin{pmatrix} 0.5 \\ -1 \end{pmatrix} + \begin{pmatrix} 3 \\ -1 \end{pmatrix} \\ &= \begin{pmatrix} 3.5 \\ -2 \end{pmatrix} \end{aligned}$$

$$\begin{pmatrix} 3.5 \\ -2 \end{pmatrix}$$

[2]

8 $\mathbf{m} = \begin{pmatrix} 11 \\ 5 \end{pmatrix}$ $\mathbf{n} = \begin{pmatrix} 8 \\ -3 \end{pmatrix}$

(a) Find $2\mathbf{m} - \mathbf{n}$.

$$2 \begin{pmatrix} 11 \\ 5 \end{pmatrix} - \begin{pmatrix} 8 \\ -3 \end{pmatrix} = \begin{pmatrix} 22 \\ 10 \end{pmatrix} - \begin{pmatrix} 8 \\ -3 \end{pmatrix} = \begin{pmatrix} 14 \\ 13 \end{pmatrix}$$

$$\begin{pmatrix} 14 \\ 13 \end{pmatrix}$$

[2]

(b) The vector $\begin{pmatrix} 5 \\ \sqrt{y} \end{pmatrix}$ has a magnitude of 7.

Find the value of y .

$$\begin{aligned} \sqrt{5^2 + \sqrt{y}^2} &= 7 \\ \text{square} \quad \quad \quad \text{square} \\ 5^2 + \sqrt{y}^2 &= 49 \end{aligned}$$

$$\begin{aligned} 25 + y &= 49 \\ -25 \quad \quad -25 \end{aligned}$$

$$y = 24$$

$$y = \underline{\quad 24 \quad} \quad [2]$$

11 (a) $\left| \frac{9m}{40m} \right| = \frac{205}{2} \leftarrow = 102.5$

Find the two possible values of m .

$$\sqrt{(9m)^2 + (40m)^2} = 102.5$$

Square

Square

$$(9m)^2 + (40m)^2 = 10506.25$$

$$81m^2 + 1600m^2 = 10506.25$$

$$1681m^2 = 10506.25$$

$\div 1681$

$\div 1681$

$$m^2 = \frac{25}{4}$$

$$m = \pm \sqrt{\frac{25}{4}}$$

$$m = \pm \frac{5}{2}$$

$$m = \frac{5}{2} \text{ or } -\frac{5}{2} \quad [3]$$