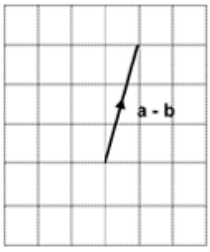
Mark scheme

Question			Answer/Indicative content	Marks	Guidance	
1			Rotation 90° [clockwise] or 270° anticlockwise (-1, 3)	2 1 1	**B1** for triangle or vertices at (-1, 5), (-1, 8) and (3, 5)	Must be rotate or rotation, not turn etc Condone -1, 3 Condone an answer [for full or part marks] that repeats the given transformation i.e. rotation, 90° [clockwise], (-1, 3) followed by translation $\begin{pmatrix}4\\-9\end{pmatrix}$ In other cases: If more than one transformation stated then max award is the **B1** for the triangle or vertices if drawn on the grid
			Total	**4**		
2			[*h* =] 4 [*A* =] 2646 with correct working	6	**M2** for $\sqrt[3]{\frac{3430}{80}}$ or 3.5 oe or $\sqrt[3]{\frac{80}{3430}}$	"Correct working" requires evidence of at least **M2**

					or $\frac{2}{7}$ **oe** or **M1** for $\frac{3430}{80}$ or 42.875 **oe** or $\frac{80}{3430}$ or $\frac{8}{343}$ **oe** AND **B2** for [*h* =] 4 or M1 for $\frac{14}{3.5}$ **oe** AND **B2** for [*A* =] 2646 or **M1** for 216 × (*their* 3.5)^2 **oe**	e.g. $14 \times \frac{2}{7}$ e.g. $216 \div (\textit{their}\ \frac{2}{7})^2$ Note : Use of scale factor = $\frac{\sqrt[3]{3430}}{\sqrt[3]{80}}$ often leads to accuracy errors so award **M2** for $\frac{\sqrt[3]{3430}}{\sqrt[3]{80}}$ **M1** for $\frac{14}{\textit{their}3.5}$ **oe** (penalise accuracy once here at first occurrence) **M1 A1** for 216 × (*their* 3.5)^2 = answer to *A*

						involving a rounding error
			Total	**6**		
3			Vector **a – b** correctly drawn with correct direction arrow on the resultant  	3	**B2** for **a – b** correctly drawn but with an incorrect or no direction arrow or **B1** for *their* $\begin{pmatrix}-1\\3\end{pmatrix}-\begin{pmatrix}-2\\0\end{pmatrix}$ or $\begin{pmatrix}1\\3\end{pmatrix}$ or for drawing $\begin{pmatrix}-1\\3\end{pmatrix}-\begin{pmatrix}-2\\0\end{pmatrix}$ **oe** on grid as two sides of a potential triangle (condone missing/wrong arrows) If **0** scored, **SC1** for vector $\begin{pmatrix}3\\3\end{pmatrix}$ drawn on grid with correct direction arrow	Full marks may be within a triangle with correct direction arrow **B2** may be within a triangle with no direction arrow[s]
			Total	**3**		
4			20 nfww	3	**M2** for $\frac{15}{\sqrt[3]{27}}\times\sqrt[3]{64}$ **oe** or **M1** for $\sqrt[3]{27}:\sqrt[3]{64}$ **soi** or for $\frac{27}{64}=\frac{15^3}{x^3}$ **oe** or better	**M2** implied by ratio 15 : 20 or 20 : 15 **M1** accept in any order, e.g. 4 : 3 **oe** accept as fraction e.g. $\frac{3}{4}$ **oe** or $\frac{4}{3}$ **oe**
			Total	**3**		
5	a		Rotation about the origin and	2		

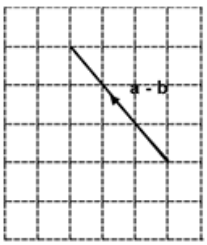
			20˚ anticlockwise **oe**		**B1** for each	Accept 0, 0 or O for origin More than one transformation scores **zero** marks Extra properties treat as choice Accept 340˚ clockwise
	b		(6, 1) and (6, 3)	1		Condone omission of bracket[s] if otherwise correct If additional coordinates listed then scores zero
			Total	**3**		
6			$\begin{pmatrix}-1\\3\end{pmatrix}$	2	**B1** for answer $\begin{pmatrix}-1\\k\end{pmatrix}$ or $\begin{pmatrix}k\\3\end{pmatrix}$	No fraction line in vector – but penalise **1** mark only in (a) and (b)
			Total	**2**		
7			[*h* =] 4.8 [*A* =] 1350 with correct working	6	**M2** for $\sqrt[3]{\frac{3750}{240}}$ or 2.5 oe or $\sqrt[3]{\frac{240}{3750}}$ or 0.4 oe or **M1** for $\frac{3750}{240}$ or 15.625 oe or $\frac{240}{3750}$ or 0.064 oe **B2** for [*h* =] 4.8 or **M1** for $\frac{12}{2.5}$ oe **B2** for [*A* =] 1350 or **M1** for 216 × (*their* 2.5)^2 oe	"Correct working" requires evidence of at least **M2** e.g. 12 × 0.4 e.g. 216 ÷ (*their* 0.4)^2 Note : Use of scale factor = $\frac{\sqrt[3]{3750}}{\sqrt[3]{240}}$ often leads to accuracy errors so award

						M2 for $\frac{\sqrt[3]{3750}}{\sqrt[3]{240}}$ **M1** for $\frac{12}{their 2.5}$ oe (penalise accuracy once here at first occurrence) **M1 A1** for 216 × (*their* 2.5) = answer to A involving a rounding error
						Examiner's Comments Many calculated the scale factor of volume as 3750 ÷ 240 or 15.625 and then they would use this to calculate the missing values. They needed to first calculate the scale factor of length by working out $\sqrt[3]{15.625}$.
			Total	**6**		
8			Correct response e.g. a vector $\begin{pmatrix} p \\ q \end{pmatrix}$ where $p^2 + q^2 = 10$ or **FT** *their* (a)	1FT	Allow correct or **FT** *their* (a) Must be numeric and column vector	e.g. $\begin{pmatrix} \pm 1 \\ \pm 3 \end{pmatrix}$ or $\begin{pmatrix} \pm 3 \\ \pm 1 \end{pmatrix}$ or $\begin{pmatrix} \sqrt{10} \\ 0 \end{pmatrix}$ etc but not *their* $\begin{pmatrix} -1 \\ 3 \end{pmatrix}$ from (a)
			Total	**1**		
9			Rotation 90° [anticlockwise] or 270° clockwise (−1, 3)	2 1 1	**B1** for triangle or vertices at (−5, 1), (−1, 1) and (−1, −2)	Must be rotate or rotation, not turn etc Condone −1, 3 Condone an answer [for full or part marks] that repeats the given transformation ie rotation, 90° [anticlockwise],(−1,

						3) followed by translation $\begin{pmatrix}8\\-5\end{pmatrix}$ In other cases: If more than one transformation stated then max award is the **B1** for the triangle or vertices if drawn on the grid
					Examiner's Comments The candidates that were most successful translated triangle B by $\begin{pmatrix}-8\\5\end{pmatrix}$ to give the image of triangle A after transformation T. For full marks T needed to be stated as a rotation with both the centre and angle being given. The most common error was to give more than one transformation in the answer, for example, rotate 90° anticlockwise about the origin and then translate by $\begin{pmatrix}10\\-1\end{pmatrix}$. Such attempts almost always scored zero, although B1 was still available if the image of triangle A after transformation T had been shown.	
			Total	**4**		
10	a		Enlargement [centre] ($^-1$, 0) [sf] $^-2$	3	**B1** for each	If more than one transformation award **0**
	b		Reflection $y = {}^-x$	2 1	**M1** for correct final image of their starting object	If more than one transformation award only **M1** if applicable If using rectangle T the image will have vertices at ($^-1$, $^-1$) ($^-1$, $^-4$) ($^-2$, $^-1$) and ($^-2$, $^-4$)
			Total	**6**		

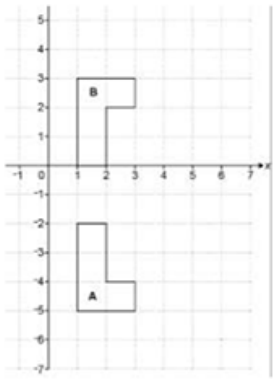
11			BMD and [diameter bisects chord] so CD [diameter] is perpendicular to AB [chord] [MD is] common SAS	1 1 1		Also accept DMB Accept e.g. 'shared'
			Total	**3**		
12	a		$\begin{pmatrix}3\\10\end{pmatrix}$	2	**B1** for either 3 or 10 in correct position or for $\left[\begin{pmatrix}6\\4\end{pmatrix}+\right]\begin{pmatrix}-3\\6\end{pmatrix}$ or $\begin{pmatrix}6\\4\end{pmatrix}-\begin{pmatrix}3\\-6\end{pmatrix}$	Not for $\begin{pmatrix}\frac{3}{10}\end{pmatrix}$
	b		$\begin{pmatrix}1\\3\end{pmatrix}$	1		Not for $\begin{pmatrix}\frac{1}{3}\end{pmatrix}$
			Total	**3**		
13	a		Rotation about the origin and 50° clockwise oe	2	**B1** for each **<u>Examiner's Comments</u>** Candidates answered this part well. Most gave a complete description of the transformation. Others were given partial credit for either stating rotation around the correct centre, or for giving the correct angle and direction of the rotation.	Accept 0, 0 or O for origin More than one transformation scores zero marks Extra properties treat as choice Accept 310° anticlockwise
	b		(1, 4) and (5, 4)	1		Condone omission of

					bracket[s] if otherwise correct If additional coordinates listed then scores zero **Examiner's Comments** There were many correct responses, but a significant number of candidates seemed uncertain with the term 'invariant'. Answers with one coordinate, four coordinates and coordinates other than the four vertices of the rectangle were given by some.
			Total	**3**	
14	a		$\begin{pmatrix}-3\\1\end{pmatrix}$	2	**B1** for answer $\begin{pmatrix}-3\\k\end{pmatrix}$ or $\begin{pmatrix}k\\1\end{pmatrix}$ No fraction line in vector – but penalise 1 mark only in (a) and (b) **Examiner's Comments** This was correctly answered by the vast majority of candidates. The most common errors were to omit the negative sign from the horizontal component, or to write the components the wrong way around. A few candidates incorrectly included a fraction line in their vector answer. **Misconception** Candidates clearly understand the concept of horizontal and vertical components, however they must make sure that they pay attention to the direction of the vector as well as the order of the components in the column vector.

	b		Correct response e.g. a vector $\begin{pmatrix} p \\ q \end{pmatrix}$ where $p^2 + q^2 = 10$ or FT *their* (a)	1FT	Allow correct or FT *their* (a) Must be numeric and column vector e.g. $\begin{pmatrix} \pm 3 \\ \pm 1 \end{pmatrix}$ or $\begin{pmatrix} \pm 1 \\ \pm 3 \end{pmatrix}$ or $\begin{pmatrix} \sqrt{10} \\ 0 \end{pmatrix}$ etc but not *their* $\begin{pmatrix} -3 \\ 1 \end{pmatrix}$ from (a) **Examiner's Comments** This question was answered correctly by almost all candidates. Of the few errors that were made, some candidates added one to a component and subtracted one from the other component, presumably with a misconception that this would retain the length while changing the direction.
	c		Vector **a** – **b** correctly drawn with correct direction arrow on the resultant  	3	**B2** for **a** − **b** correctly drawn but with an incorrect or no direction arrow or or **B1** for *their* $\begin{pmatrix} -3 \\ 1 \end{pmatrix} - \begin{pmatrix} 0 \\ -2 \end{pmatrix}$ or $\begin{pmatrix} -3 \\ 3 \end{pmatrix}$ or for drawing $\begin{pmatrix} -3 \\ 1 \end{pmatrix} - \begin{pmatrix} 0 \\ -2 \end{pmatrix}$ oe on grid as two sides of a potential triangle (condone missing/wrong arrows) If 0 scored, **SC1** for vector $\begin{pmatrix} -3 \\ 5 \end{pmatrix}$ drawn on grid with correct direction arrow Full marks may be within a triangle with correct direction arrow B2 may be within a triangle with no direction arrow[s] **Examiner's Comments**

					Candidates found this more challenging than parts (a) and (b). Those candidates that drew the vectors **a** and $^{-}$**b** to show **a** + ($^{-}$**b**) were often successful with this question. Some candidates drew these two vectors, but did not then join them together to make the resultant vector **a** – **b**. Those that wrote down the subtraction of the column vectors were also generally successful, although there were some sign errors seen when performing the calculation. Some correctly showed a line for **a** – **b**, but did not include a direction arrow; these were given 2 out of the 3 marks available **Assessment for learning** Candidates should be encouraged to show the steps in their method (either drawing or calculation), so that part marks can still be given if an error is made. When drawing the difference of two vectors **a** – **b**, consider it as **a** + ($^{-}$**b**) and hence draw **a** followed by ($^{-}$**b**). **Misconception** A vector must have a directional arrow. It is not sufficient to just draw a straight line. Exemplar 1  In this example the candidate draws a triangle of vectors, but does not place a direction arrow on the vector **a** – **b**.

					The response is otherwise correct, so 2 out of the 3 marks are given.
			Total	**6**	
15			9 nfww	3	**M2** for $\frac{6}{\sqrt[3]{8}} \times \sqrt[3]{27}$ oe or **M1** for $\sqrt[3]{8} : \sqrt[3]{27}$ soi or for $\frac{8}{27} = \frac{6^3}{x^3}$ oe or better M2 implied by ratio 6 : 9 or 9 : 6 M1 accept in any order, e.g. 3 : 2 oe accept as fraction e.g. $\frac{2}{3}$ oe or $\frac{3}{2}$ oe **Examiner's Comments** Most candidates found this question challenging. The most common error was to just directly apply the given ratio to the height of prism A, leading to 6 × $\frac{27}{8}$ or similar. Those that found the correct linear scale factor (2 : 3) usually scored all 3 marks. Those that converted $\frac{27}{8}$ or $\frac{8}{27}$ to a decimal often had difficulty in then finding the cube root, with some candidates attempting the square root or dividing by 3 instead. **Misconception** For similar shapes, the ratio of volumes is not equal to the ratio of lengths. Candidates were often unable to establish the correct relationship between the volume scale factor and the length scale factor.
			Total	**3**	
16	a		Translation $\begin{pmatrix} -5 \\ 6 \end{pmatrix}$	1 1	Marks spoilt if extra transformations Do not accept

						coordinates, with a fraction bar or in words
	b			2	**B1** for correct orientation but wrong location or for correct reflection but in $x = -1$	
			Total	**4**		
17			Angle AEB = angle DEC and [vertically] opposite Angle ABE = angle ECD and same segment Angle BAE = angle EDC and same segment [Triangle AEB is similar to triangle DEC] [corresponding] angles are equal oe or AAA oe OR After two pairs of angles with reasons gives 3rd pair of equal angles with a reason	M2 A1	For **M2** only two of the three statements and reasons are required **M1** for one pair of angles with a reason With no errors or incorrect statements seen If 0 scored, **SC1** for at least two correct pairs of angles identified with no / incorrect reasons	Allow any unambiguous labelling for angles e.g. ABE or ABD or B, but not E For reason accept e.g. opp ∠'s For same segment, accept same arc but not same chord Accept 3rd angle in triangle oe for reason with final angle if other two given correctly with correct reasons Accept they have the 'same/equal angles' oe, AA **and** similar. Accept symbol **~** for similar Condone angles identified on diagram for **SC1**

			Total	**3**		
18			43.2 to 43.3 **nfww**	4	**M3** for $30 \times \sqrt[3]{\frac{1.5}{0.5}}$ **oe** or $30 \div \sqrt[3]{\frac{1.5}{0.5}}$ **oe** or **M2** for $\sqrt[3]{\frac{1.5}{0.5}}$ **oe soi** by 1.44 to 1.45 or $\sqrt[3]{\frac{0.5}{1.5}}$ **oe soi** by 0.69 to 0.70 or $\frac{h^3}{30^3} = \frac{1.5}{0.5}$ **oe** or **M1** for $\frac{1.5}{0.5}$ **oe soi** by 3 or $\frac{0.5}{1.5}$ **oe soi** by $\frac{1}{3}$ If **0** scored then **SC1** for 90 as final answer	Accept 43 as final answer after **M3** May see as length ratio, e.g. **M2** for $\sqrt[3]{1.5} : \sqrt[3]{0.5}$ **soi** by 1.1447(…) to 1.145 : 0.7937(…) to 0.794 May see as volume ratio, e.g. **M1** for 1.5 : 0.5 **oe** May also be seen as part of wrong approach e.g. 30 × 3 scores **M1**
			Total	**4**		
19			Rotation [centre] (0, 2) 180° OR Enlargement [centre] (0, 2) [sf =] $^{-}1$	3	**B1** for each part If **0** scored **M1** for the correct object after rotation or after both transformations	More than one transformation scores **0** or **M1** Ignore direction of angle
			Total	**3**		
20	a		$\overline{CN} =$ **a** $- \frac{3}{5}$**c oe**	M1 M1		

			$\overrightarrow{CP} = \frac{5}{3}$= **a** – **c oe** or $\overrightarrow{NP} = \frac{2}{3}\mathbf{a} - \frac{2}{5}\mathbf{c}$**oe** $\overrightarrow{OP} = \frac{5}{3}\mathbf{a}$**oe** or $\overrightarrow{AP} = \frac{2}{3}\mathbf{a}$ Correct conclusion $\overrightarrow{OP} = \frac{5}{3}\overrightarrow{OA}$ **oe** or $\overrightarrow{OP}$ is a multiple of $\overrightarrow{OA}$ **oe**	B1 A1	or **FT** (*their* **(a)(ii)**) – **c** must be vector route in terms of **a** and/or **c** or **FT** $\overrightarrow{CP} = \frac{5}{3}$(*their* $\overrightarrow{CN}$) must be vector route in terms of **a** and/or **c** or **FT** $\overrightarrow{NP} = \frac{2}{3}$(*their* $\overrightarrow{CN}$) must be vector route in terms of **a** and/or **c** <u>Alternative method</u> (using similar triangles NCB and NPA) **M2** for $\overrightarrow{AP} = \frac{2}{3}\mathbf{a}$ **oe** **Dep on M2B1**	Condone omission of vector arrows etc throughout question Allow $\overrightarrow{CN}, \overrightarrow{CP}$ and $\overrightarrow{NP}$ both unsimplified and **isw** attempts to simplify NP may be embedded in working leading to OP when e.g. they do ON + NP Award B1 for e.g. OP = **c** + $\frac{5}{3}$**a** – **c** Accept OAP = $\frac{5}{3}$ **a oe** Accept correct equivalent vector conclusions involving AP and OP or OA
	b	i	**a + c**	1		Not A + C, but if use of capitals in other parts of question, penalise the first occurrence only Accept **c + a**
		ii	**a** + $\frac{2}{5}$**c** final answer	2	**M1** for correct route	**M1** for e.g. OA + AN, OC + **a** –

					or for $\overrightarrow{AN} = \frac{2}{5}\mathbf{c}$ or $\overrightarrow{BN} = \frac{-3}{5}\mathbf{c}$	NB Condone poor vector notation for method Could be written on diagram
			Total	**7**		
21			64 with correct working	4	**M3** for [8 ×] $\left(\sqrt{\frac{48}{12}}\right)^3$ or 2^3 oe or **M2** for $\sqrt{\frac{48}{12}}$ or $\sqrt{4}$ oe implied by 2 or **M1** for $\frac{48}{12}$ oe implied by 4 <u>Alternative method:</u> **M3** for [8 ÷] $\left(\sqrt{\frac{12}{48}}\right)^3$ or $\left(\frac{1}{2}\right)^3$ oe or **M2** for $\sqrt{\frac{12}{48}}$ or $\sqrt{\frac{1}{4}}$ oe implied by $\frac{1}{2}$ or 0.5 or **M1** for $\frac{12}{48}$ oe implied by $\frac{1}{4}$ or 0.25 If 0 scored, instead award **SC1** for answer 64 with no or insufficient working	"correct working" requires evidence of at least **M2** Accept ratios **M3** for 8 : 64 oe or **M2** for 2 : 4 oe or **M1** for 4 : 16 oe
			Total	**4**		
22			Yes SAS Yes RHS No	3	**B2** for two correct rows or **B1** for one correct row	Accept ticks and crosses For "No" ignore reason

			Total	**3**		
23	a		Triangle drawn with vertices at (2, 6), (2, -4), (7, ⁻4)	3	**B2** for scale factor 2.5 but wrong centre or for correct centre but wrong scale factor or for 3 correct plots but no triangle drawn OR **B1** for 2 vertices correct	Condone freehand mark intention e.g. B2 for a translation of the correct image For B2 and B1 image must fit entirely on grid
	b		Rotation 180 (⁻3, 1)	2 1 1	or **B1** for triangle or vertices at (⁻2, 2), (⁻2, 6), (⁻4, 6)	Not turn, **must be** rotate or rotation **<u>Accept:</u>** Enlargement **2** [Scale factor =] ⁻1 **1** [Centre] (⁻3, 1) **1** Condone ⁻3, 1 Allow as answer [full and part marks] Rotation, 180, (⁻3, 1) followed by/and reflection in *y*-axis (repeat of info in question) **but in other cases** If more than one other transformation given then B1 maximum if the triangle drawn on the grid e.g. Rotation 180 then

					translate 6 down is two transformations Extra properties treat as choice
			Total	**7**	
24			540	2	**M1** for 3^3 **oe**
			Total	**2**	
25			ODB or BDO and alternate BOD or DOB and vertically opposite **oe** Correct reason e.g. AAA or both triangles have the same angles **oe**	1 1 1	Accept CDB, etc.
			Total	**3**	
26	a		$\binom{1}{3}$	1	Not for $\binom{\frac{1}{3}}{}$ **Examiner's Comments** This was well answered; most candidates gave the correct vector in the required form.
	b		$\binom{3}{11}$	2	**B1** for either 3 or 11 in correct position or for $\binom{5}{3}+\binom{-2}{8}$ or $\binom{5}{3}-\binom{2}{-8}$ Not for $\binom{\frac{3}{11}}{}$ **Examiner's Comments** This was well answered by many candidates. Others found it more challenging. For some, there was more success with the horizontal component of the vector than the

					vertical one where the double negative was involved.
			Total	**3**	
27	a		Enlargement [centre] (−1,−1) [sf] −2	3	**B1** for each If more than one transformation award **0** **Examiner's Comments** Despite the clear question demand for a single transformation, most candidates gave a double transformation usually involving an enlargement and a rotation. Some gave the response of a single enlargement and would often give the correct centre, but the scale factor was the most difficult property to work out.
	b		Reflection $y = -x$	2 1	**M1** for correct final image of their starting object If more than one transformation award only **M1** if applicable If using triangle T the image will have vertices at (⁻1, ⁻1) (⁻1, ⁻4) and (⁻2, ⁻1) **Examiner's Comments** Few candidates attempted this part of the question, despite similar questions having been set many times previously. The best solutions used triangle T and operated both transformations on it, then used that to help them find the equivalent single transformation. Again, many gave a double transformation despite the clear question demand.

			Total	**6**	
28			QMT and [diameter bisects chord] so VT [diameter] is perpendicular to PQ [chord] [MT is] common SAS	1 1 1	Also accept TMQ accept e.g. 'shared' **Examiner's Comments** This was meant to be a partly completed proof. Only a few candidates realised they needed to refer to angle to angle QMT in the first part as most candidates put 90° instead and most did not know the reason why these two angles were equal. However, many used the correct term for side MT with 'common' or 'shared' being the most popular words. Also, many candidates realised it was SAS that was the reason for congruence. As there was a right angle some did give RHS instead.
			Total	**3**	
29			Rotation [centre] (2, 1) 180° OR Enlargement [centre] (2,1) [sf =] −1	3	**B1** for each part If **0** scored **M1** for the correct object after rotation or after both transformations More than one transformation scores **0** or **M1** Ignore direction of angle **Examiner's Comments** Many candidates did answer this question correctly. Several candidates

					used two transformations in their description, despite the request in bold for a single transformation (most often involving a translation in their description of their combined transformation). Some of these did correctly draw one or both images on the diagram and gained credit.
			Total	**3**	
30			55.5 to 55.6 nfww	4	M3 for $35 \times \sqrt[3]{\frac{2}{0.5}}$ oe or $35 \div \sqrt[3]{\frac{0.5}{2}}$ oe or **M2** for $\sqrt[3]{\frac{2}{0.5}}$ oe soi by 1.58 to 1.59 or $\sqrt[3]{\frac{0.5}{2}}$ oe soi by 0.62 to 0.63 or $\frac{h^3}{35^3} = \frac{2}{0.5}$ oe or **M1** for $\frac{2}{0.5}$ oe soi by 4 or $\frac{0.5}{2}$ oe soi by $\frac{1}{4}$ If **0** scored then **SC1** for 140 as final answer **Examiner's Comments**

Accept 56 as final answer after **M3**

May see as length ratio, eg **M2** for $\sqrt[3]{2} : \sqrt[3]{0.5}$ soi by

1.2599(…) to 1.26 : 0.7937(…) to 0.794

May see as volume ratio, eg. **M1** for 2 : 0.5 oe

May also be seen as part of wrong approach

eg. 35×4 scores **M1**

					There were only really two answers seen here, the wrong answer of 140 and the correct answer of 55.5 to 55.6. Unfortunately, 140 was the one that occurred most of the time. Perhaps the fact that the volume was given in litres meant that some candidates did not link this to being a volume/length scale factor question. Most candidates correctly obtained the volume scale factor of 4, but only about 1/4 of them then found the cube root and were successful in achieving full marks. The rest did 35 × 4, getting the wrong answer of 140. A few candidates multiplied 0.5 by 4 to get 2 and then multiplied 35 by 2 to reach 70 cm. There was a very small number of candidates who square rooted or cubed 4 instead of cube rooting.
			Total	**4**	
31	a	i	**a** + **c**	1	Not A + C, but if use of capitals in other parts of question, penalise the first occurrence only Accept **c** + **a** **Examiner's Comments** A significant number of candidates did not attempt this part involving vectors. Of those candidates that attempted it, the majority did give a correct answer in terms of **a** and **c**. Common incorrect answers included **ac**, **a** + 8, and column vectors such as $\binom{8}{8}$ or $\binom{a}{c}$.
		ii	$\mathbf{a} + \frac{3}{8}\mathbf{c}$ final answer	2	**M1** for correct route M1 for e.g. OA + AN, OC + **a** – NB

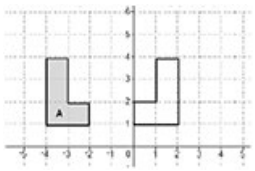
					or for $\overrightarrow{AN} = \frac{3}{8}\mathbf{c}$ or $\overrightarrow{BN} = -\frac{5}{8}\mathbf{c}$	Condone poor vector notation for method Could be written on diagram
					Examiner's Comments This part was often omitted, but those candidates who attempted the question often gave a correct answer. The most common errors included $\mathbf{a} + \frac{3}{8}$, $\mathbf{a} + 3\mathbf{c}$, $\mathbf{a} + \frac{1}{3}$ and $\mathbf{a} + \frac{3}{5}\mathbf{c}$. Only a few candidates wrote a correct vector route for $\overrightarrow{ON}$ or gave $\overrightarrow{AN} = \frac{3}{8}\mathbf{c}$ or $\overrightarrow{BN} = -\frac{5}{8}\mathbf{c}$ within their working (for which a part mark was given). **Assessment for learning** When attempting questions like this involving routes with more than one vector, candidates should always write the vector route in terms of the given line segments first, e.g. $\overrightarrow{ON} = \overrightarrow{OA} + \overrightarrow{AN}$. Examiners here could award a part mark for a correct route written in working. **Misconception** Candidates should recognise that if AN : NB = 3 : 5, then $\overrightarrow{AN}$ is $\frac{3}{8}$AB and not $\frac{3}{5}$AB.
	b		$\overrightarrow{CN} = \mathbf{a} - \frac{5}{8}\mathbf{c}$ oe $\overrightarrow{CP} = \frac{8}{5}\mathbf{a} - \mathbf{c}$ oe or $\overrightarrow{NP} = \frac{3}{5}\mathbf{a} - \frac{3}{8}\mathbf{c}$ oe $\overrightarrow{OP} = \frac{8}{5}\mathbf{a}$ oe or $\overrightarrow{AP} = \frac{3}{5}\mathbf{a}$	M1 M1 B1 A1	or **FT** (*their* **(a)(ii)**) – **c** must be vector route	Condone omission of vector arrows etc throughout question Allow $\overrightarrow{CN}, \overrightarrow{CP}$ and $\overrightarrow{NP}$ both unsimplified and

			Correct conclusion $\overrightarrow{OP} = \frac{8}{5}\overrightarrow{OA}$ **oe** or $\overrightarrow{OP}$ is a multiple $\overrightarrow{OA}$ **oe**		in terms of **a** and/or **c** or **FT** $\overrightarrow{CP} = \frac{8}{5}$ (*their* $\overrightarrow{CN}$) must be vector route in terms of **a** and/or **c** or **FT** $\overrightarrow{NP} = \frac{3}{5}$ (*their* $\overrightarrow{CN}$) must be vector route in terms of **a** and/or **c** <u>Alt method</u> (using similar triangles NCB and NPA) **M2** for $\overrightarrow{AP} = \frac{3}{5}\mathbf{a}$ oe **Dep on M2B1**	isw attempts to simplify NP may be embedded in working leading to OP when e.g. they do ON + NP Award B1 for e.g. $OP = \mathbf{c} + \frac{8}{5}\mathbf{a} - \mathbf{c}$ Accept $OAP = \frac{8}{5}\mathbf{a}$ oe Accept correct equivalent vector conclusions involving AP and OP or OA

<u>Examiner's Comments</u>

This question was a challenge for almost all candidates. The majority of candidates either didn't attempt this part at all, or annotated P on the diagram and wrote nothing further.

The candidates who made progress on this question attempted, often successfully, to find the vectors $\overrightarrow{CN}$ and $\overrightarrow{CP}$ or $\overrightarrow{NP}$ in terms of **a** and **c**. Some were then able to show that $\overrightarrow{OP} = \frac{8}{5}\mathbf{a}$ or $\overrightarrow{AP} = \frac{3}{5}\mathbf{a}$. Very few were then able to articulate the reasoning needed for the final mark, to show that OAP is a straight line using the vectors $\overrightarrow{OP}$ or $\overrightarrow{AP}$ and $\overrightarrow{OA}$.

			Total	**7**	
32	a		Translation $\begin{pmatrix}5\\-6\end{pmatrix}$	1 1	Marks spoilt if extra transformations Do not accept coordinates, with a fraction bar or in words **Examiner's Comments** Many candidates did not state 'translation' or give the correct vector. Descriptions of a movement were common, while 'transformation', 'reflection' and incorrect vector notation were often seen.
	b			2	**B1** for correct orientation but wrong location or for correct reflection but in $y = {}^{-}1$ **Examiner's Comments** Some correct reflections were seen but many candidates attempted a reflection in $y = {}^{-}1$, and often completed it incorrectly. Some responses showed a translation of $\begin{pmatrix}-1\\0\end{pmatrix}$. **Assessment for learning** Transformation questions are often a good source of procedural marks for Higher tier candidates. Knowledge of the lines $x = k$ and $y = k$ is important. They can be assessed, either within

					geometry, as here, or within questions on algebraic graphs.	
			Total	**4**		
33			Angle AED = angle BEC and [vertically] opposite Angle DAE = angle EBC and same segment Angle ADE = angle ECB and same segment [Triangle AED is similar to triangle BEC] [corresponding] angles are equal oe or AAA oe OR After two pairs of angles with reasons gives 3rd pair of equal angles with a reason	M2 A1	For **M2** only two of the three statements and reasons are required **M1** for one pair of angles with a reason With no errors or incorrect statements seen If 0 scored, **SC1** for at least two correct pairs of angles identified with no / incorrect reasons **Examiner's Comments**	Allow any unambiguous labelling for angles e.g. DAE or DAC or A, but not E For reason accept e.g. opp ∠'s For same segment, accept same arc but not same chord Accept 3rd angle in triangle oe for reason with final angle if other two given correctly with correct reasons Accept they have the 'same/equal angles' oe, AA **and** similar. Accept symbol ~ for similar Condone angles identified on diagram for **SC1**

					This question proved challenging for all candidates and was omitted by a number of candidates. A few realised that finding equal pairs of angles was the strategy. More able candidates attempted to work systematically, line by line, giving a pair of angles with a reason. Angle AED = angle BEC with the reason, [vertically] opposite, earned partial credit for some candidates, but the majority were unable to give correct geometric reasons for the other equal pairs of angles. A number gave incorrect angle pairs, such as angle A = angle C, perhaps thinking they were alternate angles. Some also referred to lengths and gave reasons of congruency, such as SAS.	
			Total	**3**		
34			125 with correct working	4	**M3** for $[8\times]\left(\sqrt{\frac{75}{12}}\right)^3$ or 2.5^3 oe or M2 for $\sqrt{\frac{75}{12}}$ or $\sqrt{6.25}$ oe implied by 2.5 or 5/2 or **M1** for $\frac{75}{12}$ oe implied by 6.25 <u>Alternative method:</u> **M3** for $[8\div]\left(\sqrt{\frac{12}{75}}\right)^3$ or 0.4^3 oe or **M2** for $\sqrt{\frac{12}{75}}$ or $\sqrt{0.16}$ oe	"correct working" requires evidence of at least **M2** Accept ratios **M3** for 8 : 125 oe or **M2** for 2 : 5 oe or **M1** for 4 : 25 oe

					implied by 0.4 or 2/5 or **M1** for $\frac{12}{75}$oe implied by 0.16 If 0 scored, instead award **SC1** for answer 125 with no or insufficient working	
					Examiner's Comments Some good solutions were seen from candidates who realised they needed to find the area scale factor, then the linear scale factor and then the volume scale factor. A few of these candidates gave this volume scale factor, 15.625, as their final answer and so only scored 3 marks. Some candidates set out their work in a table, which helped them to realise they were working initially with an area scale factor. Many candidates multiplied the volume of pyramid A by the area scale factor of 6.25 to give an incorrect answer of 50 cm^2. Other candidates reached the same answer via ratios with the value of the volume of pyramid A being $\frac{2}{3}$of the value of its area. Some candidates thought 6.25 was a length scale factor and so used 6.25^3 as their volume scale factor.	
			Total	**4**		
35			Yes SSS Yes ASA No	3	**B2** for two correct rows or **B1** for one correct row	Accept ticks and crosses For "No" ignore reason

					Examiner's Comments For the first pair of triangles, most candidates correctly answered "yes" and gave "SSS" as the reason.Only about half of candidates answered "yes" with the correct reason of "ASA" for the second pair of triangles. "No" was quite frequent and "RHS" was also a common incorrect reason. Only the more able candidates correctly answered "no" for the third pair of triangles.
			Total	**3**	
36	a		Triangle drawn with vertices at (1, 0), (1, 6), (4, 6)	3	**B2** for scale factor 1.5 but wrong centre or for correct centre but wrong scale factor or for 3 correct plots but no triangle drawn OR **B1** for 2 vertices correct Condone freehand mark intention e.g. B2 for a translation of the correct image For B2 and B1 image must fit entirely on grid **Examiner's Comments** This was generally well answered. Most candidates could enlarge the triangle by scale factor 1.5 but not always using the correct centre of enlargement. Those that did a correct enlargement from a wrong centre scored 2 marks and this was the most common award. A few used the ray method and were inaccurate with one or more of their plots and a few used the correct centre but enlarged with the wrong scale factor. **Assessment for learning**

					When using the ray method for enlargement, always check accuracy by counting squares from the centre to the image and by checking that the enlarged shape has consistent lengths with the required scale factor.
	b		Rotation 180 (1, 3)	2 1 1	or **B1** for triangle or vertices at (2, 2), (4, 2), (4, 6) Not turn, **must be** rotate or rotation **Accept** Enlargement **2** [Scale factor =] –1 **1** [Centre] (1, 3) **1** Condone 1, 3 Allow as answer [full and part marks] Rotation, 180, (1, 3) followed by/and reflection in *x*-axis (repeat of info in question) **but in other cases** If more than one other transformation given then B1 maximum if the triangle drawn on the grid e.g. Rotation 180 then move 1 across, up 2 is two transformations Extra properties treat as choice **Examiner's Comments** The candidates that were most successful here reversed the

					reflection in the *x*-axis from triangle B to draw the image of A after the first transformation. To describe the rotation, the centre and angle of rotation was needed and some, having recognised rotation, either made an error or omitted one of these properties. The most common error was to give more than one transformation for the answer, for example, rotate 180° then translate and in these cases 0 marks were given for the description.
			Total	**7**	
37	a		Triangle at ($^-$8, 6), ($^-$8, 2), (0, 6)	2	**B1** for reflection in $x = k$ or in $y = 0$ | Mark intention, condoning freehand **Examiner's Comments** **Misconception** In this part, candidates were required to reflect a triangle in the line $x = 0$ but some candidates reflected in the x-axis.
	b		Enlargement $\frac{1}{4}$ or 0.25 (0, $^-$6)	3	**B1** for each element | Marks spoilt if extra transformations Condone omission of brackets Accept centre as a vector **Examiner's Comments** **AfL** The three marks available in this part for describing fully a single transformation provided a clue that

					three pieces of information were required: enlargement, the centre, and the scale factor. Many responses were not full, and a few included a second transformation, often described by the candidate as a "move". Candidates are expected to use appropriate terminology, and so "reduction", "shrink", "÷ 4" etc. were not accepted.
			Total	**5**	
38			400	2	**M1** for 2^3 **oe** **Examiner's Comments** Most candidates did not realise in this question that a volume scale factor should be used and that this is the length scale factor cubed. It was very common to have an answer of 100 from 50 × 2.
			Total	**2**	
39			AED or DEA and corresponding common oe correct reason e.g. AAA or both triangles have the same angles oe	1 1 1	accept CED, DEC accept "same as angle DAE" oe ignore any reasons
			Total	**3**	