(5) (a) $\vec{AB} = \begin{pmatrix} 4 \\ -1 \\ 0 \end{pmatrix} - \begin{pmatrix} 1 \\ 5 \\ -3 \end{pmatrix} = \begin{pmatrix} 3 \\ -6 \\ 3 \end{pmatrix}$

$\vec{BC} = \begin{pmatrix} 8 \\ -9 \\ 4 \end{pmatrix} - \begin{pmatrix} 4 \\ -1 \\ 0 \end{pmatrix} = \begin{pmatrix} 4 \\ -8 \\ 4 \end{pmatrix}$

$\vec{AB}$ is parallel to $\vec{BC}$ since $\vec{AB} = \frac{3}{4}\vec{BC}$

and since B is a common point, A, B and C are collinear.

(b) 3 : 4

Question			Generic scheme	Illustrative scheme	Max mark
5.	(a)		$\bullet^1$ find an appropriate vector eg $\overrightarrow{AB}$	$\bullet^1$ eg $\overrightarrow{AB} = \begin{pmatrix} 3 \\ -6 \\ 3 \end{pmatrix}$	**3**
			$\bullet^2$ find a second vector eg $\overrightarrow{BC}$ and compare	$\bullet^2$ eg $\overrightarrow{BC} = \begin{pmatrix} 4 \\ -8 \\ 4 \end{pmatrix}$ $\therefore \overrightarrow{AB} = \frac{3}{4}\overrightarrow{BC}$	
			$\bullet^3$ appropriate conclusion	$\bullet^3$ ... $\Rightarrow$ AB is parallel to BC (common direction) and B is a common point $\Rightarrow$ A,B and C are collinear.	

Notes:

1. Do not penalise inconsistent vector notation (eg lack of arrows or brackets).
2. Where $\bullet^2$ is not awarded, if a candidate states that $\overrightarrow{AB} = \overrightarrow{BC}$, only $\bullet^1$ is available.
3. $\bullet^3$ can only be awarded if a candidate has stated 'parallel', 'common point' and 'collinear'.
4. Candidates who state that 'points are parallel' or 'vectors are collinear' or 'parallel and share common point $\Rightarrow$ collinear' do not gain $\bullet^3$. There must be reference to points A, B and C.
5. Do not accept 'a, b and c are collinear' at $\bullet^3$.

Commonly Observed Responses:

Candidate A – missing labels

$\begin{pmatrix} 3 \\ -6 \\ 3 \end{pmatrix}$ $\bullet^1$ ^

$\begin{pmatrix} 4 \\ -8 \\ 4 \end{pmatrix}$ $\therefore \overrightarrow{AB} = \frac{3}{4}\overrightarrow{BC}$ $\bullet^2$ ✓ 1

Missing labels at •2 is a repeated error

$\Rightarrow$ AB is parallel to BC and B is a common point

$\Rightarrow$ A, B and C are collinear $\bullet^3$ ✓ 1

Candidate B

$\overrightarrow{AB} = \begin{pmatrix} 3 \\ -6 \\ 3 \end{pmatrix}$ $\bullet^1$ ✓

$\overrightarrow{BC} = \begin{pmatrix} 4 \\ -8 \\ 4 \end{pmatrix}$

$\begin{pmatrix} 3 \\ -6 \\ 3 \end{pmatrix} = 3\begin{pmatrix} 1 \\ -2 \\ 1 \end{pmatrix}$ **and** $\begin{pmatrix} 4 \\ -8 \\ 4 \end{pmatrix} = 4\begin{pmatrix} 1 \\ -2 \\ 1 \end{pmatrix}$ $\bullet^2$ ✓

$\therefore \overrightarrow{AB} = \frac{4}{3}\overrightarrow{BC}$

Ignore working subsequent to correct statement made on previous line.

$\Rightarrow$ AB is parallel to BC and B is a common point

$\Rightarrow$ A, B and C are collinear $\bullet^3$ ✓

Question			Generic scheme	Illustrative scheme	Max mark
	(b)		$\bullet^4$ state ratio	$\bullet^4$ 3:4	1

Notes:

6. Answers in (b) must be consistent with the components of the vectors in (a) or the comparison of the vectors in (a). See Candidates C and D.
7. In this case, the answer for $\bullet^4$ must be stated explicitly in part (b).
8. The only acceptable variations for $\bullet^4$ must be related explicitly to AB and BC.
   For $\frac{BC}{AB}=\frac{4}{3}$, $\frac{AB}{BC}=\frac{3}{4}$ or $BC:AB=4:3$ stated in part (b) award $\bullet^4$. See Candidate E.
9. Accept unitary ratios for $\bullet^4$, eg $\frac{3}{4}:1$ or $1:\frac{4}{3}$.
10. Where a candidate states multiple ratios which are not equivalent, award 0/1.

Commonly Observed Responses:

Candidate C – using components of vectors

(a) $\overrightarrow{AB}=\begin{pmatrix}3\\-6\\3\end{pmatrix}$ $\bullet^1$ ✓

$\overrightarrow{BC}=\begin{pmatrix}4\\-8\\4\end{pmatrix}$

$\overrightarrow{BC}=\frac{3}{4}\overrightarrow{AB}$ $\bullet^2$ ✗

(b) 3:4 $\bullet^4$ ✓

Candidate D – using comparison of vectors

(a) $\overrightarrow{AB}=\begin{pmatrix}3\\-6\\3\end{pmatrix}$ $\bullet^1$ ✓

$\overrightarrow{BC}=\begin{pmatrix}4\\-8\\4\end{pmatrix}$

$\overrightarrow{BC}=\frac{3}{4}\overrightarrow{AB}$ $\bullet^2$ ✗

(b) 4:3 $\bullet^4$ ✓ 1

Candidate E – acceptable variation

$\frac{AB}{BC}=\frac{3}{4}$ $\bullet^4$ ✓

Ratio $=4:3$

Ignore working subsequent to correct statement made on previous line.

Candidate F – trivial ratio

Ratio is 1:1 $\bullet^4$ ✓ 2