EXPERT TUITION

Maths Questions By Topic:

Geometry & Measures Mark Scheme

Edexcel GCSE (Higher)

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Question	Answer	Mark	Mark scheme	Additional guidance
1	12	P1	for a process to find the area of cross section, eg $750 \div 25$ (= 30) oe **or** $\frac{1}{2} \times 5 \times h$ oe	May use any letter for h or may use ?
		P1	for a correct equation in h, eg $750 \div 25 = \frac{1}{2} \times 5 \times h$ oe **or** $\frac{1}{2} \times 5 \times h \times 25 = 750$ oe **or** for a complete process to find h, eg $\frac{750}{25} \times \frac{2}{5}$ oe **or** "30" $\times 2 \div 5$	
		A1	cao SC B1 for answer of 6 if P0 scored	
2	Shown	M1	for a correct expression for the area of one face of the cube, eg x^2 **or** a correct expression for the surface area of the cube, eg $6 \times x^2$	No marks for $x = \sqrt{6\pi}$ without any working.
		M1	for a correct expression for the surface area of the sphere, eg $4 \times \pi \times 3^2$ (= 36π)	
		M1	for forming a suitable equation, eg $6 \times x^2 = 4 \times \pi \times 3^2$ **or** $6x^2$ = "36π"	$6 \times x^2 = 4 \times \pi \times 3^2$ $x^2 = 36\pi \div 6$
		A1	for completing the method to $x = \sqrt{6\pi}$ or $k = 6$	$x = \sqrt{6\pi}$

Question	Answer	Mark	Mark scheme	Additional guidance
3 (a)	30	P1	for a start to the process, eg 5406 ÷ 6 (= 901) **or** 5400 ÷ 6 (= 900) **or** 5000 ÷ 6 (= 833.33..) **or** 5410 ÷ 6 (= 901.66..)	
		P1	for a process to find the length of one side, eg $\sqrt{"901"}$ **or** $\sqrt{"900"}$ **or** $\sqrt{"833.33.."}$ **or** $\sqrt{"901.66.."}$	
		A1	for 30	
(b)	Explanation	C1	for a correct explanation based on their working in (a), eg underestimate because I rounded the total area down	Must be based on the use of a rounded value in a calculation
4	A & D	B1	cao	

Question	Answer	Mark	Mark scheme	Additional guidance
5	85 with working and reasons	M1	for correct use of corresponding angles eg *AEB* = 63 **or** co-interior angles eg *BCD* = 180 – 148 (= 32) or *DEB* = 180 – 63 (= 117)	Angles must be clearly labelled on the diagram or otherwise identified. Full solution must be seen.
		M1	(dep) for a complete method to find angle *EAB* eg. 180 – "63" – (180 – 148) **or** 148 – "63" **or** "117" – (180 – 148)	Correct method can be implied from angles on the diagram if no ambiguity or contradiction.
		A1	for *EAB* = 85 (identified)	
		C2	(dep on M2) all working correct with all appropriate reasons stated. Corresponding angles are equal Allied angles / Co-interior angles add up to 180 Angles on a straight line add up to 180 Angles in a triangle add up to 180 The exterior angle of a triangle is equal to the sum of the interior opposite angles.	When reasons are given the key words underlined must be present. Reasons need to be linked to their method; any reasons not linked, do not credit. There should be no incorrect reasons given.
		(C1	for **one** reason relating to parallel lines clearly used and stated **or** for any **two** reasons clearly stated for their fully correct method)	

Question	Answer	Mark	Mark scheme	Additional guidance
6	Proof	M1	for $\overrightarrow{DQ}$ = ½ (**b** − **a**) oe or $\overrightarrow{EQ}$ = ½ (**a** − **b**) oe	Vectors could be written on the diagram
		M1	for $\overrightarrow{PQ}$ = ½ **a** + $\overrightarrow{DQ}$ **or** ½ **a** + ½ (**b** − **a**) oe **or** $\overrightarrow{PQ}$ = − ½ **a** + **b** + $\overrightarrow{EQ}$ **or** − ½ **a** + **b** + ½ (**a** − **b**) oe	
		B1	for $\overrightarrow{PQ}$ = ½ **b**	
		C1	for complete proof with statement, eg $FE = 2PQ$ **or** FE is a multiple of PQ **or** **b** = 2(½ **b**)	
7	0.5	P1	derive an algebraic expression for the area of A eg $\frac{1}{8}\pi\,[\,(5x-1)^2-(3x-1)^2\,]$	
		P1	expand and simplify for either area A or area B eg $\frac{1}{8}\pi\,(16x^2-4x)$ **or** $\pi(x^2-2x+1)$	
		P1	(dep P2) equate and rearrange into a quadratic eqn of the form $ax^2 + bx + c = 0$ eg $2x^2 + 3x - 2 = 0$	
		P1	(dep P3) factorise eg $(2x - 1)(x + 2) = 0$ **or** use of formula eg $\frac{-3 \pm \sqrt{3^2 - 4\times 2\times -2}}{2\times 2}$	
		A1	oe	Accept only the single value of 0.5 oe but award 0 marks for a correct answer with no supportive working

Question	Answer	Mark	Mark scheme	Additional guidance
8	sketch	M1 A1	for sketch of a cylinder sketch of cylinder, with dimensions shown	Hidden edges may or may not be shown 2 (cm) for radius or 4 (cm) for diameter and 5 (cm) for height
9	$c = -6$ $d = -1$	M1 A1 A1	for reflection in x-axis shown on diagram for $c = -6$ or $d = -1$ for both $c = -6$ and $d = -1$ SCB2 for $c = -1$ and $d = -6$	Vertices (3, −2), (5, −2), (3, −5) One correct value is M1A1 regardless of second value or diagram
10	8.5	P1 P1 P1 A1	for process to use the area of $PQRS$ to find the length of PQ, eg $10y = 45$ **or** $45 \div 10$ (= 4.5) for process to use the perimeter of $ABCD$, eg $2x + 2 \times$ "4.5" = 26 **or** 26 – 2 × "4.5" (= 17) **or** 26 ÷ 2 (= 13) for process to use length of BC to find length of AB, eg solves $2x + 2 \times$ "4.5" = 26 **or** (26 – 2 × "4.5") ÷ 2 **or** "13" – "4.5" for 8.5 **or** $8\frac{1}{2}$	Sets up equation for area Uses perimeter of $ABCD$ Accept $\frac{17}{2}$

Question	Answer	Mark	Mark scheme	Additional guidance
11	$\frac{1}{2}$	M1	for $\frac{1}{\sqrt{3}} \times \frac{\sqrt{3}}{2}$ **or** $\frac{\sqrt{3}}{3} \times \frac{\sqrt{3}}{2}$ **or** $(\frac{1}{2} \div \frac{\sqrt{3}}{2}) \times \frac{\sqrt{3}}{2}$ **OR** tan30 = $\frac{1}{\sqrt{3}}$ oe **or** sin60 = $\frac{\sqrt{3}}{2}$	
		A1	for $\frac{1}{2}$ or 0.5	
12	48	M1	for method to use a volume formula with correct substitution for the cone, sphere or hemisphere eg $\frac{1}{3} \times \pi \times 3^2 \times 10$ **or** $\frac{4}{3} \times \pi \times 3^3$ **or** $\frac{2}{3} \times \pi \times 3^3$ oe	May work without π or with an approximation of π; must use the correct radius of 3 (and 10) in substitution
		M1	for complete method to find total volume eg $\frac{1}{3} \times \pi \times 3^2 \times 10 + \frac{2}{3} \times \pi \times 3^3$	
		M1	(dep first M1) for correct partial simplification, eg 30π **or** 18π	Must be cone or hemisphere
		A1	cao	Accept 48π
			SC B2 for answer of 264 or 264π	

Question	Answer	Mark	Mark scheme	Additional guidance
13	shown	C1	for method to find area of semicircle, eg $\pi \times 10^2 \div 2$ (= 50π)	Can award first 3 marks if a value for π is used
		C1	for method to find area of quarter circle, for $\pi \times 20^2 \div 4$ (= 100π)	
		C1	for a complete method to find area shaded **and** area of square, eg $\pi \times 20^2 \div 4 - \pi \times 10^2 \div 2$ **and** 20×20	Working out to find the area of the shaded region **must** be shown
		C1	fully correct working leading to $\frac{\pi}{8}$	
14 (a)	1	B1	cao	
(b)	8	M1	starts process, eg $\cos(60) = \frac{4}{x}$ or $0.5 = \frac{4}{x}$ oe or $\sin 30 = \frac{4}{x}$ or $\frac{\sin 30}{4} = \frac{\sin 90}{x}$ oe	All three elements of cos, 4, x must be present in an equation. eg $\cos = 4/x$ is acceptable but $\cos(4/x)$ is insufficient
		A1	cao	

Question	Answer	Mark	Mark scheme	Additional guidance
15	21	C1 C1 C1	for angle $OAB = 90 - 56$ (= 34) for process to find angle CAD (= 69) or angle BCA (= 56) or angle COA (= 138) , eg use of alternate segment theorem or angle at centre is twice the angle at the circumference cao	Throughout, angles may be written on the diagram; accept as evidence if correct. Ignore absence of degree sign Reasons need not be given.
16	enlargement scale factor $-\frac{1}{3}$ centre (2, 2)	C2 (C1	for **all** of: enlargement, (scale factor =) $-\frac{1}{3}$ oe, (centre =) (2, 2) for **two** of: enlargement, (scale factor =) $-\frac{1}{3}$ oe, (centre =) (2, 2)) Note: award no marks if more than one transformation is given	

Question	Answer	Mark	Mark scheme	Additional guidance
17	3 : 4	P1	starts process eg $\overrightarrow{AB} = \mathbf{b} - \mathbf{a}$ oe	
		P1	for process to find $\overrightarrow{OM} = \mathbf{a} + \frac{1}{2}$ "($\mathbf{b} - \mathbf{a}$)"oe ($= \frac{1}{2}(\mathbf{a} + \mathbf{b})$)	
		P1	for process to find $\overrightarrow{AP} = -\mathbf{a} + \frac{3}{5}$ "($\frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{b}$)" oe **or** (indep) for $\overrightarrow{AN} = -\mathbf{a} +$ "k"$\mathbf{b}$	
		P1	process to find "k" using $\overrightarrow{AN} = -\mathbf{a} +$ "k"$\mathbf{b}$ as a multiple of $\overrightarrow{AP}$	
		A1	cao	
			ALTERNATIVE	
		P1	for producing OM to C such that AC is parallel to OB	Formal geometric reasoning relating to congruent and similar triangles is not required
		P1	for process to show that $MC = OM$, using congruent triangles ACM and BOM for process to find PC as a multiple of OM/5 (= 7OM/5)	
		P1	for process to find ON as a multiple of AC(OB) (= 3OB/7) using similar	
		P1	triangles ACP and NOP	
		A1	cao	

Question	Answer	Mark	Mark scheme	Additional guidance
18 (a)	isosceles triangle, base 6 cm, height 4 cm	M1	for drawing an isosceles triangle **or** for drawing a triangle of base 6cm and height 4cm	Accept a freehand drawing Only a single triangle is acceptable; do **not** accept any attempted nets or 3-D diagrams
		A1	for a fully correct diagram	Condone a perpendicular drawn from base to vertex
(b)	96 cm^2	M1	for a method to find the area of a triangular face eg ½ × 6 × 5 (= 15)	
		M1	(dep) for finding the total surface area eg 4 × "15" + 6 × 6	
		A1	for a numerical answer of 96	Ignore incorrect or absent units for this mark
			SC B1 for an answer of 84 if M0 scored	[The SC is from: 4 × ½ × 6 × 4 + 6 × 6]
		B1	cm^2	Ignore incorrect or absent numerical answer for this mark

Question	Answer	Mark	Mark scheme	Additional guidance
19	(22, 20)	P1	for process to find width or height of diagram eg 38 − 6 (= 32) **or** 36 – 7 (= 29)	Figures may be shown on the diagram
		P1	for process to find length of side of square eg "32" ÷ 4 (= 8) **or** process to find half width of diagram eg "32" ÷ 2 (= 16)	
		P1	for process to find x coordinate eg 6 + 2 × "8" (= 22) **or** 6 + "16" (= 22) **or** (6 + 38) ÷ 2 (= 22)	If (6 + 38) ÷ 2 leads to an answer other than 22, award P2 only
		P1	for process to find y coordinate eg 36 – 2 × "8" (= 20) **or** 36 – "16" (= 20) **or** 7 + "8" + "29" – 3 × "8" (= 20)	
		A1	cao SC: award 4 marks for (20, 22)	Award for P3 for (22, y) or (x, 20) or x = 22 or y = 20
20	rotation 180° about (−1, −2) **or** enlargement sf −1 centre (−1, −2)	B2	rotation 180° about (−1, −2) **or** enlargement sf −1 centre (−1, −2)	Condone missing brackets but do not accept centre written as a vector
		(B1	rotation 180° **or** rotation about (−1, −2) **OR** enlargement sf −1 **or** enlargement centre (−1, −2)) Award no marks for the description if more than one transformation is given	Do not accept 'half turn' for 'rotation 180°' Ignore references to clockwise and anticlockwise
			SC B1 for fully correct diagram if B0 scored	Triangles at (−3, 1), (−5, 1), (−4, 3) and (−3, −5), (−5, −5), (−4, −7)

Question	Answer	Mark	Mark scheme	Additional guidance
21	216	P1	for process to work with ratio eg 72 ÷ (3 + 4 + 5) (= 6) **or** 72 ÷ 12 (= 6)	
		P1	for process to find length of base or height of triangle eg 3 × "6" (= 18) **or** 4 × "6" (= 24) **OR** process to find area scale factor eg "6" × "6" (= 36)	
		P1	complete process to find the area of the triangle eg ½ × "18" × "24" **or** ½ × 3 × 4 × "6"^{2}	
		A1	cao	
22	90 – 2x	M1	for identifying an unknown angle eg $BAO = x$, $AOB = 180 - 2x$, $OBC = 90$, $ABC = 90 + x$	Could be shown on the diagram alone
		M1	full method to find the required angle eg a method leading to $180 - x - x - 90$	Needs to be an algebraic method Accept $x + x + 90 + y = 180$ for M2
		A1	for 90 – 2x	
		C2	(dep M2) full reasons for their method, from base angles in an isosceles triangle are equal angles in a triangle add up to 180° a tangent to a circle is perpendicular to the radius (diameter) angles on a straight line equal 180° the exterior angle of a triangle is equal to the sum of the interior opposite angles	Underlined words need to be shown; reasons need to be linked to their method; any reasons not linked do not credit.
		(C1	(dep M1) for a tangent to a circle is perpendicular to the radius (diameter))	Apply the above criteria

Question	Working	Answer	Mark	Notes
23	*CB* extended to form *CG*	Reasoning	B1 M1 C2 (C1	for 35 **or** 75 **or** 145 **or** 105 **or** *DEF* = 70, marked on the diagram or 3 letter description for 180-70-35 **or** 180-75-35 **or** a correct pair of angles that would lead to 75 or 70, eg *AFB* = 35 and *FAB* = 75 **or** *AFB* = 35 and *ABG* = 75 **or** *FBC* = 35 and *ABG* = 75 **or** *EDF* = 75 and *DEF* = 70 **or** *FDC* = 105 and *FBC* = 35 **or** *ABC* = 105 and *FBC* = 35 (dep on B1M1) All figures correct with all appropriate reasons stated. Angles must be clearly labelled or on the diagram. Full solution must be seen (dep on B1 or M1) for one reason clearly used and stated.) Corresponding angles are equal, alternate angles are equal, opposite angles in a parallelogram are equal, angles in a triangle sum to 180, angles on a straight line sum to 180, vertically opposite angles are equal, vertically opposite angles are equal, angles in a quadrilateral sum to 360, co-interior angles sum to 180, allied angles sum to 180, angles around a point sum to 360
24		Daisy is wrong (supported)	P1 P1 A1 C1	for process to find area of any relevant circle ie $\pi\times4^2$ (=16π), $\pi\times7^2$ (=49π), $\pi\times10^2$ (=100π) **or** 7^2 and 4^2 for completed method to find shaded area eg "$\pi\times7^2$" – "$\pi\times4^2$" (=33π) **or** use of radii eg $7^2 - 4^2$ (=33) for 2 comparable figures, eg 33π and 100π **or** 33 and 100 **or** 103 to 103.7 and 314 to 314.2 **or** 103 to 103.7 and 104.6 to 104.8 statement eg No because it should be $\frac{33}{100}$ and their accurate figures Allow use of π = 3 or better

Question	Working	Answer	Mark	Notes
25		Correct enlargement	B2 (B1	Correct enlargement (-1,-1.5), (-1,-3.5) (-2,-1.5) correct size, correct orientation in incorrect position **or** 2 out of 3 vertices correctly placed)
26		$1+\sqrt{2}$	B1 P1 P1 A1	for a value for a known trigonometric ratio stated for process to form 2 equations in a and b **or** one correct value stated for complete process to solve to reach $a = 2$ and $b = 1$ for $1+\sqrt{2}$ oe

Question	Working	Answer	Mark	Notes
27		70.5	P1 P1 P1 P1 A1	starts process of Pythagoras e.g. $5^2 + 12^2$ complete process for Pythagoras e.g. $\sqrt{5^2+12^2}$ or $\sqrt{25+144}$ or $\sqrt{169}$ (=13) (dep P1 for Pythagoras) process of adding all the lengths e.g. 5 + 5 + 12 + 12 + "13" (=47) (indep) process of multiplying at least 2 lengths by 1.5 cao SC: any evidence of working with Pythagoras award the P1 or P2
28		$\frac{2}{5}$	P1 P1 P1 A1	for first step to solve the problem e.g. $\overrightarrow{AC} = -\mathbf{a} + \mathbf{c}$ or $\overrightarrow{OX} = \frac{1}{2}\mathbf{a} + \frac{1}{2}\mathbf{c}$ or demonstrates the location of *D* and *X* on the diagram for a correct vector statement using $\overrightarrow{CD}$ eg $\overrightarrow{CD} = \overrightarrow{CX} + \overrightarrow{XD}$ or $\overrightarrow{CD} = \overrightarrow{OD} - \overrightarrow{OC}$ or $\overrightarrow{OD} = \frac{7}{2}\mathbf{c}$ or $\overrightarrow{CD} = 2.5\mathbf{c}$ oe for a correct equation or ratio using *k* eg equating $\overrightarrow{XD} = 3\mathbf{c} - \frac{1}{2}\mathbf{a} = \frac{1}{2}(-\mathbf{a} + \mathbf{c}) + \frac{1}{k}\mathbf{c}$ or $\frac{\overrightarrow{OD}}{\overrightarrow{OC}} = \frac{k+1}{k}$ or $k = \frac{1}{2.5}$ or using a ratio approach eg $(\overrightarrow{OC} : \overrightarrow{CD}) = k : 1 = 1 : 2.5$ cao

Question	Working	Answer	Mark	Notes
29			C1	states (angle) *ABC* = (angle) *BCD*
			C1	states 2nd link *AB* = *CD*
			C1	states 3rd link with reason: *BC* = *BC* (common)
			C1	concludes proof by stating (triangle) *ABC* ≡ (triangle) *DCB* with reason SAS and *AC* = *BD*
30		Proof	B1	(indep) for stating cos 30 = $\frac{\sqrt{3}}{2}$
			M1	for $PQ^2 = 10^2 + 10^2 - 2 \times 10 \times 10 \times \cos PBQ$ **or** $AC^2 = x^2 + x^2 - 2 \times x \times x \times \cos 30$ $(=x^2(2-\sqrt{3}))$ oe
			M1	for $\cos PBQ = \frac{10^2 + 10^2 - PQ^2}{2 \times 10 \times 10}$ (implies previous M1)
	cos PBQ= $\frac{10^2 + 10^2 - x^2(2-\sqrt{3})}{200}$ = $\frac{200 - x^2(2-\sqrt{3})}{200}$		M1	for $\cos PBQ = \frac{10^2 + 10^2 - (x^2 + x^2 - 2 \times x \times x \times \cos 30)}{2 \times 10 \times 10}$
			A1	conclusion of proof with all working seen

Question	Working	Answer	Notes
31		152	M1 Start to method $ABD = 38^o$ **and** BAD or DBC or $DCB = 38^o$ M1 ADB or $BDC = 180 - 2 \times 38$ (=104) A1 for 152 with working
32		Correct sketch	C1 interprets diagram eg. draw a solid shape with at least two correct dimensions C1 draws correct prism with all necessary dimensions.
33		$x = 21$, $y = 50$	P1 process to start solving problem eg. form an appropriate equation P1 complete process to isolate terms in x A1 for $x = 21$ P1 complete process to find second variable A1 $y = 50$
34		6.4	P1 Start to process eg. find scale factor (0.4) or $\frac{AE}{4} = \frac{4}{10}$ P1 Complete process to find area A1
35 (a)		(-2, -2)(-6, -2) (-2,-4) (-4, -4)	M1 Shape drawn in correct orientation A1
(b)		Enlargement sf −0.5 centre (0,0)	C1

Question	Working	Answer	Notes	
36		42	P1 process to start problem solving eg forms an appropriate equation P1 complete process to solve their equation A1 cao	
37		48	P1 begins to work with rectangle dimensions eg $l+w=7$ or $2\times l+w$ (=11) C1 shows a result for a dimension eg using $l=4$ or $w=3$ P1 begins process of finding total area eg 4 × "3" × "4" A1 cao	
38		explanation	M1 works with volume eg 240000 M1 uses conversion 1 litre = 1000 cm^3 M1 uses 8000 eg vol ÷ 8000 (=30) M1 uses "30" eg "30" × 2.50 C1 for explanation and 75 stated	begins working back eg 70÷2.50 (=28) uses conversion 1 litre = 1000 cm^3 uses 8000 eg "28"× 8000 (=224000) works with vol. eg 240000 for explanation with 240000 and 224000
39 (a)		$\frac{\sqrt{3}}{2}$	B1	
(b)		6	M1 starts process eg $\sin 30 = \frac{x}{12}$ A1 answer given	

Question	Working	Answer	Notes
40		SAS	M1 links angles PQR and PRQ (eg isosceles triangle) with full reasons M1 links TR and SQ with full reasons C1 gives full conclusion for congruency eg SAS
41		75π	P1 starts process by using $\frac{250}{3}\pi$ and $\frac{1}{2}\times\frac{4}{3}\pi r^3$ to find radius P1 starts process using ½ curved surface area eg $(4 \times \pi \times \text{“5”}^2) \div 2$ P1 complete process shown eg $(4 \times \pi \times \text{“5”}^2) \div 2 + (\pi \times \text{“5”}^2)$ A1 for 75π
42			M1 states AB as $6\mathbf{b} - 3\mathbf{a}$ M1 for $AX = \frac{1}{3}AB$ or ⅓“$(6\mathbf{b} - 3\mathbf{a})$” or ft to $2\mathbf{b} - \mathbf{a}$ M1 for $\overrightarrow{CY} = \overrightarrow{CB} + \overrightarrow{BY}$ or $6\mathbf{b} + 5\mathbf{a} - \mathbf{b}$ $(=5\mathbf{b} + 5\mathbf{a})$ M1 for $\overrightarrow{CX} = 3\mathbf{a} +$ “$2\mathbf{b} - \mathbf{a}$” or $\overrightarrow{CX} = 6\mathbf{b} - \frac{2}{3}$“$(6\mathbf{b} - 3\mathbf{a})$” $(= 2\mathbf{a} + 2\mathbf{b})$ C1 for $\frac{2}{5}\overrightarrow{CY} = \frac{2}{5}(5\mathbf{a} + 5\mathbf{b}) = 2(\mathbf{a} + \mathbf{b}) = \overrightarrow{CX}$

Question	Working	Answer	Notes
43		No with reasoning	M1 Derive AC=9 cm and identify as hypotenuse M1 $4^2 + 7^2$ A1 for using eg $AC = \sqrt{4^2 + 7^2}$ or 65 and 81 C1 for concluding explanation that ABC is not a right-angled triangle with evidence.
44		500g	P1 $\frac{1}{8} \times 160$ (=20) P1 '20' × 25 A1 500 (or 0.5) B1 Correct units g (or kg)
45	$x \times 2x \times 3x =$	Reasoning to reach $x \leq 5$	M1 Starts reasoning to find volume in terms of x M1 Gives inequality $6x^3 \leq 900$ or substitutes 5 and 6 into $6x^3$ M1 Completes reasoning to show $x \leq 5$
46	$\frac{4}{3\times2}\pi x^3 + \frac{4}{3}\pi x^3 = 2\pi x^3$ $(2x)^2 \pi h = 4x^2 \pi h$ $4x^2 \pi h = 2\pi x^3$	$h = \frac{x}{2}$	P1 Process to find volume of cone or hemisphere P1 Process to total volume of solid P1 Process to find volume of cylinder P1 Equates 2 volumes A1 Reaches $h = \frac{x}{2}$
47		Complete proof	M1 Begins proof $BAE=ACD$ and $ABE=EDC$ M1 $AB = DC$ because opposite sides of a parallelogram are equal C1 Completes proof with all reasons eg alternate angles are equal and reference to ASA
48		48	P1 Identifies that 16 ÷ 8 = 2 so $PL=2NP$ P1 Process to find area of LMN $8 \times (2+1)^2$ (=72) P1 Completes process to find area of LQM '72'−16 − 8 A1 48 cao

Question	Answer	Mark	Mark scheme	Additional guidance
49	41.6	P1	for start of process to find the length of the hypotenuse, eg (hyp^2 =) $8^2 + 10^2$ (= 164)	Note lengths may be seen on the diagram
		P1	for complete process to find hypotenuse, eg $\sqrt{8^2+10^2}$ **or** $\sqrt{64+100}$ **or** $\sqrt{164}$ (= 12.8…)	
		P1	(dep P2) for complete process to find the required perimeter, eg 8 + 8 + 10 + "12.8" + "12.8 – 10" **or** $16 + 4\sqrt{41}$	8 + 8+ "12.8" + "12.8" oe is acceptable for this mark
		A1	for answer in the range 41 to 42	If an answer in the range 41 to 42 is given in the working space then incorrectly rounded, award full marks.
50 (a)	17.8	M1	for $\tan 56 = \frac{x}{12}$ or $(BC) = 12 \times \tan 56$ oe **or** alternative method to find *BC*	For any alternative method candidates must arrive at an equation with BC as the only unknown
		A1	for an answer in the range 17.7 to 17.8	If an answer in the range 17.7 to 17.8 is given in the working space then incorrectly rounded, award full marks.
(b)	33.6	M1	for $\cos x = \frac{15}{18}$ **or** $\cos x = 0.83..$ **or** $x = \cos^{-1}\frac{15}{18}$ **or** alternative method to find *x*	For any alternative method candidates must arrive at an equation with *x* as the only unknown
		A1	for an answer in the range 33.5 to 33.91	If an answer in the range 33.5 to 33.91 is given in the working space then incorrectly rounded, award full marks.

Question	Answer	Mark	Mark scheme	Additional guidance
51	25 with reasons	M1	for method to find angle *BCD* eg 180 ÷ (3 + 1) (= 45) **or** *BAD* = 180 ÷ (3 + 1) × 3 (=135)	Could be shown on the diagram or in working
		M1	for method to find angle *BDA* eg 180 – 20 – (180 – "45") (=25) **or** method to find angle *SBD* eg *SBD* = *BCD* (=45)	Do not award if it ambiguous as to which angle is being found
		C2	for finding *SBA* (=25) and both reasons given, eg Opposite angles of a cyclic quadrilateral add up to 180 for angle *SBD* = 45 because alternate segment theorem	
		(C1	(dep M1) for one reason given Opposite angles of a cyclic quadrilateral add up to 180 for angle *SBD* = 45 because alternate segment theorem)	Underlined words need to be shown; reasons need to be linked to their method
52 (a)	11.4	M1	for start to method to find the length of *BC* eg. $8^2 + 11^2 – 2 \times 8 \times 11 \times \cos 72$	
		M1	(dep on M1) for method to use correct order of operations, eg. 64 + 121 – 54.38….. (= 130.61…)	
		A1	for answer in the range 11.4 to 11.5	If an answer within the given range is seen in working and rounded incorrectly award full marks.
(b)	41.8	M1	for 0.5 × 8 × 11 × sin 72 (= 41.8…)	Any alternative method must be complete
		A1	for answer in the range 41.5 to 41.9	If an answer within the given range is seen in working and rounded incorrectly award full marks.

Question	Answer	Mark	Mark scheme	Additional guidance
53	99.5	M1 A1	for $\sin(34) = \frac{x}{178}$ oe **or** alternative method to find x for answer in range 99.5 to 99.7	 If an answer in the range 99.5 to 99.7 is given in the working space then incorrectly rounded, award full marks
54	$\begin{pmatrix}-9\\14\end{pmatrix}$	M1 A1	for $2\begin{pmatrix}3\\4\end{pmatrix} - 3\begin{pmatrix}5\\-2\end{pmatrix}$ **or** $\begin{pmatrix}6\\8\end{pmatrix}$ **and** $\begin{pmatrix}15\\-6\end{pmatrix}$ **or** $\begin{pmatrix}-9\\y\end{pmatrix}$ **or** $\begin{pmatrix}x\\14\end{pmatrix}$ cao	May be seen in two separate calculations eg $2\times3 + -3\times5$ and $2\times4 + -3\times-2$ Condone incorrect notation if method is clear for this mark only
55	35.3	P1 P1 P1 A1	for starting the process to find length of third side of triangle, eg $9^2 - 6^2$ (= 45) **or** $6^2 + x^2 = 9^2$ for $\sqrt{9^2 - 6^2}$ or $\sqrt{81-36}$ or $\sqrt{45}$ or $3\sqrt{5}$ (= 6.7..) **or** $r^2 = 45$ for stating or using $\pi \times$ [radius]$^2 \div 4$ for answer in range 35.2 to 35.4	 [radius] is any value If an answer in the range 35.2 to 35.4 is given in the working space then incorrectly rounded, award full marks No working, answer only, no marks

Question	Answer	Mark	Mark scheme		Additional guidance
56	15.4	M1	for $\frac{AB}{\sin 34} = \frac{23.8}{\sin"120"}$ **or** $\frac{\sin 34}{AB} = \frac{\sin"120"}{23.8}$		"120" comes from 180 – 26 – 34
		M1	for $(AB =) \frac{23.8}{\sin"120"} \times \sin 34$		
		A1	for answer in range 15.36 to 15.4		If an answer in the range 15.36 to 15.4 is given in the working space then incorrectly rounded, award full marks
57	116	P1	for setting up an equation, eg $(x + 4)^2 = x^2 + 70$	for setting up an equation, eg $x^2 – (x – 4)^2 = 70$	Equation must be in a single variable. If a candidate uses a trial and improvement method, it is either full marks or no marks.
		P1	for process to reduce equation down to a linear equation ready to solve eg $8x = 54$ oe	for process to reduce equation down to a linear equation ready to solve eg $8x = 86$ oe	Candidates must get as far as $ax = b$
		A1	for 6.75 oe	for 10.75 oe	
		B1	ft (dep P2) for finding the area of B **or** for answer in range 115 to 116		
58	Enlargement sf –1.5 centre (1, 1)	B2	for enlargement scale factor –1.5 **and** centre (1, 1)		Award no marks if more than one transformation is given
		(B1	for enlargement scale factor –1.5 **or** enlargement centre (1, 1))		

Question	Answer	Mark	Mark scheme	Additional guidance
59	160π	P1	for process to find curved surface area of cone, eg $\pi \times 10 \times 25$ (= 250π) (= 785…..)	
		P1	for process to find the radius or diameter of the smaller cone eg $10 \times \frac{15}{25}$ (= 6) **or** $20 \times \frac{15}{25}$ (= 12) oe **OR** uses area scale factor, eg "250π" $\times \left(\frac{15}{25}\right)^2$ (= 90π)	15 comes from 25 – 10 $\frac{15}{25}$ may be seen as 0.6
		P1	for a complete process, eg "250π" – $\pi \times$ "6" $\times$ 15 (= 785… – 282…) **or** answer in range 502 to 503	
		A1	for 160π	Award 0 marks for an answer of 160π or an answer in range 502 to 503 with no supportive working. If 160π seen but answer in range 502 to 503 given on answer line isw and award full marks

Question	Answer	Mark	Mark scheme	Additional guidance
60	No (supported)	P1	for finding the area of 3 or more faces of the cuboid **and** adding eg (6 × 8) + (8 × 18) + (6 × 18) … or "48" + "144" + "108" … (= 300)	Could be an addition of *any* three faces eg 48 + 48 + 144 etc.
		P1	complete process to find surface area of cuboid, eg 6 × 8 × 2 + 6 × 18 × 2 + 8 × 18 × 2 (= 600)	
		P1	for process to find side length of cube, eg [surface area] ÷ 6 **and** square rooting (= 10) **OR** for a process to find the volume of the cuboid 6 × 8 × 18 (= 864) **and** cube rooting (= 9.52…) to find a side length	[surface area] must come from the addition of at least three attempts at area, but not from volume.
		P1	(dep on previous P1) for processes to find volume of cube **and** volume of cuboid, eg [side length]^3 (= 1000) **and** 6 × 8 × 18 (= 864) **OR** (dep on previous P1) for process to find surface area of cube, eg. ("9.52…")^2 × 6 (= 544.28…)	
		A1	No with 1000 **and** 864 **OR** No with 600 **and** 544(.28…)	
61	32.1	P1	starts process, eg $\sin 40 = \frac{DB}{8.6}$ oe or for 8.6 × sin 40 (=5.52797…)	Accept values rounded or truncated to 2 dp.
		P1	complete process to find *ED*, eg (8.6 × sin40) ÷ 2 (=2.76...)	
		P1	process to find angle *EAD*, eg $\tan^{-1}\left(\frac{"2.76...."}{4.4}\right)$ or $\tan^{-1}$("0.628…")	
		A1	answer in range 32.09 to 32.2	If an answer in the range is seen in working and then incorrectly rounded award full marks

Question	Answer	Mark	Mark scheme	Additional guidance
62	61	B1 M1 A1	angle *OAD* = 90, may be marked on diagram method to work out angle *OAB* (=29) cao	Angle could be shown by a right-angle symbol Correct method can be implied from angles on the diagram if no ambiguity or contradiction. Reasons need not be given. Award 0 marks for an answer of 61 with no other working.
63	155	M1 A1	for a complete method to find the volume of the hemisphere, eg $\frac{1}{2}\times\frac{4}{3}\times\pi\times 4.2^3$ oe answer in range 155 to 155.2	 If an answer in the range is seen in working and then incorrectly rounded award full marks

64	Description	C2
		
		(C1
			for (rotation) 90º clockwise about (–1, 0)
			or (rotation) 90º anticlockwise about (–1, 6)
			or (rotation) 180º about (–1, 2)
			or (rotation) 180º about (–1, 4)
			
			for (–1, 0) or (–1, 6) or (–1, 2) or (–1, 4))
				Award 0 marks if there is reference to other transformations eg coordinates given as vectors (which is a translation)

Question	Answer	Mark	Mark scheme	Additional guidance
65	8	P1 P1 P1 A1	for working with volume of the cuboid, eg 30 × 6 × 19 (= 3420) **OR** for using $\frac{2}{3}$ with one dimension, eg. 30 × 2 ÷ 3 (= 20) for "3420" × 2 ÷ 3 (= 2280) **or** "3420" ÷ 3 (= 1140) **OR** "20" × 6 × 19 (= 2280) **OR** "3420" ÷ 275 (= 12.4… = 12 cups) (dep on P2) for "2280" ÷ 275 (= 8(.29...)) **or** "1140" ÷ 275 (= 4(.14...)) **OR** "12" × 2 ÷ 3 **OR** for 275 × 8 (= 2200) **or** 275 × 9 (= 2475) cao	For P marks, ignore attempts at unit conversion
66	9.85	M1 A1	for $\sin(38) = \frac{\cdot AB}{16}$ oe **or** alternative method to find *AB* for an answer in the range 9.76 to 9.92	

Question	Answer	Mark	Mark scheme	Additional guidance
67	25.4	P2	for finding the size of the angle eg $\frac{40\times360}{\pi\times7^2}$ (=93.5(4..)) **or** for working with proportion, eg $\frac{40}{49\pi}$ (=0.259(8…) or 0.26) **or** $\frac{49\pi}{40}$ (=3.84(8…) or 3.85)	
		(P1	for finding the area of the circle eg π × 7² (=153(.938..) or 154))	May be embedded
		P1	(dep on P2) for a process to find the arc length, eg $\frac{"93.5(4...)"}{360}$ × π × 2 × 7 (=11.4(28…)) **or** $\frac{40}{49\pi}$ × π × 2 × 7 (=11.4(28…)) **or** π × 2 × 7 ÷ $\frac{49\pi}{40}$ (=11.4(28…))	
		A1	for answer in the range 25 to 25.44	If an answer is shown in the range in working and then incorrectly rounded award full marks. Accept $\frac{178}{7}$

Question	Answer	Mark	Mark scheme	Additional guidance
68	75° with reasons	M1	for finding angle $BAD = \frac{180-40}{2}$ (= 70) **or** angle $BDA = \frac{180-40}{2}$ (= 70)	Could be shown on the diagram or in working
		M1	for finding angle *BCD* = 180 – "70" (=110) or 40 + *x* + 70 + *x* = 180	
		A1	for finding angle *ADE* = 75	
		C2	(dep M2) for Opposite angles of a cyclic quadrilateral add up to 180 **and** one other reason; all reasons given must be appropriate for their working Base angles of an isosceles triangle are equal Angles in a triangle add up to 180, Angles on a straight line add up to 180 [**or** exterior angle of a cyclic quadrilateral is equal to the interior opposite angle]	Underlined words need to be shown; reasons need to be linked to their method
		(C1	(dep M2) for Opposite angles of a cyclic quadrilateral add up to 180, **or** all other reasons given appropriate for their working)	Apply the above criteria

Question	Answer	Mark	Mark scheme	Additional guidance
69	31.0	P1	for tan 35 = *BE* ÷ 15 or *BE* =10.5(0...) **OR** finding the length DM = $\frac{2}{5}\times 15 (=6)$ **or** MA = $\frac{3}{5}\times 15 (=9)$ **or** 6:9 **OR** showing the required angle on a diagram eg with an arc	*MB* = $\sqrt{9\cdot\ \ 1\ \ 5^2}$ = $\sqrt{306}$ (=17.4(9…) or 17.5) *BE* = 15×tan35 (=10.5(0…)) *AE* = 15÷cos35 (=18.3(1…)) *ME* = $\sqrt{9^2\ \ 1\ \ 8.31\ldots^2}$ = $\sqrt{416.(3\ldots)}$ (=20.4(0…))
		P1	for *MB* = $\sqrt{15^2\ +\ \text{“}9\text{”}^2}$ or $\sqrt{306}$ or 17.4(9....) **OR** *ME* = $\sqrt{\text{"9"}^2\ \text{"}\ \ 18.3(1\ldots)\text{"}^2}$ or $\sqrt{416.(3\ldots)}$ or 20.4(0…)	Check diagram for working
		P1	for using appropriate trigonometry ratio to set up an equation in angle *EMB* eg tan θ = “10.5(0...)” ÷ “17.4(9...)” **or** cos θ = “17.4(9…)” ÷ “20.4(0…)” **or** sin θ = “10.5(0…)” ÷ “20.4(0…)”	
		A1	for answer in the range 30.9 to 31	If an answer is shown in the range in working and then incorrectly rounded award full marks.

Question	Answer	Mark	Mark scheme	Additional guidance
70 (a)	2**a**	M1	for **a** – **b** + **a** + **b** (=2**a**)	
		A1	cao	
(b)	4	P1	for a process to find $\overrightarrow{MF}$= −0.5**b**−**a**−(**a**−**b**) (=0.5**b**−2**a**) **or** $\overrightarrow{CE}$= **a** + **b** **or** $\overrightarrow{FM}$ = **a**−**b**+**a**+0.5**b** (=2**a**−0.5**b**)	Accept ft from (a) providing vectors are clearly stated
		P1	For finding a suitable vector expression for **two** of ($\overrightarrow{CE}$ or $\overrightarrow{EC}$), ($\overrightarrow{CX}$ or $\overrightarrow{XC}$) or ($\overrightarrow{EX}$ or $\overrightarrow{XE}$) eg, $\overrightarrow{CX}$ = **a** +0.5**b**+ $\frac{1}{n+1}$ (0.5**b**−2**a**) **or** $\overrightarrow{CX}$ = −**a** + **b** + $\frac{n}{n+1}$(2**a**−0.5**b**) $\overrightarrow{XE}$ = $\frac{1}{n+1}$ (2**a** −0.5**b**) + 0.5**b** **or** $\overrightarrow{XE}$ = $\frac{n}{n+1}$(0.5**b** – 2**a**) + 2**a** **or** $\overrightarrow{XC}$ = $\frac{n}{n+1}$(0.5**b**−2**a**)+**a**−**b** **or** $\overrightarrow{XC}$ = $\frac{1}{n+1}$ (2**a** – 0.5**b**) – 0.5**b** − **a** **or** $\overrightarrow{EX}$ = −0.5**b**+$\frac{1}{n+1}$(0.5**b**−2**a**) **or** $\overrightarrow{EX}$ = –2**a** + $\frac{n}{n+1}$(2**a** – 0.5**b**)	$\overrightarrow{CX} = \frac{n-1}{n+1}\mathbf{a} + \frac{n+2}{2(n+1)}\mathbf{b}$ $\overrightarrow{XE} = \frac{2}{n+1}\mathbf{a} + \frac{n}{2(n+1)}\mathbf{b}$ $\overrightarrow{XC} = \frac{1-n}{n+1}\mathbf{a} + \frac{-n-2}{2(n+1)}\mathbf{b}$ $\overrightarrow{EX} = \frac{-2}{n+1}\mathbf{a} - \frac{n}{2(n+1)}\mathbf{b}$
		P1	for complete process to equate the coefficients of **a** and **b** eg $\frac{n-1}{n+1} = \frac{n+2}{2(n+1)}$	
		A1	cao	
			ALTERNATIVE	
		P1	for a process to find $\overrightarrow{MF}$= −0.5**b** − **a** − (**a** − **b**) (=0.5**b** − 2**a**) **or** $\overrightarrow{CE}$= **a** + **b** **or** $\overrightarrow{FM}$ = **a** – **b** + **a** + 0.5**b** (=2**a** − 0.5**b**)	Accept ft from (a) providing vectors are clearly stated
		P1	For finding two suitable vector expressions for $\overrightarrow{FX}$ eg $\overrightarrow{FX}$ = $\frac{n}{n+1}$(2**a** − 0.5**b**) **and** $\overrightarrow{FX}$ = **a** – **b** + *k***a** + *k***b**	
		P1	for complete process to equate the coefficients of **a** and **b** eg $\frac{2n}{n+1} - 1 = 1 - \frac{n}{2(n+1)}$	
		A1	cao	

Question	Answer	Mark	Mark scheme	Additional guidance
71	60	M1	use of parallel lines to find an angle eg ABE=70 **or** EBG=75 **or** EBC = 110 **or** shows parts of x as 35 or 25	Parts of x should be identified on the diagram by the insertion of a dividing line through angle x (need not be identified or drawn parallel).
		M1	for a complete method to find angle x; could be in working or on the diagram	Correct method can be implied from angles on the diagram if no ambiguity or contradiction.
		A1	for x = 60	
		C1	(dep on M1) for one reason linked to parallel lines and one other reason, supported by working taken from: alternate angles are equal, allied angles / co-interior angles add up to 180, angles on a straight line add up to 180, angles in a triangle add up to 180°	Underlined words need to be shown; reasons need to be linked to their method; any reasons not linked do not credit. There should be no incorrect reasons given.
72	Rotation	M1	stating rotation **or** for showing **R** [(1,1), (1,−3), (3,−3)]	Award for a triangle in the correct position without the label R as long as this is the only triangle in lower right quadrant.
	90° anticlockwise	A1	for rotation of 90° anticlockwise	Accept rotation of 270° clockwise
	centre (−1,1)	A1	for centre (−1, 1) given as a coordinate.	Can be given as a coordinate alone. Do not award A marks if there is evidence of other transformations in the description, or other ambiguity in the answer given.
73	84.9	P1	shows a process to find the radius or diameter eg $44 = 2 \times \pi \times r$ **or** $r = \frac{22}{\pi}$ **or** $d = \frac{44}{\pi}$ **or** r = 7.0028 **or** d = 14.0056..	Allow r in the range 7 to 7.1 and d in the range 14 to 14.1 Could be shown on the diagram.
		P1	(dep on P1) complete method to find the area eg ½ × "d" ^{2} × Sin60 oe, ½ × 14 × Tan60 oe, ½ × 14 × $\sqrt{14^2 - 7^2}$ oe	
		A1	for answer in the range 84.8 to 85	If the correct answer in the range is given in working and then rounded incorrectly award full marks.

Question	Answer	Mark	Mark scheme	Additional guidance
74	3.75	P1	works to find vol of frustum eg $1/3\pi(3.6)^2\times6.4 - 1/3\pi(1.8)^2\times3.2$ or 86.858.. − 10.857… (=24.192π or 76.00..)	
		P1	works to find vol of hemisphere eg $\frac{1}{2}\times\frac{4}{3}\pi\times3.6^3$ (=31.104π or 97.7....)	781.7… by use of diameter does not get the mark
		P1	mass of frustum as [vol]×density eg "76.00" × 2.4 (=182.4..) **or** mass of hemisphere as [vol]×density eg "97.7...."×4.8 (=469.037...)	[vol] is their volume which could be ft using the radius, using the diameter, or could be another value as long as it is stated as being the volume, or clearly intended from working.
		P1	mean density as total mass ÷ total volume eg ("182.4.." + "469.037") ÷ ("76…" + "97.7..") or "651.4.." ÷ "173.7...."	All figures must come from correct method shown.
		A1	answer in the range 3.7 to 3.8	
75	proof	C1	uses cyclic quad eg if $CAB = x$ then $CRO = 180 - x$ (Opposite angles of a cyclic quadrilateral add up to 180°.)	Underlined words need to be shown; reasons need to be linked to their method; any reasons not linked do not credit.
		C1	establishes relationship outside a circle eg $ORB = x$ (Angles on a straight line add up to 180)	Correct method can be implied from angles on the diagram if no ambiguity or contradiction.
		C1	uses properties of a circle eg $RO = OB$ (both radii) so $ABC = x$ (Base angles of an isosceles triangle are equal.)	
		C1	Complete proof and conclusion	Full reasons given without any redundant reasons and correct reasoning throughout.

Question	Answer	Mark	Mark scheme	Additional guidance
76	Enlargement	B2 (B1	for correct enlargement at (1,2) (2,3) (2,4) (1,4) for correct size **and** orientation in the wrong position **OR** 3 of 4 vertices correct and joined **OR** 4 correct vertices not joined)	
77 (a)	Diagram	B1	for correct vector drawn including arrow	May be drawn anywhere on the grid. Condone missing label
(b)	$\begin{pmatrix} 3 \\ 4 \end{pmatrix}$	M1	for **a** + 2**b** drawn with resultant vector **or** for writing **a** and **b** as column vectors **and** attempt to add **a** + 2**b** , eg $\binom{1}{2} + 2 \times \binom{1}{-3}$ **or** $\binom{1+2}{c}$ **or** $\binom{d}{2+-6}$ **or** $\binom{-4}{3}$	Accept consistent incorrect notation for M1
		A1	cao	
78 (a)	Shown	M1	for finding one missing angle eg *BDE* = *y* **or** *ODE* = 90 **or** *ODF* = 90 **or** *DBO* = *x* **or** *BCD* = 180 – *y* **or** (reflex) *BOD* = 2*y*	Could be shown on the diagram or in working
		A1	for a complete correct method leading to $y - x = 90$	
		C1	(dep on A1) for all correct circle theorems given appropriate for their working eg The tangent to a circle is perpendicular (90^o) to the radius (diameter) Alternate segment theorem **OR** Angle at the centre is twice the angle at the circumference Opposite angles in a cyclic quadrilateral sum to 180°	
(b)	Explanation	C1	for explanation eg No as *y* must be less than 180 as it is an angle in a triangle	

Question	Answer	Mark	Mark scheme	Additional guidance
79	39.5	P1	for a start to a process eg, for a correct trigonometric statement, eg sin48 = $\frac{7.3}{AC}$ **or** cos42 = $\frac{7.3}{AC}$ **or** $\frac{AC}{sin90} = \frac{7.3}{sin48}$ **OR** angle *CAH* unambiguously identified on a diagram	Must include correct values
		P1	for a complete correct process to find *AC*, eg (*AC* =) $\frac{7.3}{\sin(48)}$ (=9.8..) **or** (*AC* =) $\frac{7.3}{\cos(42)}$ (=9.8..) **or** (*AC* =) sin90 × $\frac{7.3}{sin48}$ (=9.8..)	
		P1	for a correct statement using angle *CAH*, eg tan(*CAH*) = $\frac{8.1}{"9.8..."}$ **OR** $\sqrt{8.1^2 + "9.8"^2}$ (=12.7…) **and** $\frac{\sin CAH}{8.1} = \frac{sin90}{"12.7"}$	
		A1	for answer in the range 39.5 – 39.51	If an answer is given in the range but then incorrectly rounded award full marks.

Question	Answer	Mark	Mark scheme	Additional guidance
80	905	P1	for correct use of formula for the volume of a sphere eg $\frac{1}{4} \times \frac{4}{3} \times \pi \times r^3$ (= 576π or 1809…) **OR** $576\pi \times 4$ **or** 2304π **or** 7238…($=\frac{4}{3} \times \pi \times r^3$)	We do not need to see what is in the brackets to award this mark. The contents of the bracket alone would score P0
		P1	for a complete correct process to find r, eg $r = \sqrt[3]{\frac{576 \times 4 \times 3}{4}}$ **or** $r = 12$	Could be shown in several stages $\sqrt[3]{\frac{576 \times 4 \times 3}{4}} = \sqrt[3]{1728}$
		P1	for a process to find the curved surface area eg $\frac{4 \times \pi \times [radius]^2}{4}$ (=144π or 452…) **OR** the surface area of both flat surfaces eg $(2 \times \frac{\pi \times [radius]^2}{2})$ **OR** complete expression for the total surface area eg $\frac{4\pi r^2}{4} + \frac{\pi r^2}{2} \times 2$ oe	Radius used must be clearly identified as their radius of the solid
		P1	for process to find the complete surface area eg $\frac{4 \times \pi \times [radius]^2}{4} + (2 \times \frac{\pi \times [radius]^2}{2})$	
		A1	answer in the range 904.7 – 905 or 288π (SCB2 for an answer in the range 358.1 – 359.2)	If an answer is given in the range but then incorrectly rounded, award full marks.

Question	Working	Answer	Mark	Notes
81		31.4	P1	for working with circumference formula, eg $\pi \times 80$ (=251. …) oe
			A1	for answer in the range 31.4 to 31.5 accept 10π
82 (a)		(−2, 1) (−4, 1) (−2, 2) (−5, 2)	B1	Shape labelled **A**
(b)		(1, −4) (3, −4) (1, −5) (4, −5)	B1	Shape labelled **B**
83		32.3	P1	for using Pythagoras to find length of third side of triangle, eg $7.5^2 - 6^2$ or $6^2 + x^2 = 7.5^2$ or uses trigonometry to find angle in triangle, eg $\sin A = \frac{6}{7.5}$ or $\cos B = \frac{6}{7.5}$
			P1	(dep P1) for complete process to find length of third side of triangle eg $\sqrt{7.5^2 - 6^2}$ or $\sqrt{56.25 - 36}$ or $\sqrt{20.25}$ (= 4.5) or uses trigonometry to find base length of triangle, eg $7.5 \times \cos$ "A" or $7.5 \times \sin$ "B" or $\frac{6}{\tan "A"}$
			P1	(dep P2) for 24 – 10 – "4.5" (= 9.5)
			P1	(indep) for process to find angle CDA, eg $\tan CDA = \frac{6}{\text{base}}$ from right- angled triangle
			A1	for answer in the range 32.2 to 32.3

Question	Working	Answer	Mark	Notes
84		15	P1	for a process to find the interior or exterior angle of a regular 12 sided polygon e.g. $\frac{10\times180}{12}$ (= 150) or $\frac{360}{12}$ (= 30), must be no contradictions
			P1	for process to find angle *STR*, eg $\frac{180-"150"}{2}$ or $\frac{"30"}{2}$
			A1	cao
85		Proof (supported)	M1	for a method to find coordinates of *M* (−1, −1) or *N* (3, 1)
			M1	for method to find gradient of *MN* or *PR* or for method to find column vector for *MN* or *PR* or for differences of *x* coordinates and differences of *y* coordinates for *MN* or *PR*
			A1	for gradients of *MN* and *PR* , ie ½ oe or for column vectors of *MN* and *PR*, $\overrightarrow{MN} = \begin{pmatrix}4\\2\end{pmatrix}$ and $\overrightarrow{PR} = \begin{pmatrix}8\\4\end{pmatrix}$ or for differences of *x* coordinates and of *y* coordinates for *MN* and *PR*
			C1	for conclusion from reasoning and correct working

Question	Working	Answer	Mark	Notes
86		68.5	B1	for angle $OAB = 90°$ or angle $OCB = 90°$, may be seen on diagram
			P1	for a process to find the length of AB or the length of CB ($= 10\sqrt{3}$ oe) eg $10 \times \tan 60°$ ($= 17.3...$) or the length of OB ($= 20$), eg $10 \div \cos 60°$
			P1	for a process (dep previous P1) to find the area of the triangle OAB ($= 50\sqrt{3}$ oe) or area of triangle OCB ($= 50\sqrt{3}$ oe) or area of kite $OABC$ ($= 100\sqrt{3}$ oe)
			P1	for a process to find the area of the sector OAC e.g. $\frac{1}{3} \times \pi \times 10^2$ ($= 104.7...$),accept rounded or truncated to 3 significant figures or more
			A1	for 68.4 − 68.6

Question	Working	Answer	Mark	Notes
87		Side elevation	C2	for the side elevation (4 cm by 2 cm rectangle with a solid line drawn 1 cm from the 2 cm edge, and correct orientation)
			[C1	for the side elevation as a rectangle]
		Front elevation	C2	for the front elevation as a trapezium in correct orientation with base 4 cm, parallel sides 1 cm and 4 cm
			[C1	for the front elevation as a trapezium with two right angles]
				[Ignore incorrect or no labelling]
88		No (supported)	M2	for the correct position of C or E
			[M1	for a correct position of B or D]
			C1	for No with correct supporting evidence, eg. showing C and E in the correct positions
				OR
				for C is a rotation of 90° anticlockwise about *O* **or** E is a rotation of 90° clockwise about *O*
			M2	for No with supporting evidence, eg. C is a rotation of 90° anticlockwise about *O* **and** E is a rotation of 90° clockwise about *O*.
			C1	

Question	Working	Answer	Mark	Notes
89		Proof	C1	for identifying one pair of equal angles with a correct reason, e.g. (angle) *BAE* = (angle) *CDE*; angles in the same segment are equal or angles at the circumference subtended on the same arc are equal or for identifying two pairs of equal angles with no correct reasons given (angles must be within the appropriate triangles)
			C1	for identifying a second pair of equal angles with a correct reason, e.g. (angle) *AEB* = (angle) *DEC*; opposite angles or vertically opposite angles are equal or for identifying the three pairs of equal angles with no correct reasons given
			C1	for stating the three pairs of equal angles of the two triangles e.g. *ABE* = *DCE*, *BEA* = *CED*, *EAB* = *EDC* with fully correct reasons
90		66.5	B1	for recognising an angle of 60 at *AOB*
			P1	for a process to find the area of the sector, e.g. $\frac{"60"}{360} \times \pi \times 11^2$ (= 63.3.. or $\frac{121\pi}{6}$)
			P1	for a process to find the area of the triangle, e.g. $\frac{1}{2} \times 7^2 \times \sin "60"$ (=21.2.. or $\frac{49\sqrt{3}}{4}$)
			P1	for a process to find the required percentage, eg. $\frac{"63.3.."-"21.2.."}{"63.3.."} \times 100$
			A1	for answer in the range 66.5 to 66.6
91		8600	P1	for process to find the length of the rectangle, e.g. 24 × 4 (= 96)
			P1	for process to find the perpendicular height of an equilateral triangle of side (24 × 2) cm, e.g. 48sin60 (= 41.5(69..)) or $\sqrt{48^2 - 24^2}$ (= $24\sqrt{3}$ oe)
			P1	for complete process to find the width of rectangle, e.g. "41.5(69..)" + 24 + 24 (= 89.5(69..))
			A1	for answer in the range 8592 to 8602

Question	Working	Answer	Notes	
92		20.9	M1	correct recall of appropriate formula eg $\sin x = \frac{5}{14}$
			A1	for 20.9(248…)
93		9.54	P1	$10^2 - 5^2$ (=75)
			P1	"75" + 4^2 (=91)
			P1	$\sqrt{(10^2 - 5^2 + 4^2)}$
			A1	9.53 – 9.54
94		203	P1	translate into algebra for rectangle: $4x+4x+3x+4+3x+4$ (=$14x+8$) or for trapezium: $5x+5x+x-3+7x-3$ (=$18x-6$)
			P1	equating: eg $18x-6=14x+8$ ($4x=14$)
			A1	solving for x: $x=14/4 = 3.5$ oe
			P1	process to find area: "3.5" × 3+4 (ft) or "3.5" × 4 ft
			A1	cao

Question	Working	Answer	Notes
95		29°	C1 angle *OTP* = 90°, quoted or shown on the diagram M1 method that leads to 180 – (90 + 32) or 58 shown at *TOP* OR that leads to 122 shown at *SOT* M1 complete method leading to "58"÷2 or (180 – "122") ÷ 2 or 29 shown at *TSP* C1 for angle of 29° clearly indicated and appropriate reasons linked to method eg angle between radius and tangent = 90° and sum of angles in a triangle = 180°; ext angle of a triangle equal to sum of int opp angles and base angles of an isos triangle are equal or angle at centre = 2x angle at circumference or ext angle of a triangle equal to sum of int opp angles
96		4.89	M1 $\frac{40}{360}\times 2\times \pi \times 7$ oe A1 4.8 – 4.9

Question	Working	Answer	Notes
97 (a)		130	P1 start to process eg draw a labelled triangle or use of sine rule $\frac{\sin Q}{8.7} = \frac{\sin 32}{5.2}$ P1 process to find of Q *eg* $Q = \sin^{-1}\left[\frac{\sin 32}{5.2} \times 8.7\right]$ P1 process to find area of triangle *PRQ*. A1 22.5 – 22.6
(b)			C1 angle *PRQ* is obtuse so need to find area of two triangles.
98		1361	P1 process using similar triangles to find base of small cone eg. 4 cm used as diameter or 2 cm used as radius P1 process to find volume of one cone P1 complete process to find volume of frustum P1 complete process to find mass or 1360 – 1362 A1 1361 or 1360 or 1400

Question	Working	Answer	Notes	
99		66.9	P1	for process to find the area of one shape, eg. 19×16 (= 304) or $\pi \times 8^2$ (= 201.06...)
			P1	for process to find the shaded area, eg. "304" – "201.06" ÷2 (= 203.46...)
			P1	for a complete process to find required percentage, eg. $\frac{"203.46"}{304} \times 100$
			A1	for answer in range 66 to 68
100		135	B1	for identifying the angle of 70° (on the diagram), showing understanding of notation
			P1	for process to find an angle in triangle *ABC,* eg. for process to find angle *BAC*, eg. (180 – 50) ÷ 2 (= 65°)
			A1	for 135
101	angle *BAD* = angle *DCA* = 22.62° angle *DBA* = angle *DAC* = 67.38°	33.8	P1	for recognition of similar triangles or equal ratio of sides OR for a method to find angle *BAD* or angle *DBA* and state that this is the same as angle *DCA* or angle *DAC*
			P1	for process to find *CB*, eg. $\frac{5}{13} = \frac{13}{CB}$
			A1	for an answer rounding to 33.8
102		8.63 to 8.65	P1	for a start of process, eg. $0.5x(x-2) = 2.5$
			P1	for rearranging to give a quadratic equation, eg $x^2 – 2x – 5$ (= 0) oe.
			P1	(dep on P1) for a process to solve their 3-term quadratic equation, condoning one sign error in use of formula (x = 3.449... and x = –1.449...)
			P1	for selecting the positive value of x and applying Pythagoras to find the hypotenuse, eg.√ ("3.449"^{2} + "1.449"^{2}) (= 3.74...)
			P1	(dep on previous P1)for complete process to find perimeter
			A1	for answer in the range 8.63 to 8.65

Question	Working	Answer	Notes
103		Proof	C1 for joining AO (extended to D) and considering angles in two triangles (algebraic notation may be used here) C1 for using isosceles triangle properties to find angle BOD (eg. $x + x = 2x$) or angle COD (eg. $y + y = 2y$) C1 for angle $BOC = 2x + 2y$ [= 2×angle BAO + 2×angle CAO] C1 for completion of proof with all relevant reasons given, eg. base angles of isosceles triangle are equal and sum of angles at a point is 360^o

Question	Working	Answer	Notes
104		Translation by $\begin{pmatrix} 4 \\ -3 \end{pmatrix}$	B1 for translation B1 $\begin{pmatrix} 4 \\ -3 \end{pmatrix}$
105		105	P1 for process to find the exterior angle or interior angle of a hexagon or octagon P1 for process to find the both exterior angles or both interior angles A1 for 105 from correct working
106	$\frac{1}{4} \times \pi \times 4.8^2$ $\frac{1}{2} \times 4.8 \times 4.8$ $\frac{1}{4} \times \pi \times 4.8^2 - \frac{1}{2} \times 4.8 \times 4.8$	6.58	B1 for use of formula for area of a circle P1 for complete process to find area of shaded region A1 for 6.56 – 6.58
107	$\angle TSU = 360 \div 5$ (=72) Exterior angles of a polygon add up to 360^o $\angle QRO = \angle OTP = 90$ The tangent to a circle is perpendicular (90^o)to the radius (diameter) $\angle ROT = 540 - 2 \times 90 - 2 \times 108$ (= 144) $\angle RUT = 144 \div 2$ (= 72) The angle at the centre of a circle is twice the angle at the circumference Base angles of an isosceles triangle are equal	proof	M1 for method to find interior or exterior angle of regular pentagon M1 for using angle between tangent and radius M1 for method to find angle *ROT* C1 for method to find angle *RUT* with reason C1 for deduction that *ST* = *UT* with reasons

Question	Answer	Mark	Mark scheme	Additional guidance
108	18.3	P1	for finding the area of the triangle eg $0.5 \times 8 \times 8$ (= 32)	Accept rounded or truncated figures
		P1	for finding the area of the circle $\pi \times 8 \times 8$ (= 201.06..)	
		P1	for finding the area of the sector eg $\frac{1}{4} \times \pi \times 8^2$ **or** "201.06.." ÷ 4 (= 50.26...)	
		A1	for an answer in the range 18.2 to 18.3	If the answer is given within the range but then rounded incorrectly award full marks.
109	14.14	P1	works out scale factor eg (9 + 6) ÷ 6 (= 2.5) **OR** for start of process to find angle *DBE* eg $\sin B = \frac{2}{6}$ oe	Note method can be carried out in either order
		P1	uses Pythagoras eg $6^2 - 2^2$ (= 32) or $\sqrt{32}$ (= 5.6...) **OR** calculates *AC* eg 2 × "2.5" (= 5) **OR** for complete process to find angle *DBE* eg $\sin^{-1}\left(\frac{2}{6}\right)$ (= 19.4...)	May be seen on diagram
		P1	complete process to find *CB* eg "2.5" × "√32" (= 10√2) **or** $\sqrt{(9+6)^2 - "5"^2}$ (= 10√2) **OR** uses trigonometry, eg 15 × cos "19.4..."	
		A1	14.1 to 14.15	If the answer is given within the range but then rounded incorrectly award full marks.

Question	Answer	Mark	Mark scheme	Additional guidance
110	$\frac{2}{5}\mathbf{a}+\mathbf{b}$	P1	for relationship involving D eg $\overrightarrow{OD}=\frac{2}{5}\overrightarrow{OB}$ or $\overrightarrow{DB}=\frac{3}{5}\overrightarrow{OB}$ **or** for relationship involving E eg $\overrightarrow{BE}=\frac{1}{5}\overrightarrow{BC}$ or $\overrightarrow{EC}=\frac{4}{5}\overrightarrow{BC}$	
		P1	for relationship involving D in terms of **a** and **b** eg $\overrightarrow{OD}=\frac{2}{5}(\mathbf{a}+\mathbf{b})$ or $\overrightarrow{DB}=\frac{3}{5}(\mathbf{a}+\mathbf{b})$ **or** for relationship involving E in terms of **a** and **b** eg $\overrightarrow{BE}=\frac{1}{5}(-\mathbf{b}-\mathbf{a}+3\mathbf{b})$ oe or $\overrightarrow{EC}=\frac{4}{5}(-\mathbf{b}-\mathbf{a}+3\mathbf{b})$ oe **or** $\overrightarrow{BC}=2\mathbf{b}-\mathbf{a}$ oe or $\overrightarrow{CB}=\mathbf{a}-2\mathbf{b}$ oe	
		P1	(dep P2) for expression for $\overrightarrow{DE}$ in terms of **a** and **b** eg $\overrightarrow{DE}=\frac{3}{5}(\mathbf{a}+\mathbf{b})+\frac{1}{5}(-\mathbf{b}-\mathbf{a}+3\mathbf{b})$	
		A1	for $\frac{2}{5}\mathbf{a}+(1)\mathbf{b}$ or $\frac{1}{5}(2\mathbf{a}+5\mathbf{b})$	

Question	Answer	Mark	Mark scheme	Additional guidance
111	Proof (supported)	M1	for using the sine rule on triangle ABD or on triangle ADC, to involve sides AB, BD, AC, or DC eg $\frac{AB}{\sin ADB} = \frac{BD}{\sin x}$ oe or $\frac{AC}{\sin ADC} = \frac{DC}{\sin x}$ oe **OR** for an expression for the area of triangle ABD or for the area of triangle ADC eg $\frac{1}{2} AB\ AD \sin x$ or $\frac{1}{2} AD\ AC \sin x$ or $\frac{1}{2} h\ BD$ or $\frac{1}{2} h\ DC$	Accept extra letters eg y shown on diagram for any angle used
		M1	for using the sine rule on both triangle ABD and on triangle ADC, to involve sides AB, BD, AC, or DC eg $\frac{AB}{\sin ADB} = \frac{BD}{\sin x}$ oe and $\frac{AC}{\sin ADC} = \frac{DC}{\sin x}$ oe **OR** for two expressions for the area of either triangle ABD or for triangle ADC eg $\frac{1}{2} AB\ AD \sin x$ and $\frac{1}{2} h\ BD$ **or** $\frac{1}{2} AD\ AC \sin x$ and $\frac{1}{2} h\ DC$	
		M1	for stating or showing $\sin ADB = \sin ADC$, eg $\sin y = \sin (180 - y)$ **OR** for using two expressions to form an equation eg $\frac{\frac{1}{2} AB\ AD \sin x}{\frac{1}{2} AD\ AC \sin x} = \frac{\frac{1}{2} h\ BD}{\frac{1}{2} h\ DC}$ oe	
		C1	for a full method to arrive at the given answer	

Question	Answer	Mark	Mark scheme	Additional guidance
112	2820	P1	for start to process to find height of triangle, eg $\tan(40) = \frac{h}{5}$ oe **or** equivalent process to find the height of the triangle **or** start to process to find slant height, eg $\frac{10}{\sin 100} = \frac{x}{\sin 40}$	
		P1	for complete process to find height of triangle, eg 5tan 40 (= 4.19...) **or** complete process to find the slant height, eg $\frac{10}{\sin 100} \times \sin 40$ (= 6.5...)	Accept 4.2
		P1	for start of process to find volume of prism, eg 10 × 20 × 12 (= 2400) or 0.5 × 10 × "4.19..."× 20 (= 419....) or $\frac{1}{2}$ × 10 ×"6.52..." ×sin 40 × 20 (419....) **or** process to find total area of cross section, eg 0.5 × 10 × "4.19..." + 10 × 12 (= 140.9...) or $\frac{1}{2}$ × "6.52..." ×"6.52..." × sin 100 + 10 × 12 (= 140.9...)	10 × 20 × 12 may be seen as part of a calculation to find the volume of the prism
		P1	for complete process to find total volume, eg (0.5 × 10 × "4.19..." + 10 × 12) × 20	
		A1	for an answer in the range 2810 to 2820	If an answer is given in the range in working and then rounded incorrectly award full marks.

Question	Answer	Mark	Mark scheme	Additional guidance
113 (a)	rotation of 180° about (2.5, −1)	M1	for method to find position of **Q**, eg shape drawn at $(-1,-2)$, $(-1,-5)$ and $(-2,-5)$ **or** for method to find position of **R**, eg shape drawn at $(4,-4)$, $(4,-7)$ and $(3,-7)$ **or** for method to translate their **Q** correctly	The method mark is awarded if no working is shown but at least 2 of the 3 aspects are correct in the description
		A2	for rotation of 180° about (2.5, −1) or enlargement by scale factor −1, centre (2.5, −1)	Cannot award A marks for a combination of transformations With no extra incorrect aspects
		(A1	for any 2 of the 3 aspects)	
(b)	(2.5, −1)	B1	for (2.5, −1) ft from rotation or enlargement in (a)	No follow through from a combined transformation in part (a)
114	60 (supported)	M1	for angle *DBF*, eg 180 – 100 (= 80)	Angles may be shown on the diagram or in working
		M1	for angle *BFD*, eg 180 – "80" – 40 (= 60) or for angle *CBF* = 40	
		A1	for angle *ABD* = 60	
		C1	(dep M2) for at least 2 reasons from Opposite angles of a cyclic quadrilateral add up to 180 Angles in a triangle add up to 180 Alternate segment theorem **OR** Opposite angles of a cyclic quadrilateral add up to 180 Alternate segment theorem Angles on a straight line add up to 180	Underlined words need to be shown; reasons need to be linked to their method

Question	Answer	Mark	Mark scheme	Additional guidance
115	Proof	P1	for start to process to find area of *ABCDEF*, eg area of equilateral triangle $= \frac{1}{2} \times x \times x \times \sin 60$ $(= \frac{\sqrt{3}}{4}x^2)$ **OR** for start to process to find area of *FGHIJK*, eg area of equilateral triangle $= \frac{1}{2} \times px \times px \times \sin 60$ $(= \frac{\sqrt{3}}{4}p^2x^2)$	Any correct process to find the area of part of the hexagon is acceptable for this mark, eg $\frac{1}{2} \times x \times x \times \sin 120$ or $\frac{1}{2} \times (x + 2x) \times \frac{\sqrt{3}}{2}x$ Allow sin 60 left in expressions for the first 3 marks.
		P1	for complete process of finding area of *ABCDEF*, eg $6 \times \frac{1}{2} \times x \times x \times \sin 60$ or $6 \times \frac{1}{2} \times x \times x \times \frac{\sqrt{3}}{2}$ $\left(= \frac{3\sqrt{3}}{2}x^2\right)$ oe **OR** for complete process of finding area of *FGHIJK*, eg $6 \times \frac{1}{2} \times px \times px \times \frac{\sqrt{3}}{2}$ $\left(= \frac{3\sqrt{3}}{2}p^2x^2\right)$ oe	
		P1	for process of finding area of *ABCDEF* eg $\frac{3\sqrt{3}}{2}x^2$ oe **AND** for process of finding area of *FGHIJK*, eg $p^2 \times \frac{3\sqrt{3}}{2}x^2$ oe	
		C1	correct algebra leading to given result, $\frac{3\sqrt{3}}{2}(p^2 - 1)x^2$	Accept $\frac{3\sqrt{3}}{2}x^2(p^2 - 1)$ as final result.

Question	Answer	Mark	Mark scheme	Additional guidance
116	45	P1	for 180 – 117 (=63) **or** states, or uses, exterior angle + x =117	Angles may be shown on the diagram. Any angle labelled correctly as 63 and not contradicted scores this mark
		P1	for process to find the exterior or the interior angle of the pentagon, eg 360 ÷ 5(=72) **or** 180 – (360 ÷ 5) (=108) **or** ((5–2) × 180) ÷ 5 (=108)	Exterior = 108 or interior =72 does not score the mark
		P1	for a complete process to find x, eg 180 – "72" – "63" **or** "108" – "63" **or** 117 – "72"	
		A1	cao	An answer of 45 with no supporting working scores 0
117	Enlargement	B2	vertices at (2.5, 1) (2.5, 6) (5, 6)	
		(B1	for triangle of the correct size and orientation in the wrong position **or** a correct enlargement of a different scale factor centre (0, 1) **or** correct orientation with 2 of 3 vertices correct)	
118	1.95	P1	for correct substitution into the cosine rule, eg $3.4^2 = 6.1^2 + 6.2^2 - 2 \times 6.1 \times 6.2 \times \cos BCA$	Can be any angle within triangle ABC
		P1	for a full process to find BCA eg (cos BCA =) $\frac{6.1^2 + 6.2^2 - 3.4^2}{2 \times 6.1 \times 6.2}$ **or** (BCA =) 32(.08046913…)	P2 can be awarded for BCA = 32(.08046913…)
		P1	correct substitution into the sine rule, eg $\frac{DC}{\sin("32.08..." \times \frac{2}{5})} = \frac{6.2}{\sin(180 - "32.08..." - ("32.08..." \times \frac{2}{5})}$	
		P1	for complete process to find DC eg (DC =) $\frac{6.2 \times \sin "12.832"}{\sin "135.088"}$	
		A1	Answer in the range 1.94 to 1.951	Must not come from incorrect processing

Question	Answer	Mark	Mark scheme	Additional guidance
119	264	P1	correct substitution into the volume formula, eg $56.8 = \frac{1}{3} \times \pi \times r^2 \times 3.6$	
		P1	completes process to find base radius **or** the value of r^2, eg $r = \sqrt{\frac{56.8 \times 3}{\pi \times 3.6}}$ (=3.88158…) or $r^2 = \frac{56.8}{1.2\pi}$ (=15.066)	
		P1	Uses Pythagoras to find the sloping length, eg $\sqrt{"3.88 \ldots"^2 + 3.6^2}$ (=5.29……)	
		P1	process to find an equation in *AOB*, eg $\pi \times$ "3.88" $\times$ "5.29" $= \frac{AOB}{360} \times \pi \times$ "5.29"^{2} **or** $\frac{AOB}{360} \times \pi \times 2 \times$ "5.29" $= 2 \times \pi \times$ "3.88" **or** $\frac{AOB}{360} \times$ "5.29" = "3.88"	*AOB* does not need to be the subject of the equation
		A1	answer in the range 263.9 to 264.1	
120	4 : 3	P1	Process to find a missing vector using the given ratios as fractions, eg. $\frac{1}{3}$ of $\overrightarrow{OX}$ ($=\frac{1}{3}$ **a**) or. $\frac{1}{4}$ of $\overrightarrow{OY}$ ($=\frac{1}{4}$ **b**)	
		P1	for a process to use $\overrightarrow{ZO} = \overrightarrow{YX} = \mathbf{a} - \mathbf{b}$ oe	Might be embedded in their answer for ZP
		P1	for a process to find either $\overrightarrow{ZP}$ or $\overrightarrow{ZR}$ in terms of **a** and **b**, eg. either $\overrightarrow{ZP} = \mathbf{a} - \mathbf{b} + \frac{1}{3}\mathbf{a}$ or $\overrightarrow{ZR} = \mathbf{a} - \mathbf{b} + \frac{1}{4}\mathbf{b}$	The award of this mark implies the first two process marks.
		P1	for a process to write $\overrightarrow{ZP}$ and $\overrightarrow{ZR}$ as multiples of the same vector, eg. multiplying both by 12 to get the ratio, $\frac{4}{3}$**(a** – 0.75**b)** and **a** – 0.75**b** respectively	
		A1	oe	

Question	Answer	Mark	Mark scheme	Additional guidance
121	162 supported	M1	for method to find sum of the interior angles of a hexagon eg $(6 - 2) \times 180$ (= 720) oe **OR** for method to find sum of the interior angles of a pentagon, eg $(5 - 2) \times 180$ (= 540) **OR** for method to find angle *AFC* or *BCF*, eg $(360 - 2 \times 117) \div 2$ (= 63) **OR** for dropping a perpendicular from *A* or *B* to *ED* with 90° marked on *ED* and 27° at the top	Must be a complete process that would lead to a figure of 720 if evaluated correctly. For a pentagon there must be an indication that they have divided the hexagon into two halves. 63 may be shown on the diagram for angle *AFC* or angle *BCF*
		M1	for method to use ratio 2 : 1 eg marks as $2x$ and x or as x and $\frac{1}{2}x$ on diagram **OR** for ([angle sum of hexagon] $- 2 \times 117) \div 6$ (= 81) oe or ([angle sum of hexagon] $\div 2 - 117) \div 3$ (= 81) oe **or** $117 + 117 + 2x + 2x + x + x$ = [angle sum of hexagon] oe **OR** eg ([angle sum of pentagon] $- 117 - 180) \div 3$ (= 81) oe **or** $117 + 180 + 2x + x$ = [angle sum of pentagon] oe	Ratio must be used correctly if awarded for diagram Award provided [angle sum of hexagon] is greater than 700 or [angle sum of pentagon] is greater than 500 Algebraic route needs to show both sides of the equation. LHS of equation may be simplified.
		M1	for finding angle *FED* = 81 or for finding angle *CDE* = 81 **OR** for complete process to find angle *AFE* eg ([angle sum of hexagon] $- 2 \times 117) \div 6 \times 2$ oe **OR** ([angle sum of pentagon] $- 117 - 180) \div 3 \times 2$ oe	This may be shown by solving a correct equation to find the value of *x*.
		C1	for accurate working leading to angle *AFE* = 162	Award marks for 162 on the diagram with working and not contradicted by the answer line. Award 0 marks for 162 without working.

Question	Answer	Mark	Mark scheme	Additional guidance
122	No Supported	P1	for finding the area of a circle eg $\pi \times 0.8^2$ (= 2.01...)	Must be area of circle and not part of a volume, eg $\pi r^2 h$ May be seen as $2\pi r^2$
		P1	for finding the curved surface area eg $2\pi \times 0.8 \times 1.8$ (= 9.047…)	May be seen from $2\pi rh$ or from πdh
		P1	for use of the coverage information with an area eg "2.01…" ÷ 5 (= 0.402…) or "4.02…" ÷ 5 (= 0.804…) or "9.047…" ÷ 5 (= 1.8095…) or "11.058" ÷ 5 (= 2.2116..) or "13.069…" ÷ 5 (= 2.6138…) **OR** for process to find total coverage for comparison eg 5 × 7 (= 35)	Accept numbers without working written to no less than 2dp Do not award if a volume has been used as part of the calculation. An independent mark for 5 ×7
		P1	(dep P1) for finding total surface area for 3 tanks eg [total surface area] × 3 (= 39.2…) **OR** for complete process to find the number of tins needed for total area of 3 tanks eg "13.069"....× 3 ÷ 5 (= 7.84.…) **OR** for complete process to find coverage needed from each tin eg "13.069"...× 3 ÷ 7 (= 5.6...)	[total surface area] must come from the addition of two attempts at area, but not from volume.
		C1	for conclusion "No" supported by accurate figures eg 8 tins **or** 7.84 (> 7) **or** 39.2 > 35 **or** 5.6 (>5)	Clear statement that there is **not** enough paint supported by correct figures for comparison. NB: 2.6 × 3 = 9 tins needed is inaccurate 8 or 7.84 tins is sufficient without restating the 7, 5.6 m^2 is sufficient without restating the 5 but 39.2 and 35 are needed for comparison. A statement of "No, 8 tins" alone gets 0 marks without supporting working.

Question	Answer	Mark	Mark scheme	Additional guidance
123	36	P1	for process to find an expression for the area of triangle eg $\frac{1}{2} \times 24 \times AE \times \sin 30$ (= $6AE$)	Accept any correct expression, eg $\frac{1}{2} \times 24 \times y \times \sin 30$
		P1	(dep P1) for process to link the area of rectangle with the area of the triangle eg $2 \times \frac{1}{2} \times 24 \times AE \times \sin 30$ (= $12AE$) or for $AB = 12$	
		P1	(indep) for use of given ratio eg $AE = 3AB$ oe, eg area of rectangle = $AE \times AB = 3x \times x$	May be shown on the diagram by labelling AE and AB with, for example, $3x$, x or x, $\frac{1}{3}x$ or $\frac{3}{4}x$, $\frac{1}{4}x$ Do not accept 3, 1 or 1, $\frac{1}{3}$ or $\frac{3}{4}$, $\frac{1}{4}$ for this mark.
		A1	cao	

Question	Answer	Mark	Mark scheme	Additional guidance
124	098.6	P1	for using bearings to determine ABC as 67°	Accept 67 written on the diagram.
		P1	for using the cosine rule to find AC eg $(AC^2 =) 9^2 + 8^2 - 2 \times 9 \times 8 \times \cos[67]$ oe or AC = 9.4199…	Accept correct substitution into RHS of equation Accept AC in the range 9.41 to 9.42
		P1	(dep P1) for using the sine rule to find angle BAC eg $\frac{9}{\sin BAC} = \frac{"9.42"}{\sin[67]}$ oe **OR** for using the cosine rule to find angle BAC eg $9^2 =$ "9.42^2" $+ 8^2 - 2 \times$ "9.42" $\times 8 \times \cos BAC$ oe	
		P1	for rearranging eg $\sin BAC = 9 \times \frac{\sin[67]}{"9.42"}$ oe **OR** eg $\cos BAC =$ ("9.42^2" $+ 8^2 - 9^2$) ÷ (2 × "9.42" × 8) oe	Accept any equivalent form with values substituted
		A1	**OR** for angle $BAC = 61.57…$ for angle in the range 98.5 to 98.6	If the correct answer is given without supportive evidence award 0 marks. Condone missing "0" at the front. If an answer within the range is seen in working and rounded incorrectly award full marks.

Question	Answer	Mark	Mark scheme	Additional guidance
125	17.3	P1	for full process to find either angle eg (180 − 90) ÷ (2+3) ×2 (=36) **or** for 36 or 54 seen as an angle	May be seen on diagram Condone correct values if incorrectly placed.
		P1	for a correct equation using trigonometry eg cos [*A*] = 14÷ *AB*	This must be shown as an equation with all four elements (eg cos, [*A*], 14, *AB*) present. [*A*] could be 36 or any angle clearly and unambiguously identified as *A*. This also applies to [*B*] with Sine.
		P1	(dep previous P mark) for rearranging their trigonometry equation to make *AB* the subject eg (*AB* =) "14 ÷ cos 36"	
		A1	for an answer in the range 17.3 to 17.4	If an answer is shown in the range in working and then incorrectly rounded award full marks.
126	73.6	P1	for correct initial use of Pythagoras eg $5^2 + 5^2$ (=50) **or** a trigonometric ratio in the form $\frac{5 \div 2}{0.5AC}$ = sin 45 oe	
		P1	for finding the length of half of the diagonal eg $\sqrt{"50"} \div 2$ (= 3.5...) **or** $0.5AC = \frac{5 \div 2}{\sin 45}$ (=3.5...) oe	do not accept $\sqrt{20} \div 2$
		P1	for process to use tan eg tan *TAC* = (12 ÷ "3.5..") (=3.3..) **or** complete alternative method arriving at an equation with the subject as sin *TAC* or cos *TAC*	
		A1	for an answer in the range 73.58 to 74.1	

Question	Answer	Mark	Mark scheme	Additional guidance
127	39.9	P1	for finding the length of the minor or major arc eg $\frac{220}{360}\pi\times12$ (= 23(.03834..))	Allow appropriate rounding if calculation seen in parts
		P1	for substituting into the sine or cosine rule to find *OD* eg 14 ÷ sin140 = *OD* ÷ sin 24 **or** (*OD*²=) 6² +14² − 2 × 6 × 14 × cos 24 (=78.5....)	Must involve *OD* in the relationship but may be implied
		P1	for a complete process to find the length *OD* eg 14 ÷ sin140 × sin24 (=8.8(58778..))	
		P1	for a complete process to find the perimeter eg "23(.03834..)" + 14+ "8.8(58778..)" – 6	May be seen in multiple calculations
		A1	for an answer in the range 39.8 to 40	If an answer in the range is seen in working and then incorrectly rounded award full marks.
128	(−3.5, 1)	M1	for a complete method to show the transformations	Image at (−4,1), (−3,1) and (−3.5, −2)
		A1	cao	

Question	Answer	Mark	Mark scheme	Additional guidance
129	Triangle of area 18	M1	for a complete method to find area of trapezium eg $\frac{1}{2}(2 + 7) \times 4$ (= 18) **OR** for a triangle drawn of area 36 **OR** for a triangle that would give an area ft their area of trapezium	The value for the area of the trapezium must be clear for the ft to be checked.
		A1	for a triangle drawn of area 18 eg base = 6, height = 6 or base = 9, height = 4	Accept use of dimensions that are not whole numbers as long as the intention is clear
130 (a)	50.5	M1	for cos *ABC* = $\frac{7}{11}$ (0.63…) oe	Must be a complete statement for cos, sin or tan with all three elements present.
		A1	for answer in the range 50.4 to 50.51	If an answer is in the range 50.4 to 50.51 is given in the working space then incorrectly rounded, award full marks.
(b)	Increase (supported)	C1	States increase with supporting reason eg " $\frac{7}{10}$ is greater than $\frac{7}{11}$" " 0.636 is less than 0.7" …."cos increases as angle decreases" "decreasing the denominator increases the value of the fraction" "angle is now 45.6" (accept 45.5 – 45.6)	If figures are given they must be correct (truncated or rounded).

Question	Answer	Mark	Mark scheme	Additional guidance
131	140	P1	for complete process to find sum of the interior angles of a pentagon eg $(5 - 2) \times 180$ or exterior $360 \div 5 = 72$, interior $180 - 72 = 108$, 108×5 **OR** for complete process to find sum of the exterior angles of the pentagon eg $(180 - x) + (180 - 2x) + (180 - 125) + (180 - 115) + (180 - 90)$	Must be a complete process that could lead to a figure of 540 if that process is evaluated incorrectly
		A1	for sum of interior angles is 540 **OR** for sum of exterior angles is 360	360 must be identified as the sum of the exterior angles
		P1	for start to process to find angle *ABC* eg [angles in a pentagon] – 115 – 125 – 90 (= 210) or $115 + 125 + 90 + x + 2x =$ [angles in a pentagon] **OR** $(180 - x) + (180 - 2x) + (180 - 125) + (180 - 115) + (180 - 90) = 360$	Award provided [angles in a pentagon] is greater than 400 Algebraic route needs to show both sides of the equation. LHS of equation may be simplified
		P1	for process to find angle *ABC* eg "210" ÷ 3 (= 70), "210" divided in the ratio 2 : 1 **or** for process to find angle *BCD* eg $\frac{2}{3} \times$ "210" **or** for $3x =$ "210" or $-3x = -$"210"	Award if 70 is given for either *ABC* or *BCD* on the diagram
		A1	cao	Award marks for 140 on the diagram with working and not contradicted by the answer line. Award 0 marks for 140 without working.

Question	Answer	Mark	Mark scheme	Additional guidance
132	13.1	P1	for start of process to find the length of BD, eg $\frac{BD}{\sin 34°} = \frac{12.5}{\sin 109°}$	
		P1	for complete process to find the length of BD, eg $BD = \frac{12.5}{\sin 109°} \times \sin 34°$ (= 7.39...)	Accept 7.4 for the award of the first two P marks
		P1	for process to find the length of AD, eg $AD^2 = 11.4^2 + \text{“ } 7.39^2 \text{ ”} - 2 \times 11.4 \times \text{“7.39”} \times \cos 86°$	
		P1	for process to use correct order of operations, eg 129.96 + 54.6(5...) – 11.7(5...) (= 172.85...)	
		A1	for answer in the range 13.1 to 13.2	If an answer is given within the range and then incorrectly rounded to 3 sig figs award full marks.
133 (a)	Proof	C1	for starting the proof, identifying a pair of relevant equal sides or angles with reasons from $AD = BC$ (opposite sides of a parallelogram are equal) angle PAD = angle QCB (opposite angles of a parallelogram are equal) angle ADP = angle CBQ (given or both 90^o)	
		C1	(dep C1) for complete identification of all three equal aspects with reasons	
		C1	(dep C2) for conclusion of congruency proof	Congruency conclusion must include a reference to ASA
(b)	Explanation	C1	for identifying a pair of equal sides or angles in $APCQ$, with reason, eg $AP = QC$ since triangle ADP is congruent to triangle CBQ	
		C1	(dep C1) for reasoning that $APCQ$ is a parallelogram so opposite sides of a parallelogram are parallel	

Question	Working	Answer	Mark	Notes
134		14.4	P1	for start of process, eg $0.5 \times 11 \times CD \times \sin 105 = 56$
			P1	for complete process to find CD, eg (CD =) $\frac{56}{0.5 \times 11 \times \sin 105}$ oe (= 10.54)
			P1	for process to find AC, eg (AC^2 =) $11^2 + [CD]^2 - 2 \times 11 \times [CD] \times \cos 105$ (AC = 17.09)
			P1	for process to find AB, eg $\frac{AB}{\sin 48} = \frac{[AC]}{\sin 118}$
			A1	answer in range 14.3 to 14.4
135		Proof	C1	draws OC and considers angles in an isosceles triangle (algebraic notation may be used, eg two angles labelled x)
			C1	finds sum of angles in triangle ABC, eg $x + x + y + y = 180$, or sum of angles at O, eg $180 - 2x + 180 - 2y$
			C1	complete method leading to $ACB = 90$
			C1	complete proof with all reasons given, eg base angles of an isosceles triangle are equal, angles in a triangle add up to 180º, angles on a straight line add up to 180º
136		$\frac{2}{5}$	P1	for process to find $\overrightarrow{AB}$ (= **b** – **a**) or $\overrightarrow{BA}$ (= **a** – **b**)
			P1	for process to find $\overrightarrow{MN}$ ($= -\frac{1}{2}\mathbf{b} + \mathbf{a} + 2\mathbf{a}$) or $\overrightarrow{PN}$ (= –k(**b** – **a**) + 2**a**) or $\overrightarrow{MP}$ ($= -\frac{1}{2}\mathbf{b} + \mathbf{a} + k(\mathbf{b} - \mathbf{a})$ or $\frac{1}{2}\mathbf{b} + (1 - k)(\mathbf{a} - \mathbf{b})$)
			P1	for process to find two of $\overrightarrow{MN}$, $\overrightarrow{PN}$ and $\overrightarrow{MP}$
			P1	for process to find k, using $\overrightarrow{MN}$ as a multiple of $\overrightarrow{PN}$ or using $\overrightarrow{MN}$ as a multiple of $\overrightarrow{MP}$ or using $\overrightarrow{PN}$ as a multiple of $\overrightarrow{MP}$
			A1	for $\frac{2}{5}$ oe

Question	Working	Answer	Mark	Notes
137		Shows polygon is a hexagon	M1	for a complete method to find the interior or exterior angle of the dodecagon eg $180-\frac{360}{12}$, $\frac{180}{12}(12-2)$ oe (= 150), 360 ÷ 12 (=30)
			M1	for a complete method to find the interior angle of polygon **P** eg at *B* or *C*: 360 – "150" – 90 (= 120) or "30" + 90 (= 120) **or** for a complete method to find the interior or exterior angle of the hexagon eg $180-\frac{360}{6}$, $\frac{180}{6}(6-2)$ oe (= 120), 360 ÷ 6 (= 60)
			A1	for 30 and 120 **or** 30 and 60 **or** 120 and 150 **or** 60 and 150
			C1	complete solution, fully supported by accurate figures
138		5.86	M1	for $\sin 23 = \frac{AB}{15}$ NB Allow any alternative equivalent method to form an equation in *AB*
			A1	5.8 to 5.9
139		5.59	M1	For use of $\pi r^2 = 49$, where *r* is the radius or *r* = 3.9(49…) or diameter = 7.8(9865…)
			M1	For use of Pythagoras to set up an equation in x^2 e.g. $x^2 + x^2 = (d)^2$ or $x^2 = r^2 + r^2$ For use of trigonometry to set up an equation in *x* eg $\sin 45 = x \div d$
			M1	(dep on M2) Rearrange to $(x^2 =)$ 2× "3.949.." ^{2} Rearrange to (*x*=) "7.898.." × sin 45 oe
			A1	5.5 to 5.6
140		2.63	P1	for setting up the expression $\frac{1}{2}(x+3)(2x-1)\sin 45$ (may be seen in an equation)
			P1	(dep) for expanding the brackets in the expression or for the equation $\frac{1}{2}(x+3)(2x-1)\sin 45 = 6\sqrt{2}$ oe
			P1	(dep) for the process to set up the equation and rearrange to the form $ax^2 + bx + c = d$ e.g. to $2x^2 + 5x - 27 = 0$ or $24 = 2x^2 + 5x - 3$
			P1	(dep) for substitution into the quadratic formula e.g. $\frac{-5 \pm \sqrt{5^2 - 4\times 2\times -27}}{4}$
			A1	for 2.63(10436…)

Question	Working	Answer	Mark	Notes
141	Note *DOC*=*DOA*, *ADO*=*CDO*	21.6	P1	Recognises that *OAD* or *OCD* is 90° or right angle
			P1	for using trigonometry to set up an equation in *DOA* or *ADO* eg Cos *DOA* = $\frac{5}{9}$
			P1	for using inverse trigonometry to find *DOA* or *ADO* eg *DOA* = $\text{Cos}^{-1}\frac{5}{9}$ (= 56.25…)
			P1	for a complete process to find arc length *ABC* or *AC* eg $\frac{360-2\times"56.25.."}{360}\times2\times\pi\times5$ (=21.598..) or $\frac{2\times"56.25.."}{360}\times2\times\pi\times5$ (=9.8174..)
			A1	for answer in the range 21.5 to 21.65

Question	Working	Answer	Notes
142		252	P1 For start to process eg. radius = 12 ÷ 4 (=3) M1 Method to find area of trapezium or semicircle or circle P1 Process to find area of the shaded region A1 251.7 – 252
143	$DN = MB$ (given) $\angle NDC = \angle MBC$ (base angles of isosceles triangle) $DC = BC$ (sides of a rhombus are equal) $\therefore\ \Delta DNC \equiv \Delta BMC$ (SAS)	Proof	C1 One correct relevant statement C1 All correct relevant statements C1 Correct conclusion with reasons
144	$AC^2 = 20^2 + 20^2 = 800$ $AX^2 = 10^2 + 10^2 = 200$ $\sqrt{200} \times \tan 55 = VX \quad (= 20.19...)$ $VM^2 = \sqrt{"20.19"^2 + 10^2} \quad (= 22.54...)$ $4 \times \frac{1}{2} \times "22.54" \times 20 + 20^2$	1300	Let X be centre of base, M be midpoint of AB P1 process to find AC or AX P1 process to find VX or VA P1 process to find height of sloping face or angle of sloping face. P1 process to find surface area of one triangular face. A1 For 1300 – 1302

Question	Working	Answer	Notes
145	$\vec{OM}$ **= 3a** $\vec{AB}$ = 6**b** – 6**a** $\vec{MC}$ = 3**a** + 2(6**b** – 6**a)** = 12**b** – 9**a** = 3(4**b** -3**a)** $\vec{MN}$ = *k***b** –3**a** *MNC* is a straight line so $\vec{MC}$ is a scalar multiple of $\vec{MN}$	4	P1 For process to start e.g. $\vec{OM}$ = 3a **or** $\vec{MA}$ **= 3a** P1 For process to find $\vec{AB}$ (=6**b** – 6**a**) P1 For process to find $\vec{MC}$ (=3**a** + 2(6**b** – 6**a) and** $\vec{MN}$ (= *k***b** –3**a**) P1 For correct process to find *k* e,g. 3*k***b** - 9**a** = 12**b** - 9**a** A1

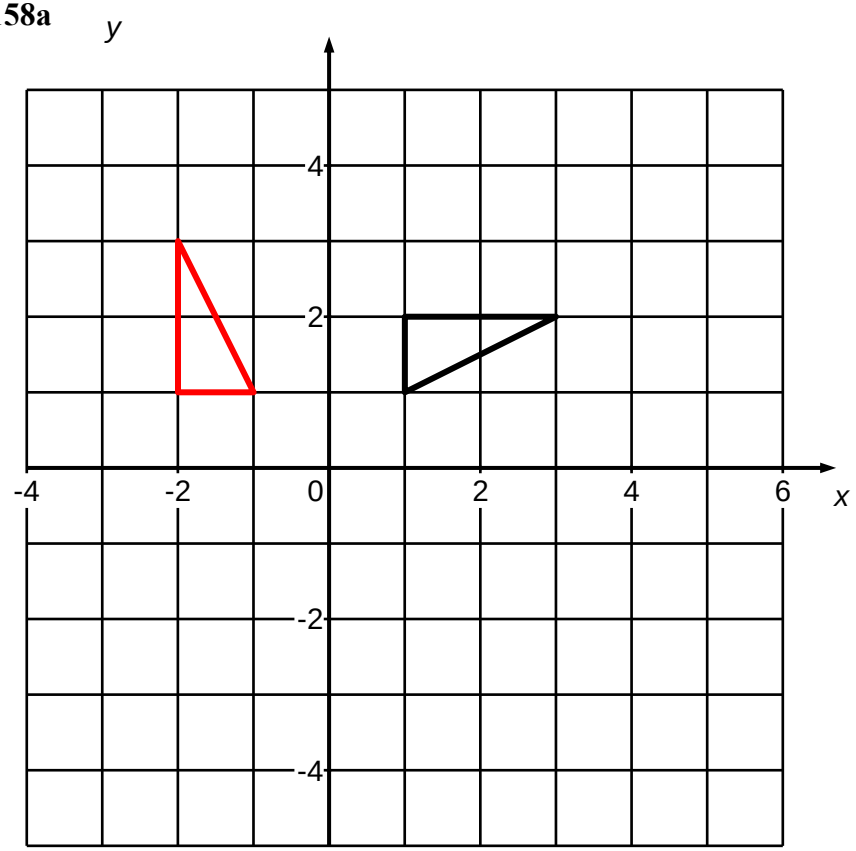
Question	Working	Answer	Notes
146	160 tiles 18 packs	18	M1 a full method to find the area of the trapezium M1 a full method to calculate both areas in consistent units M1 for the area of the trapezium ÷ area of a tile (with consistent units) M1 (dep on previous M) for complete method to find the number of packs required A1
147	1.5×1.7−1.7 Or 0.5 × 1.7 = (0.85)	0.664(09..)	P1 for finding the difference in height by ratio or multiplier P1 for use of tan ratio P1 (dep) for "0.85" ÷ tan 52 oe A1 0.664 to 0.6641
148		430	P1 for appropriate use of Pythagoras P1 for setting up an equation equivalent to $x\ = 15\ -5\ -7$ or better eg $\sqrt{151}$ P1 for finding the volume using their "$\sqrt{15\ -5\ -7}$" A1 430 to 430.1
149	$l = 20x$ $x = 3$	20736	P1 for a first step to solve the problem eg method to find the slant height of the cone or the volume equals $768\pi x^3$ P1 for setting up an equation for the curved surface area in terms of x eg $2160\pi = \pi \times 12x \times 20x$ P1 for complete method to find the value of x P1 for a method to find the volume or value of V A1 cao

Question	Working	Answer	Notes
150		plan	C1 a partially correct plan C1 correct plan
151		complete chain of reasoning	C1 starts chain of reasoning eg finds area of large square and area of triangle or use of Pythagoras C1 for $(x+y)^2 - 4\times(x\times y\div 2)$ oe or $\sqrt{x^2+y^2}\times\sqrt{x^2+y^2}$ C1 complete chain of reasoning with correct algebra
152		Triangle (–6, 2), (–6, –1), (–3, –1)	M1 for correct shape and the correct orientation in the wrong position or two vertices correct. A1 cao
153		18.2	M1 for $\frac{260}{360}\times\pi\times 8$ oe or $\frac{100}{360}\times\pi\times 8$ oe A1 for 18.1 to 18.2
154		$\frac{1}{4}$	P1 starts process eg $\overrightarrow{AB} = 2\mathbf{b} - 2\mathbf{a}$ P1 process to find $\overrightarrow{AP}$ or $\overrightarrow{BP}$ P1 complete process to find $\overrightarrow{OP}$ A1 for $\frac{1}{4}$ oe

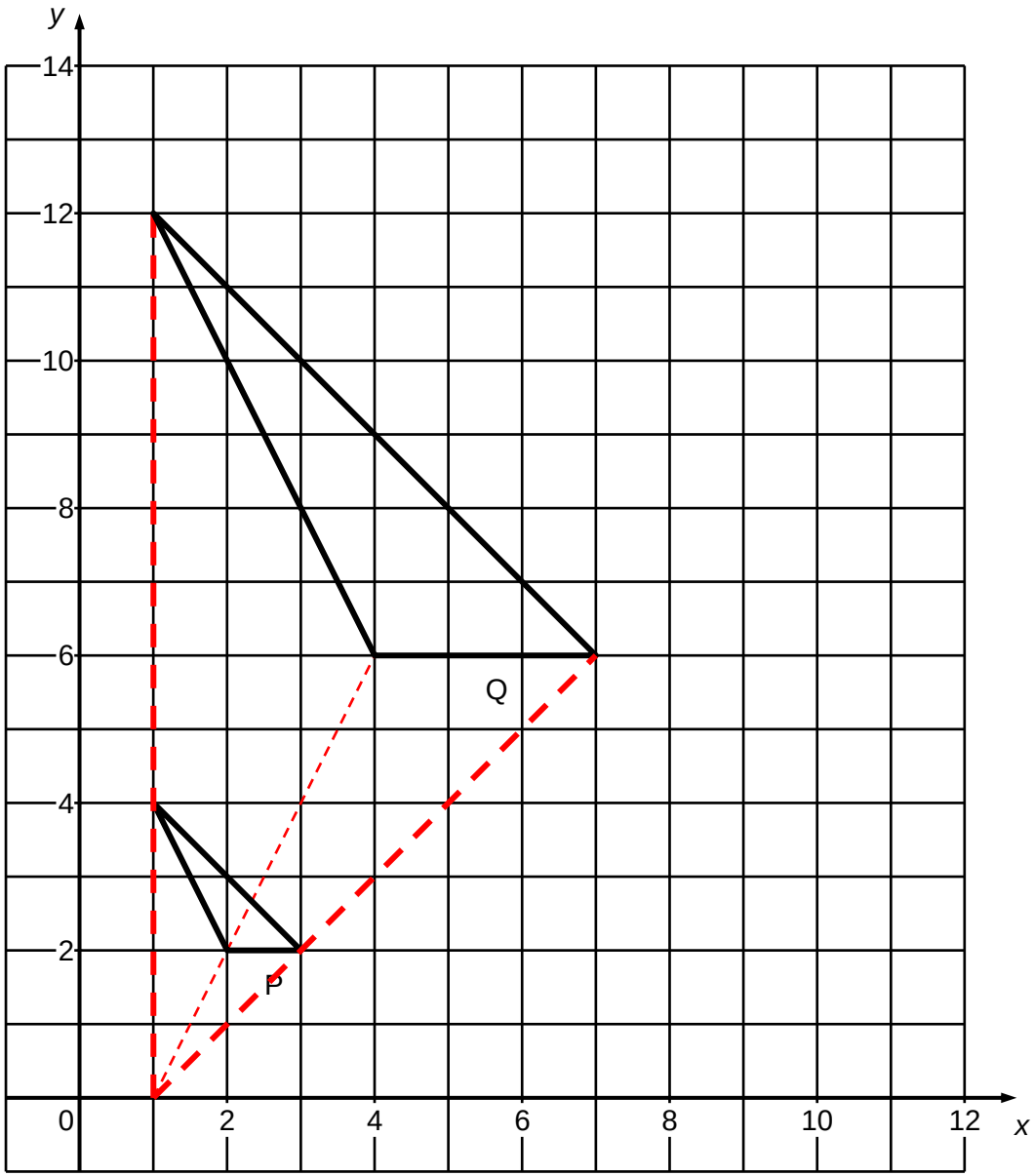
Question	Working	Answer	Notes
155		10.4	P1 starts process by using cosine rule to find *CD* eg $(CD)^2 = 4.9^2+3.8^2 - 2\times4.9\times3.8\times\cos80$ (= 31.98..) P1 uses sine rule to find angle *ACD* or angle *ADC* eg $\frac{\sin C}{3.8}=\frac{\sin 80}{'5.655'}$ or $\frac{\sin D}{4.9}=\frac{\sin 80}{'5.655'}$ P1 uses sine rule to find *BC* or *BD* eg $\frac{BD}{\sin 25}=\frac{'5.655'}{\sin'33.6'}$ P1 process to find area eg 1/2 *ab*sin*C* A1 for 10.4 to 10.43

Question	Working	Answer	Mark	Notes
156		42	3	M1 for a method to find angle *ABD* eg *ABD* = 360 −130 −130 −40 (= 60) or angle *DBC* eg *DBC* = 180 − 2 × 72 (= 36) (may be on the diagram) M1 for a complete method eg (180 – "60" − "36") ÷ 2 A1 cao OR M1 for a method to find angle *ABC* eg *ABC* = 540 −130 − 40 −130 −72 −72 (= 96) M1 for a complete method eg (180 − "96") ÷ 2 A1 cao
157		15 200	3	M1 for a method to obtain at least 2 different areas from 50×80 (= 4000), $\frac{1}{2} \times 40 \times 60$ (= 1200), 60×80 (= 4800) M1 (dep on M1) for adding at least 4 correct face areas A1 cao
158 (a)		Transformation	2	B2 for a triangle with vertices at (−1, 1), (−2, 3) and (−2, 1) (B1 for a triangle in correct orientation or rotated 90° clockwise centre the origin)
(b)		Description	3	B1 Enlargement B1 Scale factor 3 (accept × 3) B1 Centre (1,0) NB: More than one transformation is B0
159		270	3	M1 for correct use of formula for volume of a cylinder using exact or (some) approximate figures eg $\pi \times 31^2 \times 97.5$ or $\pi \times 31^2 \times 100$ or using an estimate of π eg $\pi = 3$ in the volume formula M1 for a complete method to find an estimate for the volume in cm^3 with at least 2 values rounded eg $\pi \times 30^2 \times 100$ (= 270 000) eg $3.1 \times 30^2 \times 100$ eg $3 \times 31^2 \times 100$ A1 accept answer in the range 270 − 300 from a method using estimates

158a



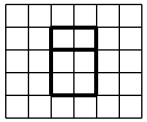
158b



Question	Working	Answer	Mark	Notes
160		18	4	M1 for correct initial use of Pythagoras eg $(AB^2 =)\ 10^2 - 6^2$ $(= 64)$ or $AB = 8$ M1 (dep M1) for "$\sqrt{64}$" $\div 2$ $(= 4)$ M1 for method to find area of trapezium eg $\frac{1}{2} \times$ "4" $\times (6 \div 2 + 6)$ A1 cao OR M1 for correct initial use of Pythagoras eg $(AB^2 =)\ 10^2 - 6^2$ $(= 64)$ or $AB = 8$ M1 (dep M1) for method to find area of ΔABC eg $\frac{1}{2} \times$ "$\sqrt{64}$" $\times 6$ $(= 24)$ or area of ΔAED $\frac{1}{2} \times 6 \div 2 \times$ "4" $(= 6)$ or $24 \times (\frac{1}{2})^2$ $(= 6)$ M1 for a complete method to find area of $EDBC$ e.g $\frac{3}{4} \times$ "24" eg "24" − "6" A1 cao

Question	Working	Answer	Mark	Notes
*161		155°	5	M1 for a method to find angle *AOD* e.g 90 − 40 (= 50) M1 for a complete method to find angle *BCD* eg 360 − '50' (= 310) and '310' ÷ 2 (= 155) A1 for 155 C2 for complete reasons for their method Angle between tangent and radius = 90 Angle at the centre is twice the angle at the circumference oe Angle sum of a triangle = 180 Sum of angles round a point = 360 (C1 for at least two reasons, one of which must be a circle theorem) OR M1 for a method to find angle *AOD* eg 90 − 40 (= 50) M1 for a complete method to find angle *BCD* eg 50 ÷ 2 (= 25) and 180 − '25' (= 155) A1 for 155 C2 for complete reasons for their method Angle between tangent and radius = 90 Angle at the centre is twice the angle at the circumference oe Opposite angles of a cyclic quadrilateral add up to 180 Angle sum of a triangle = 180 (C1 for at least two reasons, one of which must be a circle theorem)

Question	Working	Answer	Mark	Notes
162 (a)		$3\mathbf{a} + 3\mathbf{b}$	2	M1 for $\vec{AB} = 6\mathbf{b} - 6\mathbf{a}$ oe or $\vec{BA} = 6\mathbf{a} - 6\mathbf{b}$ oe or $(\vec{OM}) = \frac{1}{2}(6\mathbf{a} + 6\mathbf{b})$ oe A1 cao
*(b)	Method 1 Show that $\vec{AG}$ is parallel to $\vec{AN}$	Shown	4	M1 for a method to find $\vec{OG}$ or $\vec{GM}$ in terms of **a** and **b** eg $\vec{OG} = \frac{2}{3}$ "$(3\mathbf{a} + 3\mathbf{b})$" $(= 2\mathbf{a} + 2\mathbf{b})$ eg $\vec{GM} = \frac{1}{3}$ "$(3\mathbf{a} + 3\mathbf{b})$" $(= \mathbf{a} + \mathbf{b})$ M1 for a method to find $\vec{AN}$ in terms of **a** and **b** eg $-6\mathbf{a} + 6\mathbf{b} \div 2$ $(= 3\mathbf{b} - 6\mathbf{a})$ M1 for a method to find $\vec{AG}$ in terms of **a** and **b** eg $-6\mathbf{a}$ + "$2\mathbf{a} + 2\mathbf{b}$" $(= 2\mathbf{b} - 4\mathbf{a})$ C1 for correct simplified expressions in terms of **a** and **b** for $\vec{AG}$ and $\vec{AN}$ followed by conclusion OR M1 for a method to find $\vec{OG}$ in terms of **a** and **b** eg $\frac{2}{3}$ "$(3\mathbf{a} + 3\mathbf{b})$" $(= 2\mathbf{a} + 2\mathbf{b})$ M1 for a method to find $\vec{GN}$ in terms of **a** and **b** eg $-$"$(2\mathbf{a} + 2\mathbf{b})$" $+ 6\mathbf{b} \div 2$ $(= \mathbf{b} - 2\mathbf{a})$ M1 for a method to find $\vec{AG}$ in terms of **a** and **b** eg $\frac{1}{2}(6\mathbf{b} - 6\mathbf{a}) - \frac{1}{3}$ "$(3\mathbf{a} + 3\mathbf{b})$" $(= 2\mathbf{b} - 4\mathbf{a})$ C1 for correct simplified expressions in terms of **a** and **b** for $\vec{AG}$ and $\vec{GN}$ followed by conclusion
	Method 2 Show that $\vec{AG}$ is parallel to $\vec{GN}$			

Question	Working	Answer	Mark	Notes
163		Diagram drawn	3	B3 for fully correct shape (B2 for 3 or 4 vertices correct or enlargement scale factor 3 in wrong position or enlargement, centre *A*, with different scale factor) (B1 for 2 vertices correct or enlargement, not from *A*, with different scale factor)
164			2	B2 for correct side elevation (B1 for a rectangle with base 2 squares or height 3 squares)
165	$(7 + 3 + 3) \times (4 + 3 + 3) - 7 \times 4 = 102$ OR $2 \times 7 \times 3 + 2 \times 4 \times 3 + 4 \times 3 \times 3 = 102$	11	4	M1 for a correct method to find the area of one appropriate rectangle M1 for a complete method to find the area of the path M1 (dep on M1) for "102" ÷ 10 A1 cao from correct working
*166		95° with reasons	4	M1 for angle *DBC* = 180 – 125 (= 55) **or** angle *EAC* = 180 – 125 (=55) (May be on diagram) A1 for *x* = 95 C2 (dep on M1) with full reasons for their given method, e.g. angles on a straight line add up to 180° **and** angles in a triangle add up to 180° **and** corresponding angles are equal **or** allied angles / co-interior angles add up to 180^{o} **and** angles in a triangle add up to 180° (C1 (dep on M1) for one appropriate reason linked to parallel lines) M1 for angle *CDB* = 125 – 30 (= 95)) (May be on diagram) A1 for *x* = 95 C2 (dep on M1) for full reasons, for their given method, e.g. exterior angles are equal to the sum of the interior opposite angles **and** corresponding angles are equal (C1 (dep on M1) for one of these appropriate reasons linked to parallel lines)
167 (a)		049	1	B1 for answer in range 47 to 51
(b)		12	2	M1 for line drawn on a bearing of 320° ±2° A1 for answer in range 10 to 14

Question	Working	Answer	Mark	Notes
168	**B** at (1, 0), (1, –1), (3, –2) **C** at (–2, –1), (–2, –2), (0, –3) Rotation 90° clockwise (or 270° anti-clockwise) about (–2, 2)	Rotation 90° clockwise centre (–2, 2)	3	M2 for stating rotation 90° clockwise (or 270° anti-clockwise) or centre (–2, 2) (M1 for showing **B** and **C** correctly on the grid) A1 for a fully correct description NB Award a maximum of M1 if more than one transformation is given
169		3.75 oe	3	M1 for a correct scale factor or ratio using two corresponding sides from similar triangles or two sides from the same triangle (may be seen in an equation) e.g $\frac{6}{1.5}$ oe or $\frac{1.5}{6}$ oe or $\frac{5}{6}$ or $\frac{6}{5}$ etc. (accept these written as ratios) M1 for a complete method to find ED A1
170		$9x^2 + 7x - 2$	4	M1 for finding an expression for a missing length eg $4x - 1 - x - x$ $(=2x - 1)$ or $x + 2 - 2x$ $(=2 - x)$ M1 for a correct expression for one area from the cross-section, eg. $x \times 2x$ or $(4x - 1)(x + 2 - 2x)$ or for one volume of cuboid(s), eg. $x \times 2x \times (x + 1)$ M1 for a complete method to find the volume A1 for $9x^2 + 7x - 2$ or $(9x - 2)(x + 1)$ oe
171		8	4	M1 for $(2\sqrt{10})^2 - 2^2$ $(= 36)$ A1 for $(CD =)$ 6 M1 (dep on M1) for '6' $\times 4 - \frac{1}{2} \times$ '6' $\times 2 - \frac{1}{2} \times 2 \times 2 - \frac{1}{2} \times$ ('6' $- 2) \times 4$ C1 for area of 8 from fully correct working

Question	Working	Answer	Mark	Notes
172		750 cm^3	3	M1 for 30 × 25 A1 for 750 B1 (indep) for cm^3
173 (a)		Correct shape	2	B2 for correct reflection with vertices (–4, 2) (–6, 3) (–6, 7) (–4, 6) (B1 for reflection in a vertical or horizontal line)
(b)		Correct shape	2	B2 for correct rotation with vertices (–1, 3) (–5, 3) (–6, 5) (–2, 5) (B1 for rotation of 90(°) clockwise about (0,1) **or** correct orientation fully in top left quadrant)
*174		Conclusion (supported)	5	M1 for finding the area of one rectangle which is not 6 × 10 eg 2×2.5 (=5) or 4×10 (=40) or 2.5×6 or 5×2 M1 for a complete method to find the total area eg 5+5+40 or 60−10 (=50) M1 for a complete method to find the number of tins needed eg "50" ÷ 5 ÷ 2.5 (=4) OR for a complete method to find the number of litres needed. eg "50" ÷ 5 (=10) OR for a complete method to find the area covered by 3 tins eg 3×2.5×5 (=37.5) A1 for 50 (m^2) **and** 4 (tins needed) **or** for 10 (litres) **and** 7.5 (litres) **or** for 50(m^2) **and** 37.5(m^2) C1 (dep M2) for a conclusion supported by their calculations
175		100 – 25π	3	M1 for π×5×5 or 25π M1 for (10×10 –"π×5×5") A1 for 100 – 25π oe NB: ignore the inclusion of any units.

Question	Working	Answer	Mark	Notes
176 (a)		Correct construction	2	M1 for correct construction arcs or bisector within guidelines but no (or incorrect) construction arcs A1 for bisector within guidelines with correct arcs shown
(b)		Correct construction	2	M1 for correct construction arcs or perpendicular within guidelines but no (or incorrect) construction arcs A1 for perpendicular within guidelines with correct arcs shown
*177		69° (supported)	5	M1 for method to find angle PSR eg 90 – 48 (= 42) or method in triangle POS to find angle POS (= 84) M1 for method to find angle PMS (= 42) A1 cao C2 (dep on at least M1) for correct and complete set of appropriate reasons (C1 for one correct reason involving a circle theorem supported by working) eg The tangent to a circle is perpendicular (90) to the radius (diameter) Alternate segment theorem. Angles in a triangle add up to 180 Base angles of an isosceles triangle are equal. The angle at the centre of a circle is twice the angle at the circumference.

Question	Working	Answer	Mark	Notes
178 (a)(i)		$\mathbf{a} + \mathbf{b}$	2	B1 for $\mathbf{a} + \mathbf{b}$ oe
(ii)		$-\mathbf{a} + 3\mathbf{b}$		B1 for $-\mathbf{a} + 3\mathbf{b}$ oe
(b)		$\frac{3}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$	2	M1 for $\overrightarrow{OP} + \frac{1}{4}\overrightarrow{PR}$ or $\overrightarrow{OR} + \frac{3}{4}\overrightarrow{RP}$ (may be in terms of **a** and **b)** A1 for $\frac{3}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$ or $\frac{3}{4}(\mathbf{a} + \mathbf{b})$
*(c)		$OS = \frac{3}{4}OT$	2	C2 (dep A1) for *S* divides *OT* in the ratio 3:1 oe or $OS = \frac{3}{4}\,OT$ oe (C1 (dep A1) for *S* lies on *OT* or that *OT* and *PR* intersect at *S* oe)
179		$\frac{1}{4} - \frac{\sqrt{6}}{12}$	3	M1 for $\frac{1}{2} \times \frac{\sqrt{2}}{2} \times \frac{\sqrt{2}}{2}$ or $\frac{1}{2} \times \frac{\sqrt{2}}{2} \times \frac{\sqrt{3}}{3}$ M1 for $\frac{1}{2} \times \frac{\sqrt{2}}{2} \times \frac{\sqrt{2}}{2} - \frac{1}{2} \times \frac{\sqrt{2}}{2} \times \frac{\sqrt{3}}{3}$ A1 for $\frac{1}{4} - \frac{\sqrt{6}}{12}$ oe OR M1 for (BC =) $\frac{\sqrt{2}}{2} - \frac{\sqrt{3}}{3}$ M1 for $\frac{1}{2} \times \left\{\frac{\sqrt{2}}{2} - \frac{\sqrt{3}}{3}\right\} \times \frac{\sqrt{2}}{2}$ A1 for $\frac{1}{4} - \frac{\sqrt{6}}{12}$ oe

Question		Working	Answer	Mark	Notes
180			40°	4	M1 for angle FBC=70 or CFG = x or ABF = 110 may be seen in diagram M1 for angle CBF = BFC =70 or 90 – ½ x A1 for 40 supported by working C1 (dep on M2) for all reasons and linked to appropriate working, e.g. Alternate angles are equal; Allied angles / Co-interior angles add up to 180°; Base angles of an isosceles triangle are equal; angles in a triangle add to 180°, angles on a straight line equals 180°
*181			NO with evidence	4	M1 for 50 × 40 × 30 (=60000) M1 for "60000" ÷ 3000 (=20) M1 for "20" × £3.50 C1 eg for 70 and comparison resulting in NO OR M1 for £60 ÷ 3.50 (=17 bottles) M1 for "17" × 3000 (=51000) M1 for 50 × 40 × 30 (=60000) C1 eg for 51000 and 60000 and comparison resulting in NO
182	(a)		150	2	M1 for 180 – (360 – 330) or 180 – 30 or 330 – 180 or a complete diagram showing the bearing of 330° A1 cao
	(b)		11 40	4	M1 for 200 ÷ 120 (=1 2/3 h) M1 for conversion between hours and minutes A1 for 1 h 40 min or 100 minutes B1 (ft dep on M1) for 11 40
183			126	4	M1 for method to find exterior or interior angle of octagon M1 for method to find exterior or interior angle of pentagon M1 for complete method A1 cao

Question	Working	Answer	Mark	Notes
184		13.75	5	M1 for finding perimeter of rectangle e.g. $5x + 5 + 5x + 5 + 4x + 4x$ $(= 18x + 10)$ M1 for finding perimeter of trapezium e.g. $9x - 2 + 7x - 2 + 10x$ $(=26x - 4)$ M1 for equation e.g. $26x - 4 = 18x + 10$ (or $8x = 14$) A1 for finding the value of x as 1.75 B1 ft for subs of x into $5x + 5$ and evaluated (=13.75)
185		756π	5	M1 for $\frac{1}{3}\pi r^2 \times 10$ $(=270\pi)$ A1 for $r = 9$ M1 (dep on M1) for $\frac{1}{2} \times \frac{4}{3}\pi \times "9"^3$ $(= 486\pi)$ M1 for 270π + "486π" oe A1 cao
*186		Proof	5	M1for finding one other vector expressed as **a** and/or **b** M1 for method to find one of $\overrightarrow{DM}$, $\overrightarrow{MA}$ or $\overrightarrow{DA}$ eg $\overrightarrow{DM} = -\mathbf{b} + \frac{1}{2}(3\mathbf{b} + \mathbf{a})$ oe, $\overrightarrow{MA} = \frac{1}{2}(3\mathbf{b} + \mathbf{a}) + \mathbf{a}$ oe or $\overrightarrow{DA} = 2\mathbf{b} + 2\mathbf{a}$ oe M1 for method to find two of $\overrightarrow{DM}$, $\overrightarrow{MA}$ or $\overrightarrow{DA}$ A1 for two of $\overrightarrow{DM} = \frac{1}{2}(\mathbf{a} + \mathbf{b})$, $\overrightarrow{MA} = 1.5(\mathbf{a} + \mathbf{b})$, $\overrightarrow{DA} = 2(\mathbf{a} + \mathbf{b})$ ie simplified but oe C1 (dep on working shown) for conclusion relating to correct working
*187		Similarity and proof	5	B1 for method matching a pair of opposite angles, e.g. if $EAB = x$, $BDE = 180 - x$, $EAB + BDE = 180$ B1 for linking angles between quad and triangle, e.g. if $BDE = 180 - x$ then $BDC = x$ B1 for stating or implying $ACE = BCD$ (same angle) C1 for Opposite angles of a cyclic quadrilateral add up to 180^o or statement linking three angles for similarity C1 for complete proof

Question		Working	Answer	Mark	Notes
188			12	3	M1 for a method to find volume of a cuboid, eg. $2 \times 10 \times 15$ (= 300) or $5 \times 5 \times x$ (= $25x$) M1 (dep) for "300" ÷ "25" oe A1 cao OR M1 for 10 ÷5 (= 2) and 15 ÷ 5 (= 3) or 10 ÷5 (= 2) and 2 ÷ 5 (= 0.4) M1 (dep) for 2 × "2" × "3" or 15 × "2" × "0.4" A1 cao
189	(a)		Triangle with vertices at (–3, 3), (–3, 4) and (–1, 4)	2	B2 for a triangle with vertices at (–3, 3), (–3, 4), (–1, 4) (B1 for triangle in correct orientation and size or rotated 90º clockwise about centre *O* or three correct vertices without joining)
	(b)		Reflection in line $y = x$	2	B1 for reflection B1 for (in the line) $y = x$ Note: award no marks if more than one transformation is given

Question		Working	Answer	Mark	Notes
*190			Has enough (with evidence)	5	M1 for splitting the shape (or showing recognition of the "absent" triangles) and using a method to find the area of one shape M1 for a complete method to find the total area, (= 9 m^2) M1 (dep on M1) for a method to find the number of packs required from their total area, eg. "9" ÷ 2 = 4.5 rounded up to 5 M1 for a method to find 75% of 24.80 or 75% of the cost of their total number of packs, eg. 24.80 x "5" × $\frac{75}{100}$ (= 93) or 24.80 × $\frac{75}{100}$ (= 18.6) C1 for a conclusion supported by fully correct answers, eg. showing 9 (m^2), 5 (packs) and 93 or 7 (from 100 – 93) OR M1 for method to find 75% of £24.80, eg. 24.80 × $\frac{75}{100}$ (= 18.6) M1 for method to find total number of packs Mary can buy, eg. 100 ÷ "18.60" = 5.3.... truncated to 5 or 10 (m^2) M1 for finding area of one relevant shape or showing how one pack (2 m^2) can fit in the diagram M1 (dep on previous M1) for complete method to show that 5 packs can cover the floor C1 for a conclusion supported by fully correct answers, showing the capacity (10) greater than total area (9)

Question	Working	Answer	Mark	Notes
*191		40° with reasons	4	M1 for finding one related angle using parallel lines A1 for $x = 40(^{o})$ C2 for full reasons linked to appropriate method eg. alternate angles are equal **and** angles in a triangle add up to 180° eg. angles on a straight line add up to 180° **and** corresponding angles are equal **and** alternate angles are equal eg. co-interior (allied) angles add up to 180^{o} **and** exterior angle of a triangle is equal to sum of interior opposite angles Other solutions may include reasons such as: vertically opposite angles are equal the sum of angles at a point is equal to 360^{o} (C1 (dep on M1) for one appropriate reason linked to parallel lines)
192		48	5	M1 for 8 – 2 (= 6) M1 (indep) for $x^2 + 8^2$ (provided $x \leq 8$) M1 (dep on previous M1) fo $\sqrt{"x"^2 + 8^2}$ or $\sqrt{"100"}$ M1 (dep on M2) for $4 \times 2 + 4 \times "10"$ A1 cao
193		18	4	M1 for a method to find the exterior angle of a pentagon eg. 360 ÷ 5 (=72) or the interior angle of a pentagon, eg. 180 – 360 ÷ 5 (= 108) A1 for 72 or 108 M1 (dep M1) for a fully complete method to find the required angle, *DCF* A1 for 18 or ft their interior or exterior angle

Question		Working	Answer	Mark	Notes
194			$\frac{14}{3}$	5	M1 for correct substitution into a volume formula for a cylinder or a cone, eg. $\frac{1}{3}\times\pi\times3^2\times4$ (= 12π) or $\pi\times3^2\times(6-4)$ (= 18π) or $\pi\times3^2\times h$ (= 9πh) or $\pi\times3^2\times(h-2)$ M1 for method to find volume after 5 hours, eg. "12π" + "18π" (= 30π) M1 (dep on M1) for use of a correct ratio, eg. "30π" × $\frac{9}{5}$ (= 54π) or "30π" × $\frac{4}{5}$ (= 24π) M1 for deriving an equation in h, eg. "54π" = "9πh" + "12π" A1 for $\frac{14}{3}$ or equivalent fraction

Question		Working	Answer	Mark	Notes
195			9	4	M1 for method to find area of one rectangle, eg 15 × 8 (=120) or 15 × 11 (=165) M1 (dep) for subtracting from/by given area, eg (138 – "120") (=18) or "165" – 138 (=27) M1 for final step from complete method shown, eg 15 − "18"÷ 3 or "27" ÷ 3 A1 cao **OR** M1 for a correct expression for the area of one rectangle, eg (8 + 3) × (15 − x) or 8 × x M1 (dep) for a correct equation eg (8 + 3) × (15 − x) + 8 × x = 138 M1 for correct method to isolate x, eg 3x = 27 A1 cao
*196			x = 130 + correct reasons	4	M1 for angle BFG = 65 may be seen on diagram M1 (dep) for correct method to calculate x, eg (x=) 65 + 65 (=130) **or** (x=) 180 − (180 – 2 × 65) (=130) C2 for x = 130 **and** full appropriate reasons related to method shown (C1 (dep on M1) for any one appropriate reason related to method shown) eg alternate angles; base angles in an isosceles triangle are equal; angles in a triangle add up to 180°; angles on a straight line add up to 180°; exterior angle of triangle = sum of two interior opposite angles; co-interior angles add up to 180° (allied angles) NB Any reasons stated **must** be used

Question		Working	Answer	Mark	Notes
197			construction	2	M1 for a pair of arcs or a single arc, centre *C*, that cut line *AB* **and** at least one pair of arcs not at *C* within guidelines A1 for perpendicular within guidelines with appropriate construction arcs **OR** M1 for an arc, centre *A* radius *AC* **and** an arc centre *B* radius *BC*. The two arcs must intersect below *AB* A1 for perpendicular within guidelines with appropriate construction arcs (SC If M0 scored, B1 for correct perpendicular line within guidelines)

Question	Working	Answer	Mark	Notes
198		25	4	M1 for complete method to work out interior angle of a regular octagon **or** 135° identified as an interior angle of the octagon M1 for complete method to work out angle *KFG* or angle *KFG* identified as 110° M1 (dep on M2) for complete method to work out angle *KFE*, eg "135" − "110" or (8×"135" − 4×"135" − 4×"110") ÷ 4 or (3×180 − 2×"135" − 2×"110") ÷ 2 A1 for 25 with supporting working **OR** M1 for complete method to work out the exterior angle of a regular octagon **or** 45° identified as an exterior angle of the octagon M1 for complete method to work out angle *KFG* or angle *KFG* identified as 110° M1 (dep on M2) for complete method to work out angle *KFE*, eg 180 − "45" − "110" A1 for 25 with supporting working **OR** M1 for complete method to work out the exterior angle of a regular octagon **or** 45° identified as an exterior angle of the octagon M1 for complete method to work out angle *JKF* or angle *JKF* identified as 70° M1 (dep on M2) for complete method to work out angle *KFE*, eg "70" − "45" A1 for 25 with supporting working

Question		Working	Answer	Mark	Notes
199	(a)		7.5	2	M1 for $\frac{12}{18}$ oe **or** $\frac{18}{12}$ oe **or** $\frac{12}{5}$ oe **or** $\frac{5}{12}$ oe A1 cao
	(b)		45	3	M1 for $\left("\frac{3}{2}"\right)^2$ oe or $\left("\frac{2}{3}"\right)^2$ oe M1 for complete method to find area of shaded region, eg $36 \times "1.5"^2 - 36$ A1 cao (SC B2 for 81)
200			128π	5	M1 for $\frac{4\pi r^2}{2} = 32\pi$ oe A1 for (r =) 4 M1 for $2\times\pi\times"4"\times10$ (=80π) **or** $\pi\times"4"^2$ (=16π) or ft their r M1 for 32π + "80π" + "16π" oe or 402.1 −402.3 or ft their r A1 cao

Question		Working	Answer	Mark	Notes
*201			3	4	M1 for a method to calculate at least one area eg 10 × 7 (=70) or 16 × 10 (=160) M1 for a method to find the total area (=124) M1 (dep on M1) for "124" ÷ 36 C1 (dep on M3) for 3 (pigs) clearly identified and supported by correct calculations Or M1 for an area of 36m² drawn with dimensions shown M1 for 3 areas of 36m² drawn with dimensions shown M1 (dep on M1) for method to find the area left (=16) C1 (dep on M3) for 3 (pigs) clearly identified and supported by correct calculations
202	(a)		Shape drawn	2	B2 for shape with vertices at (0, –1), (–1, – 3), (–2, –3), (–2, –1) (B1 for rotation of 180° about the wrong centre)
	(b)		Triangle drawn	2	B2 for triangle with vertices at (6, 9), (9, 9), (9, 3) (B1 for 2 vertices correct or enlargement sf 3 in wrong position or enlargement, centre (0, 0), but sf >1, ≠ 3)
203			36	3	M1 for a correct method to find either an interior or an exterior angle; eg. (180 × 3) ÷ 5 or 540 ÷ 5 (=108) or 360 ÷ 5 (=72) M1 (dep) for a complete method to find angle *CFD*. A1 cao

Question		Working	Answer	Mark	Notes
204			6	3	M1 for $\frac{15}{10}$ (=1.5) or $\frac{10}{15}$ (=0.66..) or $\frac{16}{10}$(=1.6) or $\frac{10}{16}$(=0.625) M1 for $\frac{15}{10}$ × 16 (=24) oe A1 cao OR M1 for $\frac{15}{16}$(=0.9375) or $\frac{16}{15}$ (=1.066…) or $\frac{16}{10}$(=1.6) or $\frac{10}{16}$(=0.625) M1 for $\frac{15}{16}$× 10 (=9.375) oe A1 20.625 oe
205			55	3	M1 for angle ABO = 90 or angle ADO = 90, or angle OBC = 15 or angle FDO = 90 or angle EBO = 90 (could be marked on the diagram) M1 for reflex angle BOD = 360 – (360 – 90 – 90 – 40) (= 220) or angle BCD = (360 – 90 – 90 – 40) ÷ 2 (= 70) or angle BDO or angle DBO = 90 – (180 – 40)/2 (= 20) or angle BOC = 180 – (15 + 15) (=150) A1 cao
*206			Proof	3	M1 for $\overrightarrow{MN} = \overrightarrow{MO} + \overrightarrow{ON}$ (= **n** – **m**) or $\overrightarrow{NM} = \overrightarrow{OM} + \overrightarrow{NO}$ (= **m** – **n**) or $\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$ (= 2**n** – 2**m**) or $\overrightarrow{BA} = \overrightarrow{OA} + \overrightarrow{BO}$ (= 2**m** – 2**n**) M1 for $\overrightarrow{MN}$= **n** – **m** and $\overrightarrow{AB}$= 2**n** – 2**m** oe C1 (dep on M1, M1) for fully correct proof, with $\overrightarrow{AB}$= 2$\overrightarrow{MN}$ or $\overrightarrow{AB}$ is a multiple of $\overrightarrow{MN}$ [SC M1 for $\overrightarrow{MN}$= 0.5**n** – 0.5**m** and $\overrightarrow{AB}$ = **n** – **m** C1 (dep on M1) for fully correct proof, with $\overrightarrow{AB}$= 2$\overrightarrow{MN}$ or $\overrightarrow{AB}$ is a multiple of of $\overrightarrow{MN}$]

Question		Working	Answer	Mark	Notes
207			120 cm^3	4	M1 for $\frac{1}{2} \times 3 \times 4$ M1 (dep) for '$\frac{1}{2} \times 3 \times 4$' $\times 20$ A1 for 120 B1 (indep) for cm^3
208	(a)		Shape with vertices at (–1, 3), (0, 6), (2, 6), (1, 3)	1	B1 for correct shape in correct position
	(b)		Rotation centre (0,0) 90˚ anticlockwise	3	B1 rotation B1 (centre) (0,0) B1 90˚ anticlockwise or 270˚ clockwise Note: award no marks if more than one transformation is given
209			38	5	M1 $3x - 5 = 19 - x$ M1 for a correct operation to collect the x terms or the number terms on one side of an equation of the form $ax + b = cx + d$ A1 for $x = 6$ M1 for substituting their value of x in the three expressions and adding **or** substituting their value of x after adding the three expressions A1 cao

Question		Working	Answer	Mark	Notes
*210			Not enough, needs £133	5	M1 for splitting the shape (or showing recognition of the "absent" rectangle) and using a correct method to find the area of one shape M1 for a complete and correct method to find the total area M1 for a complete method to find 70% of 19 (= 13.3) or 70% of their total cost or 70% of their area A1 114(m^2) and (£)133 **or** 114(m^2) and (£)13.3(0) and 108(m^2) C1 (dep on M2) for a conclusion supported by their calculations OR M1 for a complete method for the number of tins required for one section of the area of the floor M1 for a complete method to find the number of tins for the whole floor M1 for a complete method to find 70% of their total number of tins and multiply by 19 A1 (£)133 C1 (dep on M2) for a conclusion supported by their calculations

Question		Working	Answer	Mark	Notes
*211		$360 - y$	$180 - \frac{y}{2}$	4	M1 $ADC = \frac{y}{2}$ A1 $180 - \frac{y}{2}$ C2 (dep on M1) for both reasons Angle at centre is twice the angle at the circumference Opposite angles in cyclic quadrilateral add to 180° (C1 (dep on M1) for one appropriate circle theorem reason) OR M1 reflex $AOC = 360 - y$ A1 $\frac{360 - y}{2}$ oe C2 (dep on M1) for both reasons Angles around a point add up to 360° Angle at centre is twice the angle at the circumference (C1 (dep on M1) for one appropriate circle theorem reason)
212			Triangle with vertices at (–1,–4), (–1,–5), (–3,–4.5)	2	M1 for correct shape and size and the correct orientation in the wrong position or two vertices correct A1 cao

Question		Working	Answer	Mark	Notes
213	(a)	$\overrightarrow{AB} = -\mathbf{a} + \mathbf{b}$ $\overrightarrow{ON} = \overrightarrow{OA} + \frac{2}{3}\overrightarrow{AB}$ $\overrightarrow{ON} = \mathbf{a} + \frac{2}{3}(-\mathbf{a} + \mathbf{b})$ $= \frac{1}{3}\mathbf{a} + \frac{2}{3}\mathbf{b}$ OR $\overrightarrow{ON} = \overrightarrow{OB} + \frac{1}{3}\overrightarrow{BA}$ $\overrightarrow{ON} = \mathbf{b} + \frac{1}{3}(-\mathbf{b} + \mathbf{a})$ $= \frac{1}{3}\mathbf{a} + \frac{2}{3}\mathbf{b}$	$\frac{1}{3}\mathbf{a} + \frac{2}{3}\mathbf{b}$	3	M1 for correct vector equation involving $\overrightarrow{ON}$, eg. $\overrightarrow{ON} = \overrightarrow{OA} + \overrightarrow{AN}$, may be written, partially or fully, in terms of **a** and **b**, e.g. $(\overrightarrow{ON} =)$ $\mathbf{a} + \frac{2}{3}\overrightarrow{AB}$ M1 for showing answer requires $\overrightarrow{AN} = \frac{2}{3}\overrightarrow{AB}$ or $\overrightarrow{BN} = \frac{1}{3}\overrightarrow{BA}$ A1 $\frac{1}{3}\mathbf{a} + \frac{2}{3}\mathbf{b}$ oe
	(b)	$\overrightarrow{OD} = \overrightarrow{OA} + \overrightarrow{AC} + \overrightarrow{CD}$ $= \mathbf{a} + \mathbf{b} + \mathbf{b}$ $= \mathbf{a} + 2\mathbf{b}$ $\overrightarrow{OD} = 3(\frac{1}{3}\mathbf{a} + \frac{2}{3}\mathbf{b})$ $\overrightarrow{OD} = 3\overrightarrow{ON}$	Proof	3	M1 for a correct vector statement for $\overrightarrow{OD}$ or $\overrightarrow{ND}$ in terms of **a** and **b**, e.g. $\overrightarrow{OD} = \mathbf{a} + \mathbf{b} + \mathbf{b}$ oe or $\overrightarrow{ND} = \frac{2}{3}(-\mathbf{b} + \mathbf{a}) + \mathbf{b} + \mathbf{b}$ oe A1 for correct and fully simplified vectors for $\overrightarrow{ON}$ (may be seen in (a)) **and** for $\overrightarrow{OD}$ $(= \mathbf{a} + 2\mathbf{b})$ or $\overrightarrow{ND}$ $(= \frac{2}{3}\mathbf{a} + \frac{4}{3}\mathbf{b})$ C1 (dep on A1) for statement that $\overrightarrow{OD}$ or $\overrightarrow{ND}$ is a multiple of $\overrightarrow{ON}$ (+ common point)

Question		Working	Answer	Mark	Notes
214	(a)	(4,0) (3, 0) (3, -1) (2, -1) (2, 2) (4, 2)	Correct position	2	B2 for correct shape in correct position (B1 for any incorrect translation of correct shape)
	(b)		Rotation 180° (0,1)	3	B1 for rotation B1 for 180° (ignore direction) B1 for (0, 1) **OR** B1 for enlargement B1 for scale factor -1 B1 for (0, 1) (NB: a combination of transformations gets B0)

Question		Working	Answer	Mark	Notes
215			1.5	4	M1 for correct expression for perimeter eg. $4 + 3x + x + 6 + 4 + 3x + x + 6$ oe M1 for forming a correct equation eg. $4 + 3x + x + 6 + 4 + 3x + x + 6 = 32$ oe M1 for $8x = 12$ or $12 \div 8$ A1 for 1.5 oe **OR** M1 for correct expression for semi-perimeter eg. $4 + 3x + x + 6$ oe M1 for forming a correct equation eg. $4 + 3x + x + 6 = 16$ oe M1 for $4x = 6$ or $6 \div 4$ A1 for 1.5 oe

Question		Working	Answer	Mark	Notes
216			1 hour 45 mins	6	M1 for method to find volume of pond, eg $\frac{1}{2}(1.3 + 0.5) \times 2 \times 1$ (= 1.8) M1 for method to find the volume of water emptied in 30 minutes, eg $1 \times 2 \times 0.2$ (= 0.4), $100 \times 200 \times 20$ (= 400000) A1 for correct rate, eg 0.8 m³/hr, 0.4 m³ in 30 minutes M1 for correct method to find total time taken to empty the pond, eg "1.8" ÷ "0.8" M1 for method to find extra time, eg 2 hrs 15 minutes − 30 minutes A1 for 1.75 hours, $1\frac{3}{4}$ hours, 1 hour 45 mins or 105 mins **OR** M1 for method to find volume of water emptied in 30 minutes,.eg. $1 \times 2 \times 0.2$ (= 0.4), $100 \times 200 \times 20$ (= 400000) M1 for method to work out rate of water loss eg. "0.4" × 2 A1 for correct rate, eg 0.8 m³/hr M1 for correct method to work out remaining volume of water eg. $\frac{1}{2}(1.1 + 0.3) \times 2 \times 1$ (= 1.4) M1 for method to work out time, eg "1.4" ÷ "0.8" A1 for 1.75 hours, $1\frac{3}{4}$ hours, 1 hour 45 mins or 105 mins NB working could be in 3D or in 2D and in metres or cm throughout

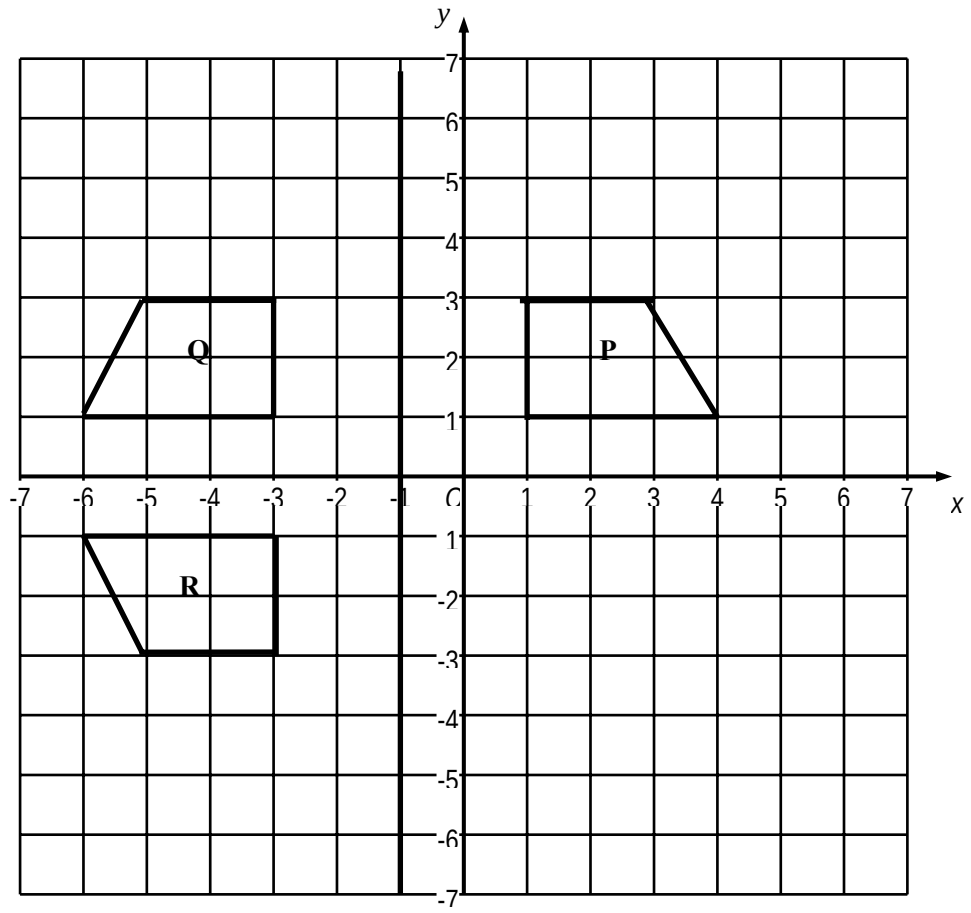
Question		Working	Answer	Mark	Notes
217			$5x^2$	4	M1 for $4x \times 4x$ M1 for $(2x \times 4x)/2$ or $(2x \times x)/2$ or $(3x \times 4x)/2$ M1(dep M2) for "$16x^2$" – "$4x^2$" – "x^2" – "$6x^2$" A1 for $5x^2$ **OR** M1 for $\sqrt{(2x)^2 + (4x)^2}$ $(= \sqrt{20x^2} = \sqrt{20}\,x)$ M1 for $\sqrt{(x)^2 + (2x)^2}$ $(= \sqrt{5x^2} = \sqrt{5}\,x)$ M1(dep M2) for $\frac{"\sqrt{5}\,x" \times "\sqrt{20}\,x"}{2}$ $(= \frac{\sqrt{100}}{2}\,x^2)$ A1 for $5x^2$
218	(a		**a - b**	1	B1 for **a - b** oe
	(b)		$\frac{2}{5}\mathbf{a} + \frac{3}{5}\mathbf{b}$	3	M1 for a correct vector statement for $\overrightarrow{NR}$ eg. $(\overrightarrow{NR} =)$ $\overrightarrow{NQ} + \overrightarrow{QR}$ or $(\overrightarrow{NR} =)$ $\overrightarrow{NS} + \overrightarrow{SR}$ M1 for $\frac{2}{5}SQ$ $(+ QR)$ or $\frac{3}{5}QS$ $(+ SR)$ (SQ, QR, QS, SR may be written in terms of **a** and **b)** A1 for $\frac{2}{5}(\mathbf{a} - \mathbf{b}) + \mathbf{b}$ oe or $\frac{3}{5}(\mathbf{b} - \mathbf{a}) + \mathbf{a}$ oe

Question		Working	Answer	Mark	Notes
*219		Angle *AED* = 38 alternate angles are equal Angle *ADE* = (180 – 38) ÷ 2 = 71 *x* = 180 – 71 base angles of an isosceles triangle are equal angles in a triangle add up to 180 angles on a straight line sum to 180 **OR** angle *AEF* = 142 allied angles/co-interior angles add up to 180 *ADE* = 142 ÷ 2 = 71 base angles of an isosceles triangle are equal exterior angle of a triangle is equal to the sum of the interior opposite angles , *x* = 180 – 71 angles in a straight line add to 180 **OR** Angle *AED* = 38 alternate angles are equal for angles *BAE* and *AED* **and** *BAD* and *ADC* (*x*) Angle *DAE*= (180 – 38) ÷ 2 = 71 base angles of an isosceles triangle are equal angles in a triangle add up to 180 **Or** Angle *AED* = 38 alternate angles are equal Angle *ADE* = (180 – 38) ÷ 2 = 71 base angles of an isosceles triangle are equal and angles in a triangle sum to 180 *x* = 38 + 71 alternate angles *BAD* and *ADC*(*x*) are equal	*x* = 109	4	B1 for angle *AED* = 38 or *AEF* = 142 M1 for a complete method to find one of the base angles of the isosceles triangle C2 (dep M1) for *x* = 109 with complete reasons (C1 (dep M1) for one reason correctly used and stated)

Question		Working	Answer	Mark	Notes
220			54	3	M1 for 180 – 360 ÷ 5 **or** 108 seen as the interior angle of a pentagon M1 (dep on previous M1) for 360 – 2 × '108' – 90 A1 for 54 cao **OR** M1 for 180 × (5 – 2) (= 540) ÷ 5 or 108 given as the interior angle of a pentagon M1 (dep on previous M1) for 360 – 2 × '108' – 90 A1 for 54 cao

Question		Working	Answer	Mark	Notes
221		**Q** at (– 3, 1), (– 6, 1) (–5, 3) (– 3, 3) **R** at (–3, – 1), (–6, – 1), (–5, – 3) (–3, –3)	Rotation 180° about (–1, 0)	3	M1 for showing **R** correctly on the grid without showing **Q or** for showing **Q and R** correctly on the grid A1 for rotation of 180° A1 for (centre) (–1, 0) **Or** M1 for showing **R** correctly on the grid without showing **Q or** for showing **Q and R** correctly on the grid A1 for Enlargement Scale Factor –1 A1 for centre (–1, 0) **NB** Award no marks for any correct answer from an incorrect diagram or any Accuracy marks if more than one transformation is given
222			68	3	M1 for angle *OBC* = 90° or angle *OAC* = 90° (may be marked on the diagram or used in subsequent working) M1 for correct method to find angle *BOC* or *AOC* or *AOB* e.g. angle *BOC* = 180 – 90 – 34 (= 56) or angle *AOC* = 180 – 90 – 34 (=56) or angle *AOB* = 180 – 2 × 34 (= 112) A1 cao **NB** (68 must be clearly stated as an answer and not just seen on diagram)
223		Vertices at (–2, –4), (–4, –4), (–4, –6), (–2, –5)	Correct diagram	3	M1 for a similar shape in the correct orientation in the third quadrant M1 for an image in the correct orientation of the correct size A1 cao

221.



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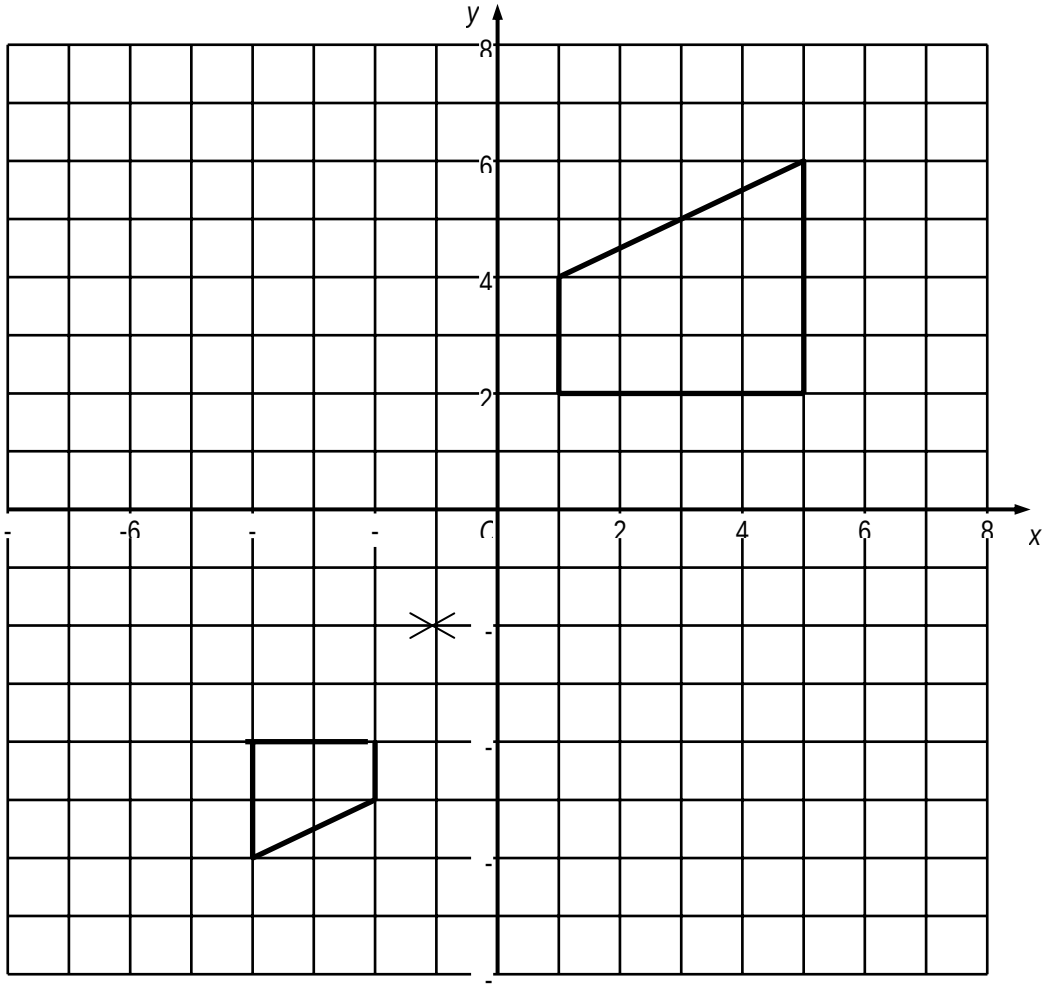


Question		Working	Answer	Mark	Notes
224			75π	3	M1 for $(4 \times \pi \times 5^2) \div 2$ oe M1 for $\pi \times 5^2$ oe A1 for 75π accept 235.5 Condone the use of π = 3.14…
225	(a (b)		**6b – 3a**	1 4	B1 for **6b – 3a** oe M1 for $\overrightarrow{AX} = \frac{1}{3}\overrightarrow{AB}$ or $\frac{1}{3}$ '(**6b – 3a**)' or ft to **2**b – a M1 for $\overrightarrow{OY} = \overrightarrow{OB} + \overrightarrow{BY} = \mathbf{6b} + \mathbf{5a} - \mathbf{b}$ (= **5b + 5a**) oe M1 for $\overrightarrow{OX}$ = **3a** + '**2b – a**' = **2a + 2b** oe **Or** $\overrightarrow{OX} = \mathbf{6b} - \frac{2}{3}$ '(**6b – 3a**)' (= **2a + 2b**) oe C1 for $\frac{2}{5}\overrightarrow{OY} = \frac{2}{5} \times 5(\mathbf{a} + \mathbf{b}) = 2(\mathbf{a} + \mathbf{b}) = \overrightarrow{OX}$

Question	Working	Answer	Mark	Notes
226		Enlargement, scale factor 2.5, centre (0,0)	3	B1 for enlargement B1 for scale factor 2.5 oe B1 for (0,0); accept origin or *O* NB: if two different transformations are stated then 0 marks.
227	$\frac{9}{2}\times(12+18)=135$ 135 ÷ 20 = 6.75 (=7 bags) 7 × 4.99 OR $18\times9-\frac{1}{2}(6\times9)=135$ 135 ÷ 20 = 6.75 (=7 bags) 7 × 4.99	34.93	4	M1 for $\frac{9}{2}\times(12+18)$ or $18\times9-\frac{1}{2}(6\times9)$ or $9\times12+\frac{1}{2}\times(18-12)\times9$ or 135 seen M1 (dep) for '135'÷ 20 or 6 or 7 seen M1 (dep on previous M1) for '6' × 4.99 or '7' × 4.99 A1 cao [SC: M1 for (12×9 + 6×9) ÷ 20 (= 162÷20) or 8 or 9 seen M1 (dep) for '8' × 4.99 or '9' × 4.99 OR M1 for (18×9 − 6×9) ÷ 20 (= 108÷20) or 5 or 6 seen M1 (dep) for '5' × 4.99 or '6' × 4.99]
228		380	3	M1 fo 4×7 + 5×2 (=38) or 9×2 + 5×4 (=38) or 4×7×10 or (7×9 − 5×5) or 5×2×10 (=100) or 9×2×10 (=180) or 5×4×10 (=200) or 9×7×10 (=630) or 5×5×10 (=250) M1 (dep) or '38'×10 or 380 or 4×7×10 + 5×2×10 or 9×2×10 + 5×4×10 or ×10 A1 ca
229		36 – 9π	3	M1 fo π×6×6 or 36π seen value 113.03-113.2 M1 for 12×12 –'π×6×6')÷4 or value 7.7-7.8 A1 for 36 – 9π oe **OR** M1 fo π×6×6÷4 or 9π seen or value 28.2-28.3 M1 fo 6×6 – 'π×6×6÷4' or value 7.7-7.8 A1 for 36 –9π oe NB: for M marks π may be given numerically.

Question		Working	Answer	Mark	Notes
230			230	2	M1 for 180 + 50 A1 cao **OR** M1 for 360 – (180 – 50) or 360 – 130 A1 cao **OR** M1 for 50 + (90 – 50) + 90 + 50 or 50 + 40 + 90 + 50 A1 cao **OR** M1 for a suitable diagram (sketch) with bearing of lighthouse from ship indicated and 50° marked at lighthouse; diagram only intended to indicate position of 50°; ignore other labels and markings unless they create ambiguity. A1 cao
231			84	4	M1 for $x - 1 + 3x + 1 + 3x$ (= 56) or $7x = 56+1–1$ or $\frac{3x(x-1)}{2}$ oe M1 for $7x = 56$ or 8 seen M1 for 0.5×(‘8’ – 1)×(3×’8’) A1 cao Ignore any statement of units. SC B2 for 8 as the answer or 7 identified as the height and 24 identified as the base of the triangle.

Question		Working	Answer	Mark	Notes
232			12	4	B1 for 60 seen M1 for (360 – 60) ÷ 2 (=150) M1 for 360 ÷ (180 – 150) or 150×n=180(n-2) oe A1 cao **OR** B1 for 60 seen M1 for 60 ÷ 2 (=30) M1 for 360 ÷ (60÷2) A1 cao **OR** M2 for 30 seen M1 for 360 ÷ 30 A1 cao

Question		Working	Answer	Mark	Notes
233	(a)		$\mathbf{a} - 3\mathbf{b}$	1	B1 for $\mathbf{a} - 3\mathbf{b}$ oe
	(b)			4	M1 for (**NC** =) $2\mathbf{a} - 2\mathbf{b}$ oe M1 for (**NM** =) $\mathbf{b} + \frac{1}{2}"(\mathbf{a} - 3\mathbf{b})"$ A1 for $\frac{1}{2}(\mathbf{a} - \mathbf{b})$ oe and $2\mathbf{a} - 2\mathbf{b}$ oe C1 for **NC** is a multiple of **NM** (+ common point) **OR** M1 for (**NC** =) $2\mathbf{a} - 2\mathbf{b}$ oe M1 for (**MC** =) $\frac{1}{2}"(\mathbf{a} - 3\mathbf{b})" + \mathbf{a}$ A1 for $\frac{3}{2}(\mathbf{a} - \mathbf{b})$ oe and $2\mathbf{a} - 2\mathbf{b}$ oe C1 for **NC** is a multiple of **MC** (+ common point) **OR** M1 for (**NM** =) $\mathbf{b} + \frac{1}{2}"(\mathbf{a} - 3\mathbf{b})"$ M1 for (**MC** =) $\frac{1}{2}"(\mathbf{a} - 3\mathbf{b})" + \mathbf{a}$ A1 for $\frac{1}{2}(\mathbf{a} - \mathbf{b})$ oe and $\frac{3}{2}(\mathbf{a} - \mathbf{b})$ oe C1 for **NM** is a multiple to **MC** (+ common point)

Question		Working	Answer	Mark	Notes
234	(a)	360 ÷ 60 = 6 300 ÷ 60 = 5 6 × 5 =	Yes and 30	3	M1 for dividing side of patio by side of paving slab eg. 360 ÷ 60 **or** 300 ÷ 60 **or** 3.6 ÷ 0.6 **or** 3 ÷ 0.6 **or** 6 and 5 seen (may be on a diagram) **or** 6 divisions seen on length of diagram **or** 5 divisions seen on width of diagram M1 for correct method to find number of paving slabs eg. (360 ÷ 60) × (300 ÷ 60) oe **or** 6 × 5 **or** 30 squares seen on diagram (units may not be consistent) A1 for Yes **and** 30 (**or** 2 extra) with correct calculations **OR** M1 for correct method to find area of patio **or** paving slab eg 360 × 300 **or** 108000 seen **or** 60 × 60 **or** 3600 seen **or** 3.6 × 3 **or** 10.8 seen **or** 0.6 × 0.6 **or** 0.36 seen M1 for dividing area of patio by area of a paving slab eg. (3.6 × 3) ÷ (0.6 × 0.6) oe (units may not be consistent) A1 for Yes **and** 30 (**or** 2 extra) with correct calculations **OR** M1 for method to find area of patio or area of 32 slabs eg. 60 × 60 × 32 **or** 360 × 300 M1 for method to find both area of patio **and** area of 32 slabs eg. 60 × 60 × 32 **and** 360 × 300 (units may not be consistent) A1 for Yes **and** 115200 **and** 108000 **OR** Yes **and** 11.52 **and** 10.8 **NB : Throughout the question, candidates could be working in metres or centimetres**

Question		Working	Answer	Mark	Notes
234	(b)	1726 25890 27616 **8 6 3** **2** 2 4 | 1 8 | 9 **3** **7** 1 6 | 1 2 | 6 **2** 6 1 6 | | 800 | 60 | 3 | | --- | --- | --- | --- | | 30 | 24000 | 1800 | 90 | | 2 | 1600 | 120 | 6 | 24000+1800+90+1600+120+6 = 27616	276.16	3	M1 for complete correct method with relative place value correct. Condone 1 multiplication error, addition not necessary. **OR** M1 for a complete grid. Condone 1 multiplication error, addition not necessary. **OR** M1 for sight of a complete partitioning method, condone 1 multiplication error. Final addition not necessary. A1 for digits 27616 A1 ft (dep on M1) for correct placement of decimal point after addition (of appropriate values) (SC: B1 for attempting to add 32 lots of 8.63)

Question		Working	Answer	Mark	Notes
235			Rotation 180° Centre (3, 3) **or** Enlargement Scale factor -1 Centre (3, 3)	3	B1 for rotation B1 for 180° B1 for (3, 3) **OR** B1 for enlargement B1 for scale factor -1 B1 for (3, 3) B0 for a combination of transformations

Question		Working	Answer	Mark	Notes
236		$3x-15 = 2x+24$ $x = 39$ **OR** $2x+3x-15+2x+2x+24 = 360$ $9x + 9 = 360$ $9x = 351$ $x = 39$ **OR** $2x + 2x+24 = 180$ $4x + 24 = 180$ $4x = 156$ $x = 39$ **OR** $2x + 3x-15 = 180$ $5x - 15 = 180$ $5x = 195$ $x = 39$	39	3	M1 for forming an appropriate equation eg. $3x - 15 = 2x + 24$ **OR** $2x + 3x - 15 + 2x + 2x + 24 = 360$ **OR** $2x + 2x + 24 = 180$ **OR** $2x + 3x - 15 = 180$ **OR** $2x + 3x - 15 = 2x + 2x + 24$ M1 (dep) for correct **operation(s)** to isolate x and non-x terms in an equation to get to $ax = b$ A1 cao **OR** M2 for $\frac{351}{9}$ oe **or** $\frac{195}{5}$ oe **or** $\frac{156}{4}$ oe A1 cao

Question		Working	Answer	Mark	Notes
237		$6 \times 10 \times 8 = 480$ $480 \div (6 \times 20) =$	4	3	M1 for $6 \times 10 \times 8$ **or** 480 seen M1 (dep) for '480' $\div (6 \times 20)$ oe A1 cao **OR** M1 for $20 \div 10$ (=2) **or** $10 \div 20 (=\frac{1}{2})$ **or** $\frac{8}{20}$ oe **or** $\frac{20}{8}$ oe M1 (dep) for $8 \div$ '2' **or** $8 \times \frac{1}{2}$ **or** $\frac{8}{20} \times 10$ oe **or** $10 \div \frac{20}{8}$ A1 cao SC : B2 for answer of 16 coming from $\frac{20 \times 8 \times 6}{10 \times 6}$ oe

Question		Working	Answer	Mark	Notes
238		180 – (360 ÷ 6) = 120 180 – (360 ÷ 8) = 135 360 – 120 – 135 = **OR** 360 ÷ 6 = 60 360 ÷ 8 = 45 60 + 45 =	105	4	NB. Do remember to look at the diagram when marking this question. Looking at the complete method should confirm if interior or exterior angles are being calculated M1 for a correct method to work out the **interior** angle of a regular hexagon eg. 180 – (360 ÷ 6) oe **or** (6 - 2)×180 ÷ 6 oe **or** 120 as **interior** angle of the hexagon M1 for a correct method to work out the **interior** angle of a regular octagon 180 – (360 ÷ 8) oe **or** (8 - 2)×180 ÷ 8 oe **or** 135 as **interior** angle of the octagon M1 (dep on at least M1) for a complete method eg. 360 – "120" – "135" A1 cao **OR** M1 for a correct method to work out an **exterior** angle of a regular hexagon eg. 360 ÷ 6 **or** 60 as **exterior** angle of the hexagon M1 for a correct method to work out an **exterior** angle of a regular hexagon 360 ÷ 8 **or** 45 as **exterior** angle of the octagon M1 (dep on at least M1) for a complete method eg. "60" + "45" A1 cao SC : B1 for answer of 255

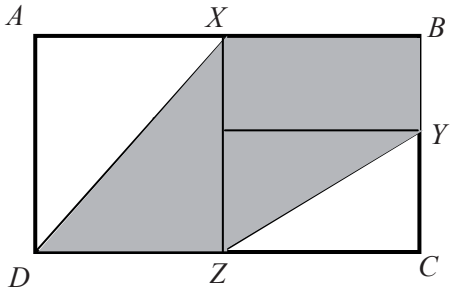
Question		Working	Answer	Mark	Notes
239	(a)		35	1	B1 for 34 – 36
	(b)		110	1	B1 for 108 – 112
	(c)		Position of *B* marked	2	B1 for a point marked on a bearing of 40° (±2°) from *H* **or** for a line on a bearing of 40° (±2°) (use straight line guidelines on overlay) B1 for a point 4 cm (± 0.2cm) from *H* **or** for a line of length 4 cm (± 0.2cm) from *H* (use circular guidelines on overlay) NB. No label needed for point
240		$\frac{1}{2} \times 4 \times 3 = 6$ $\left(\frac{1}{2}\right)^2 \times 6 =$	1.5	3	M1 for $\frac{1}{2} \times 4 \times 3$ oe M1 for $\left(\frac{1}{2}\right)^2 \times$ "6" A1 cao **OR** M2 for $\frac{1}{2} \times 2 \times 1.5$ oe (M1 for triangle with all lengths $\frac{1}{2}$ corresponding lengths of triangle *ABC* seen in any position **or** vertices seen at (1, 1) (3,1) and (2.5, 2.5) or stated) A1 cao

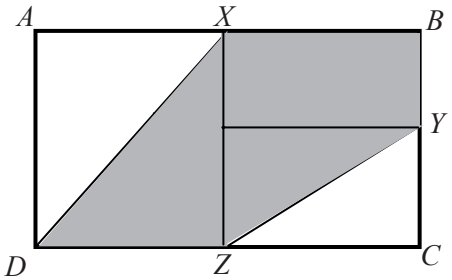
Question		Working	Answer	Mark	Notes
241*		*ABO* = *ADO* = 90° (Angle between tangent and radius is 90°) *DOB* = 360 – 90 – 90 – 50 (Angles in a quadrilateral add up to 360°) *BCD* = 130 ÷ 2 (Angle at centre is twice angle at circumference) **OR** *ABD* = (180 – 50) ÷ 2 (Base angles of an isosceles triangle) *BCD* = 65 (Alternate segment theorem)	65^o	4	B1 for *ABO* = 90 **or** *ADO* = 90 (may be on diagram) B1 for *BCD* = 65 (may be on diagram) C2 for *BCD* = 65^o stated **or** *DCB* = 65^o stated **or** angle C = 65^o stated **with** all reasons: angle between tangent and radius is 90^o; angles in a quadrilateral sum to 360^o; angle at centre is twice angle at circumference (accept angle at circumference is half (or $\frac{1}{2}$) the angle at the centre) (C1 for one correct and appropriate circle theorem reason) QWC: Working clearly laid out and reasons given using correct language **OR** B1 for *ABD* = 65 or *ADB* = 65 (may be on diagram) B1 for *BCD* = 65 (may be on diagram) C2 for *BCD* = 65^o stated **or** *DCB* = 65^o stated **or** angle C = 65^o stated **with** all reasons: base angles of an isosceles triangle are equal; angles in a triangle sum to 180^o; tangents from an external point are equal; alternate segment theorem (C1 for one correct and appropriate circle theorem reason) QWC: Working clearly laid out and reasons given using correct language

Question		Working	Answer	Mark	Notes
242		Vol cylinder = $\pi \times (2x)^2 \times 9x$ $= 36\pi x^3$ $36\pi x^3 = \frac{4}{3}\pi r^3$ $r^3 = 27x^3$	$3x$	3	M1 for sub. into $\pi r^2 h$ eg. $\pi \times (2x)^2 \times 9x$ oe M1 for $\pi \times (2x)^2 \times 9x = \frac{4}{3}\pi r^3$ oe A1 oe eg. $\sqrt[3]{\frac{36x^3}{\frac{4}{3}}}$ NB : For both method marks condone missing brackets around the $2x$

Question		Working	Answer	Mark	Additional Guidance
243 **FE**		No of tiles around room = 2 × lengths of room = 8, 16, 16, 12 Total number of tiles = 8 × 16 + 8 × 12 = 224 Cost = 4 × 224 **OR** Area of the room =4 × 8 + 4 × 6 = 56 Area of a tile = 0.5 × 0.5 = 0.25 Number of tiles = 56 ÷ 0.25 = 224 Cost = 4 × 224	£ 896	6	M1 for doubling each length to show number of tiles for each side B1 for 8, 16, 16 and 12 M1 for a full method of finding the number of tiles (12 × 16 + 8 × 4) A1 for at least one 'section' correct M1 for 4 × '224' A1 cao **OR** M1 for full method for finding the area of the room A1 at least one area correct B1 for area of tile = 0.25m^2 or 2500 cm^2 or 4 tiles = 1 m^2 M1 for area of room ÷ area of a tile M1 for 4 × number of tiles A1 cao
244		$\frac{x}{5} = \frac{2}{4}$ $\frac{y}{x+5} = \frac{9}{6}$ or $\frac{y}{9} = \frac{x+5}{6}$	$x = 2.5$ $y = 11.25$	4	M1 a correct expression for x involving ratios of sides, e.g. $\frac{x}{5} = \frac{2}{4}$ oe A1 cao M1 $\frac{y}{x+5} = \frac{9}{6}$ or $\frac{y}{9} = \frac{x+5}{6}$ oe A1 cao **OR** $\frac{y}{5} = \frac{9}{4}$ A1 cao

Question	Working	Answer	Mark	Additional Guidance
245	Let $AB = x, AD = y$ Area of rectangle $= xy$ Area AXD = $\frac{xy}{4}$ Area CYZ = $\frac{xy}{8}$ Shaded area = $\frac{5xy}{8}$	$\frac{5}{8}$	4	M1 a full method to find the unshaded area and subtracting from 1 B1 area of AXD = area of $ABCD \div 4$ B1 area of CYZ = area of $ABCD \div 8$ A1 cao **OR** **Diagram** M1 for dividing left into 2 congruent triangles for dividing right into 4 congruent triangles B1 left = $2A$ and $2A$ or shaded = $\frac{1}{2}$ of $\frac{1}{2} = \frac{1}{4} = \frac{2}{8}$ B1 right = $2A$ and A and A or shaded = $\frac{3}{4}$ of $\frac{1}{2} = \frac{3}{8}$ A1 cao **Substitution** M1 for deciding upon suitable side lengths for AD and AB and calculating dimensions of internal shapes B1 for area of DZX B1 for area of $ZXBY$ A1 cao **OR** M1 for deciding upon suitable side lengths for AD and AB and calculating dimensions of internal shapes B1 for area ADX B1 for area ZCY A1 cao





Question		Working	Answer	Mark	Additional Guidance
246	(a) (i)	$\vec{BC} = \vec{CO} + \vec{OB}$	12a – 4b	4	M1 $\vec{BC} = \vec{CO} + \vec{OB}$ A1 cao
	(ii)	$\vec{AQ} = \vec{AO} + \vec{OB} + \vec{BQ}$ $= -4a + 4b + \frac{1}{4}(12a - 4b)$	3b – a		M1 $-4a + 4b + \frac{1}{4}$ '(12a – 4b)' A1 cao
	(b)	$\vec{OX} = 12b$, $\vec{AX} = -4a + 12b$ $= 4(-a + 3b)$	Correct reason, with correct working	3	B1 $\vec{OX} = 12b$ B1 $\vec{AX} = -4a + 12b$ C1 convincing explanation

Question	Working	Answer	Mark	Notes
*247		$x = 30^o$ with complete reasons	4	M1 for a correct first step, eg angle *GED* = 55 or angle *GAD* = 55 or angle *EGA* = 180 – 55 (= 125) A1 for 30 C2 for 30 with full reasons, appropriate to their given method eg alternate angles are equal **and** corresponding angles are equal **and** angles on a straight line add up to 180 eg corresponding angles are equal **and** angles in a triangle add up to 180 **and** alternate angles are equal (C1 (dep on at least M1) for one appropriate reason relating to parallel lines or opposite angles of a parallelogram)
248		Correct position of *C*	3	M1 for line drawn or point marked on a bearing of 130° from *A* M1 for line drawn or point marked on a bearing of 245° from *B* A1 for correct position of *C*
*249		No (supported)	5	M1 for π × 9 ÷ 2 (=14.137…) or π × 5 ÷ 2 (=7.85…) or for π × 9 (=28.27…) or π × 5 (=15.7…) M1 for complete method to work out perimeter eg 2 + 2 + (π × 9 ÷ 2) + (π × 5 ÷ 2) (= 25.99...) M1 (dep M1) for method to find number of rolls required for their perimeter, eg "their total perimeter" ÷ 2.4 eg 25.99..÷2.4 (=10.8), "47.97.."÷2.4 (=19.9) or "43.47.." ÷2.4 (=18.3) M1 for method to work out cost eg 3×10 + 2×3.99 (= 37.98) or 11 × 3.99 (=43.89), 20 →67.98, 19→63.00 or for method to find how many rolls can be bought for £35 (= 10) C1 for a conclusion supported by fully correct answers eg 37.98 (for comparing with 35) e.g 10.8 and 10 OR M1 for π × 9 ÷ 2 (=14.137…) or π × 5 ÷ 2 (=7.85…) or for π × 9 (=28.27…) or π × 5 (=15.7…) M1 for complete method to work out perimeter eg 2 + 2 + (π × 9 ÷ 2) + (π × 5 ÷ 2) (= 25.99...) M1 for a method to find how many rolls can be bought for £35 (=10) M1 for a method to work out the coverage of 10 rolls e.g. 10 × 2.4 (=24) C1 for a conclusion supported by fully correct answers eg 25.9(...) and 24

Question	Working	Answer	Mark	Notes
250		100	4	M1 for 360 ÷ 9 (= 40) or (9 – 2) × 180 (= 1260) M1 (dep) for 180 – "40" or "1260" ÷ 9 (= 140) oe M1 (dep M2) for a complete method to find the required angle, eg "140" – (360 – "140" – "140") ÷ 2 or ("140" ÷ 7) × 5 A1 for 100 supported by working
*251		No with correct calculations	5	M1 for splitting the cross section into separate areas and a method to find the area of one part OR for splitting up the pool into smaller prisms and a method to find the volume of one prism, e.g. a cuboid M1 (dep) for a complete method to find the cross-sectional area OR for a method to find the volume of more than on prism M1 (dep) for a complete method to find the vol of the pool (= 70 (m^3) OR for a complete method to find the depth of 60000L of water M1 for method to find figure for comparison, eg distance between surface and top of pool ("70" – "60") ÷ (5 × 10) C1 No, with correct calculations, eg water level is 20cm below top of pool

Question	Working	Answer	Mark	Notes
252		41.6	6	M1 for $0.5 \times 5.4 \times 7.3 \times \sin B = 19$ M1 for $(B =) \sin^{-1}\left(\frac{19}{0.5\times5.4\times7.3}\right)$ oe (= 74.6) M1 for $(AC^2 =) 5.4^2 + 7.3^2 - 2\times5.4\times7.3\times\cos$ "74.6" M1 (dep) for correct order of evaluation or 61.(479…) M1 for $\frac{\sin C}{5.4} = \frac{\sin "74.6"}{"7.84"}$ oe or $0.5\times7.3\times$ "7.84" $\times \sin C = 19$ A1 for answer in the range 41.55 to 41.65 from correct working OR (with perpendicular from C meeting AB at a point X) M1 for $0.5 \times 5.4 \times CX = 19$ M1 for $(CX =) \frac{19}{0.5\times5.4}$ (= 7.037...) M1 for $BCX = \cos^{-1}\frac{"7.04"}{7.3}$ (= 15.425…) M1 for $(BX =) \sqrt{7.3^2 - "7.04"^2}$ (= 1.94…) M1 for $ACX = \tan^{-1}\frac{5.4 - "1.94"'}{"7.04"}$ (= 26.17…) A1 for answer in the range 41.55 to 41.65 from correct working OR (with perpendicular from A meeting BC at a point Y) M1 for $AY = \frac{19}{7.3 \div 2} = 5.20547$ .. M1 for $BY = \sqrt{5.4^2 - "5.20547"^2}$ (= 1.43630..) M1 for $CY =$ $7.3 - "1.43630$ .." (= 5.86369 ...) M1 for $\tan C = \frac{"5.20547.."}{"5.86369"..}$ (= 0.8877..) M1 for $C =$ $\tan^{-1}"0.8877$ .." A1 for answer in the range 41.55 to 41.65 from correct working

Question	Working	Answer	Mark	Notes
253		26	3	M1 for (360 − 90) ÷ 2 (= 135) M1 for $4x + 31 =$ "135" or $6x - 21 =$ "135" A1 cao OR M1 for forming an appropriate equation eg $4x + 31 = 6x - 21$ or $6x - 21 + 4x + 31 + 90 = 360$ oe M1 (dep) for isolating terms in x and number terms A1 cao
254		180	3	M1 for a correct start to the process, eg 300 ÷ 5 (= 60) or 300 ÷ (5 × 1.5) (= 40) or 8 ÷ 5 (= 1.6) or 5 ÷ 8 (= 0.625) M1 for a complete method that will lead to the number of bricks needed to build the wall (= 480) or for a complete method that will lead to the number of extra bricks needed to build the wall, eg 300 ÷ 5 × 3 A1 cao
255		6.56	4	M1 for $200^2 + 60^2$ (= 43600) M1 for $\sqrt{40000 + 3600}$ or $\sqrt{43600}$ (= 208.8…) M1 for a complete method eg ("208.8" + 2 × 200 + 2 × 60) ÷ 100 × 0.9 oe A1 for 6.55 – 6.561
256	$\pi \times 6^2 - 2 \times 6 \times 6$	41.1	4	M1 for correct method to work out the area of the circle or quarter circle or semi-circle eg $\pi \times 6^2$ (=113(.09..)); $\pi \times 6^2 \div 2 = 56.5(4..)$; $\pi \times 6^2 \div 4 = 28.2(7\ldots)$) M1 for method to work out the area of the square (=72) oe or a triangle eg ½×6×6 (=18) M1 for complete method to find shaded area. A1 for value in the range 41.04 - 41.112

Question	Working	Answer	Mark	Notes
257		126	3	M1 for 180 – (360 ÷ 5) (= 108) or (5 – 2) × 180 ÷ 5 (= 108) M1 for a complete method eg $\frac{360-"108"}{2}$ or $180-\frac{"108"}{2}$ A1 cao
258		28.9	5	M1 for sin 62 = $\frac{BD}{15}$ **or** $\frac{BD}{\sin 62}=\frac{15}{\sin 90}$ oe M1 for (*BD* =) 15 × sin 62 **or** $\frac{15}{\sin 90}$ × sin 62 oe (= 13.24...) M1 for tan *BCD* = $\frac{"13.24"}{24}$ oe **or** tan *BDC* = $\frac{24}{"13.24"}$ with *BDC* clearly identified M1 for *BCD* = $\tan^{-1}\frac{"13.24"}{24}$ oe **or** *BDC* = $\tan^{-1}\frac{24}{"13.24"}$ with *BDC* clearly identified A1 for 28.8 – 28.9 **OR** M1 for cos(90 − 62) = $\frac{BD}{15}$ M1 for (*BD* =) 15 × cos(90 − 62) (= 13.24...) M1 for tan *BCD* = $\frac{"13.24"}{24}$ oe **or** tan *BDC* = $\frac{24}{"13.24"}$ with *BDC* clearly identified M1 for *BCD* = $\tan^{-1}\frac{"13.24"}{24}$ oe **or** *BDC* = $\tan^{-1}\frac{24}{"13.24"}$ with *BDC* clearly identified A1 for 28.8 – 28.9

Question	Working	Answer	Mark	Notes
*259		28°	4	M1 for angle *ABD* = 62° M1 for angle *BAD* = 90° C2 for angle *ADB* = 28° with full, appropriate reasons given angles in the same segment are equal; angles in a semicircle are 90°; angles in a triangle add up to 180° (C1 (dep on relevant M1) for one correct and appropriate reason relating to a circle theorem) OR M1 for angle *AOD* = 62° × 2 (= 124°) M1 for (180° − 124°) ÷ 2 C2 for angle *ADB* = 28° with full, appropriate reasons given the angle at the centre of a circle is twice the angle at the circumference; base angles of an isosceles triangle are equal; angles in a triangle add up to 180° (C1 (dep on relevant M1) for one correct and appropriate reason relating to a circle theorem)
*260		No with explanation and supportive working	4	M1 for method to find the volume of compost needed to fill one or more baskets eg $\frac{2}{3} \times \pi \times 20^3$ (= 16755(.16…)) Or $\frac{4}{3} \times \pi \times 20^3$ (= 33510(.32…)) M1 for appropriate use of 1 litre = 1000 cm^3, eg 4 × 50 × 1000 (= 200000) or "16755" ÷ 1000 M1 for complete method to find values needed to make decision C1 for conclusion supported by correct values, eg 200000 and 201061(.92...) (accept 201000 to 201120) or 16666(.66...) and 16755(.16…) or 11.9(36...) NB Calculations can be in litres or cm^3

Question	Working	Answer	Mark	Notes
261		Correct conclusion from correct working	4	B1 for $\overrightarrow{AB} = -5\mathbf{a} + 2\mathbf{b}$ or $\overrightarrow{BA} = 5\mathbf{a} - 2\mathbf{b}$ M1 for a correct vector statement for $\overrightarrow{OT}$ eg $\overrightarrow{OA} + \overrightarrow{AT}$ or $\overrightarrow{OB} + \overrightarrow{BT}$ or $\overrightarrow{OA} + \frac{5}{6}\overrightarrow{AB}$ or $\overrightarrow{OB} + \frac{1}{6}\overrightarrow{BA}$, may be written partially or fully in terms of **a** and **b** M1 for $5\mathbf{a} + \frac{5}{6}(-5\mathbf{a} + 2\mathbf{b})$ oe or $2\mathbf{b} + \frac{1}{6}(5\mathbf{a} - 2\mathbf{b})$ oe A1 for $\frac{5}{6}(\mathbf{a} + 2\mathbf{b})$ is parallel to $\mathbf{a} + 2\mathbf{b}$

Question	Working	Answer	Mark	Notes
262		9.25	3	M2 for $x + x + 4 + x + x + 4 = 45$ oe or $x + x + 4 = 22.5$ oe (M1 for $x + x + 4 + x + x + 4$ oe) A1 for 9.25 or $\frac{37}{4}$ oe OR M1 for $45 - 8$ (= 37) or $22.5 - 4$ (= 18.5) M1 for $(45 - 8) \div 4$ or $(22.5 - 4) \div 2$ A1 for 9.25 or $\frac{37}{4}$ oe
263		124° with reasons	4	M1 for a method to find any angle, eg. angle *DEF* = 180 – 70 – 54 (= 56) or angle *AEB* = 70 or angle *EAB* = 54 or angle *GEB* = 180 – 70 (= 110) A1 for $x = 124$ NB: angles may be just shown on the diagram C2 for full reasons, appropriate to their given method, with no additional reasons (C1 for one appropriate reason relating to parallel lines) Possible reasons: corresponding angles are equal; alternate angles are equal; co-interior angles (allied) add up to 180 angles on a straight line add up to 180 ; angles in a triangle add up to 180; vertically opposite angles are equal ; the exterior angle of a triangle is equal to the sum of the interior opposite angles; angles at a point add up to 360;

Question	Working	Answer	Mark	Notes
264		3	5	M1 for a complete method to find the area of the cross section, eg. 15 × 2 + "(12 – 4)" × 2 + 15 × 2 (= 76) or for finding the volume of a relevant prism, eg. 15 × 2 × 120 (= 3600) "(12 – 4)" maybe just seen on the diagram M1 for a method to find the volume of the bar, eg. "76" × 120 (= 9120) or ft "area of cross section"×120 provided "area of cross section" includes a method to find the area of at least **two** relevant rectangles M1 for "volume" × 8, eg. "9120" × 8 (= 72960) or 250 × 1000 ÷ 8 (= 31250) NB "volume" must be dimensionally correct M1 (dep on previous M1) for 250 ÷ ("volume" × 8) ÷ 1000, eg. 250 ÷ "72960 ÷ 1000" (= 3.4265….) or "31250" ÷ "9120" A1 for an answer of 3 with correct working
265		30.1	4	M1 for a correct trigonometric statement to find an unknown angle, eg. $\sin(30+x)$ or $\cos A = \frac{10.4+5.2}{18}$ or $\frac{\sin ADC}{18} = \frac{\sin 30}{10.4}$ M1 for a complete method to find the angle, eg. $\sin^{-1}\left(\frac{10.4+5.2}{18}\right)$ (= 60.07...) or $\cos^{-1}\left(\frac{10.4+5.2}{18}\right)$ (= 29.92..) or $\sin^{-1}\left(\frac{18 \times \sin 30}{10.4}\right)$ (= 59.92.. or 180 – 59.92.. = 120.07..) M1 (dep on M2) for a fully complete method to find angle *x*, eg. "60.07.". – 30 or 60 – "29.92.." or 90 – "59.92.." A1 for answer in the range 30.07 to 30.1 OR M1 for $(BC^2=)\ 18^2 - (10.4 + 5.2)^2$ or $BC^2 + (10.4 + 5.2)^2 = 18^2$ M1 for $(BC =)\ \sqrt{18^2 - (10.4 + 5.2)^2}$ (= 8.97...) M1 (dep on M2) for a fully complete method to find angle *x*, eg. $\tan^{-1}\left(\frac{5.2}{"8.97..."}\right)$ A1 for answer in the range 30.07 to 30.1

Question		Working	Answer	Mark	Notes
266			28.9	3	M2 for $\frac{75}{360} \times 2 \times \pi \times 6$ oe + $\frac{75}{360} \times 2 \times \pi \times 10$ oe (= 7.85... + 13.08... = 20.94..) (M1 for $\frac{75}{360} \times 2 \times \pi \times 6$ oe or $\frac{75}{360} \times 2 \times \pi \times 10$ oe) A1 for 28.9 to 28.95

Question		Working	Answer	Mark	Notes
267			80.4	6	M1 for $0.5 \times 7 \times 8 \times \sin x = 18$ M1 (dep) for $(x =) \sin^{-1}\left(\frac{18}{0.5 \times 7 \times 8}\right)$ oe $(= 40)$ M1 (dep on at least M1) for $(AC^2 =) 7^2 + 8^2 - 2\times7\times8\times\cos$ "40" M1 (dep on previous M1) for correct order of evaluation or 27.2(03…) or 5.2(15…) M1 (dep) for $\sin A = \frac{8 \times \sin"40"}{"5.2(15..)"}$ or $\sin A = \frac{18}{0.5 \times 7 \times "5.2(15..)"}$ or $\cos A = \frac{"5.2(15..)"^2 + 7^2 - 8^2}{2 \times "5.2(15..)" \times 7}$ A1 for answer in the range 80.3 to 80.4 from correct working OR (with perpendicular from A meeting BC at a point X) M1 for $0.5 \times 8 \times h = 18$ M1 (dep) for $(h =) \frac{18}{0.5 \times 8}$ $(= 4.5)$ M1 (dep on at least M1) for $BAX = \cos^{-1}\frac{"4.5"}{7}$ $(= 49.99\ \ldots)$ M1 (dep) for $(BX =) \sqrt{7^2 - "4.5"^2}$ $(= 5.3619\ldots)$ M1 (dep) for $CAX = \tan^{-1}\frac{8 - "5.3619"}{"4.5"}$ $(= 30.38\ \ldots)$ A1 for answer in the range 80.3 to 80.4 from correct working NB Similar method applies for use of perpendicular from C to AB

Question		Working	Answer	Mark	Notes
268			40 000	2	M1 for 100 × 100 isolated or 4 × 100 × 100 A1 cao
*269			No not enough	5	M1 for substituting into Pythagoras' theorem M1 for complete correct use of Pythagoras' theorem M1 for a complete method to find the perimeter of their trapezium A1 51.(20655..) C1 (dep on correct first 2 M marks) for correct conclusion dependent upon supporting calculations
270			Correct line drawn	2	M1 for two pairs of relevant arcs drawn A1 correct line drawn (with arcs) SC B1 Correct line no arcs visible
271			Rotation about (2,1) through 180°	3	B1 rotation B1 about (2,1) B1 through 180° Or B2 enlargement scale factor −1 B1 about (2,1) Note Award no marks if more than one transformation is given .
*272	(a)			1	C1 for a complete reason eg Angles in a semicircle are 90^{o}, alternate segment theorem
	(b)		2.75	4	M1 for 7 × sin 35 M1 for 7 × sin 35 × 2 M1 (indep) for "*DB*"× cos 70 A1 2.74 - 2.75

Question		Working	Answer	Mark	Notes
273			31.1	5	M1 for $\frac{1}{2} \times 8.4 \times x \times \sin 40 = 100$ M1 for 100÷(0.5×8.4×sin 40) (= 37.(041...)) M1 (dep on 1st M1) for substituting the appropriate figures into the cosine rule eg 8.4^2+'37.041'^{2}-2×8.4×'37.041'cos40° M1 (dep on previous M1) for correct order of evaluation or (c^2=) 965.(897...) A1 31.07 - 31.1

Question		Working	Answer	Mark	Notes
274			Enlargement	2	B2 for fully correct triangle (B1 for 2 vertices correct or enlargement scale factor 2 in the wrong position or enlargement, centre *A*, with a different scale factor)
*275			No supported by working	4	M1 for π × 7 (= 21.9 to 22) or π × 7 × 2.54 = (55.5 to 56) M1 (dep) for a complete method that could lead to two figures that are comparable eg π × 7 × 2.54; π × 7 and 50 ÷ 2.54 A1 for correct comparable figures eg 55.5 to 56 (cm); 21.9 to 22 (in) and 19.6 to 19.7 (in) C1 (dep M2) for a correct conclusion based on their comparable figures OR M1 for eg 50 ÷ π (= 15.9 to 15.92) or 50 ÷ 2.54π (=6.26 to 6.27) M1 (dep) for a complete method that could lead to two figures that are comparable eg (50 ÷ π) ÷ 2.54; 50 ÷ π and 7 × 2.54 A1 for correct comparable figures eg 6.26 to 6.27 (in); 15.9 to 15.92 (cm) and 17.7 to 17.8 (cm) C1 (dep M2) for a correct conclusion based on their comparable figures
276			245	2	M1 for method to identify the angle required, including on a diagram A1 cao
277		BC = $\frac{12}{\tan 60}$ = 6.92(8…) DE = 6.92(…) × tan 30 = 4 CE = 12 + 4 AC = $\frac{12}{sin60}$ = 13.8(5…) CE = $\frac{13.8(5\ldots)}{cos30}$	16 with supporting working	4	M1 for a method to find BC or AC or AD B1 for angle EAD = 30˚ or AED = 60° or ACD = 30˚ or CAD = 60° M1 for a method to find CE A1 for 15.9-16.1 with supporting working

Question		Working	Answer	Mark	Notes
278			22.5	3	M1 for $\frac{1}{2} \times 7 \times 5 \times \sin 40$ or $\frac{1}{2} \times 7 \times 5 \times \sin(180 - 40)$ M1 (dep M1) for doubling the area of the triangle A1 for 22.4 – 22.5 OR M1 for complete method to find height of parallelogram, eg 5 sin40° M1 (dep M1) for complete method to find the area of the parallelogram, eg 7 × 5sin40° A1 for 22.4 – 22.5
279		$\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$ $= \mathbf{a} + \mathbf{b}$ $\overrightarrow{AC} = \frac{7}{2}\overrightarrow{AB}$ $\overrightarrow{OC} = \overrightarrow{OA} + \overrightarrow{AC}$ $= 2\mathbf{a} + \mathbf{b} + \frac{7}{2}(\mathbf{a} + \mathbf{b})$	$\frac{11}{2}\mathbf{a} + \frac{9}{2}\mathbf{b}$	4	M1 for $\overrightarrow{AB} = \overrightarrow{AO} + \overrightarrow{OB}$ $(= -(2\mathbf{a} + \mathbf{b}) + (3\boldsymbol{a} + 2\boldsymbol{b}))$ or $\mathbf{a} + \mathbf{b}$ M1 for $\overrightarrow{AC} = \frac{7}{2}\overrightarrow{AB}$ or $\overrightarrow{BC} = \frac{5}{2}\overrightarrow{AB}$, may be in terms of **a** and **b** M1 (dep M2) for complete method to find $\overrightarrow{OC}$ in terms of **a** and **b** A1 for $\frac{11}{2}\mathbf{a} + \frac{9}{2}\mathbf{b}$ or equivalent simplest form (SCB2 for $\frac{11}{2}\mathbf{a} + \frac{23}{2}\mathbf{b}$ or $\frac{11}{2}\mathbf{a} + \frac{19}{2}\mathbf{b}$)

Question		Working	Answer	Mark	Notes
280	(a)		Correct shape	2	B2 cao (B1 for shape in the correct orientation below the line $y = x$ or for 2 vertices correct) with vertices at (2, 1), (4, 1), (4, 0), (3, 0)
	(b)		Translation by $\begin{pmatrix} 4 \\ -1 \end{pmatrix}$	2	B1 for translation B1 for $\begin{pmatrix} 4 \\ -1 \end{pmatrix}$ NB: B0 if more than one transformation given
*281			No + reason	4	M1 for intention to find the circumference eg $140 \times \pi$ (= 439.82...) A1 for circumference = 439 - 440 M1 (dep on M1) for a complete method shown that could arrive at two figures that are comparable eg "C"÷60×12 (=87.96..) , 90÷12×60 (=450) , 90×60÷"C" (=12.27), "C"÷90×12 (=58.64..) C1 (dep on both M marks) for No and explanation that shows a correct comparison eg only 84 people could sit around the tables or that 13 tables are needed or that 480 cm is needed.
282	(a)		65	5	M1 for splitting up the cross section into separate areas and a method to find the area of one part OR for splitting up the pool into smaller prisms and a method to find the volume of one small prism, e.g. a cuboid M1 (dep) for a complete method to find the area of the cross section [with correct dimensions] OR for a method to find the total volume of more than one correct prism M1 (dep) for a complete method to find the volume of the pool [with correct dimensions] (= 195) M1 for "195" × 1000 ÷ 50 (=3900) oe where "195" comes from a volume A1 cao
	(b)		C	1	B1 cao

Question		Working	Answer	Mark	Notes
283		$AC^2 = 5^2 + 3^2$ $AC = \sqrt{25+9}$ (=5.83) $\frac{5}{5.83} = \frac{DB}{3}$ $DB = \frac{5}{5.83} \times 3$ (= 2.57) 5 + 3 + 5.83 + 2.57 = **OR** $AC = \sqrt{25+9}$ (=5.83) $\tan A = \frac{3}{5}$ $A = 30.96$ $\sin 30.96 = \frac{DB}{5}$ $DB = 5 \times \sin 30.96$ (= 2.57) 5 + 3 + 5.83 + 2.57 =	16.4	5	M1 for $(AC^2) = 5^2 + 3^2$ =34) M1 for $\sqrt{25+9}$ or $\sqrt{34}$ (=5.83) M1 for $\frac{5}{'5.83'} = \frac{DB}{3}$ or $DB \times AC = 5 \times 3$ M1 for $(DB =) \frac{5}{'5.83'} \times 3$ A1 for 16.4 to 16.41 **OR** M1 for $(AC^2) = 5^2 + 3^2$ (=34) M1 for $\sqrt{25+9}$ or $\sqrt{34}$ (=5.83) M1 for using a correct trig ratio in an attempt to find angle A or angle C, e.g. $\tan A = \frac{3}{5}$, $\sin A = \frac{3}{'5.83'}$, $\cos C = \frac{3}{'5.83'}$ M1 for using DB in a a correct trig ratio, e.g. sin'30.96' = $\frac{DB}{5}$ A1 for 16.4 to 16.41
284			35°	4	M1 for $ABC = 90$ M1 for $(ACB =)$ 180 – 90 – 25 (= 65) M1 for $(DBC =)$ 180 – '65' – 80 (=35) A1 cao supported by working OR M1 for $(AOB =)$ 180 – 2 × 25 (= 130) M1 for $(ADB =)$ 130 ÷ 2 (=65) M1 for $(DAC =)$ 180 – 65 – 80 A1 cao supported by working.

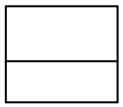
Question		Working	Answer	Mark	Notes
285			8.52	5	M1 for $\frac{BD}{\sin 45} = \frac{7.4}{\sin 80}$ oe M1 for $(BD =) \frac{7.4}{\sin 80} \times \sin 45$ (= 5.3133..) M1 for 5.8^2 + '5.31'^{2} – 2 × 5.8 × '5.31' cos100 M1 (dep) for correct order of evaluation or 72.5(73...) A1 for 8.51 – 8.52 OR M1 for $\frac{AD}{\sin(180-80-45)} = \frac{7.4}{\sin 80}$ oe M1 for $(AD =) \frac{7.4}{\sin 80} \times \sin(180-80-45)$ (= 6.15...) M1 for 7.4^2+ ('6.15' + 5.8)^2 – 2 × 7.4 × ('6.15' + 5.8) × cos45 M1 (dep) for correct order of evaluation or 72.5(7398...) A1 for 8.51 – 8.52

Question	Working	Answer	Mark	Notes
286		28.3	2	M1 for $\pi \times 9$ or $2 \times \pi \times 4.5$ oe A1 for 28.25 – 28.3
287		Translation $\begin{pmatrix} 5 \\ -3 \end{pmatrix}$	2	B1 for translation B1 for $\begin{pmatrix} 5 \\ -3 \end{pmatrix}$ NB No marks if more than one transformation given.
*288		54 with reasons	3	M1 for angle *RWY* or angle TWZ = 180 − 126 (= 54) or angle *TWR* or angle *WRS* = 126 (may be marked on diagram) A1 for 54 C1 for appropriate reasons for method shown eg. Angles on a straight line add up to 180 and Alternate angles are equal OR Corresponding angles are equal and Angles on a straight line add up to 180 OR Vertically opposite angles are equal and Allied angles / Co-interior angles add up to 180 OR Angles at a point add up to 360 with other reasons as above.
289		$5\frac{2}{3}$	4	M1 for $AB = 2x$ or $DC = 2x + 4$ or for 38 − 4 M1(dep) for x + "x" + "$2x$" + "$2x$ + 4" or for "38 – 4" ÷ 6 M1 for "$6x + 4$" = 38 A1 for $5\frac{2}{3}$ oe NB: Accept answers in the range 5.6 to 5.7 if M3 scored. SC if M0 then B2 for answer in range 5.6 – 5.7

Question		Working	Answer	Mark	Notes
290			186.20	5	M1 for use of consistent units to find volume, 11 × 4 × 0.06 (=2.64) or 1100× 400 × 6 (=2640000) M1 (dep on vol calculation) for attempt to find number of bags needed, eg "2.64" ÷ 0.4 (=6.6 →7) M1 for the cost of gravel before discount eg "6.6" × 38 or "7" × 38 M1 for attempt to find the total cost after discount"266" × 0.7 oe A1 for 186.2(0) OR M1 for cost of gravel per bag after discount, 38 × 0.7 (=26.60) M1 for use of consistent units to find volume, 11 × 4 × 0.06 (=2.64) or 1100× 400 × 6 (=2640000) M1 (dep on vol calculation) for attempt to find number of bags needed, eg "2.64" ÷ 0.4 M1 for total cost of gravel after discount "7" × "26.6" A1 for 186.2(0)
291	(a)		7.5	3	M1 for $4.5^2 + 6^2$ (=56.25) M1 for $\sqrt{56.25}$ or $\sqrt{(4.5^2 + 6^2)}$ A1 for 7.5
	(b)		217	4	M1 for use of appropriate trig ratio eg tan $CAB = \frac{4.5}{6}$ (= 0.75), sin $CAB = \frac{4.5}{"7.5"}$ (= 0.6), cos $CAB = \frac{6}{"7.5"}$ (= 0.8) M1 for inverse trig shown correctly eg $CAB = \tan^{-1}\frac{4.5}{6}$ (= 0.75), $CAB = \sin^{-1}\frac{4.5}{"7.5"}$ (= 0.6), $CAB = \cos^{-1}\frac{6}{"7.5"}$ (= 0.8) A1 for 36.8 to 37 (or 53 to 53.2 if identified as *ACB*) B1ft for bearing 180 + "36.8" if "36.8" is not 40-50 eg 216.8 to 217

Question		Working	Answer	Mark	Notes
292	(a)		7.5	2	M1 for sight of $\frac{9}{6}$ (=1.5) oe or $\frac{6}{9}$ (=0.66..) oe or $\frac{5}{6}$ (=0.83..) oe or $\frac{6}{5}$ (=1.2) oe or a ratio, eg 6:9 oe or decimal, eg 1.5 oe A1 cao
	(b)		8	2	M1 for $12 \times \frac{6}{9}$ oe or $12 \div \frac{9}{6}$ oe or $\frac{12}{"7.5"} \times 5$ oe A1 cao
293			302	3	M1 for $\frac{1}{2} \times \frac{4}{3} \times \pi \times 4^3$ oe (= 133.9 – 134.2) M1 for $\frac{1}{3} \times \pi \times 4^2 \times 10$ oe (= 167.4 – 167.7) A1 for 301 – 302 (or 96π or $\frac{288}{3}\pi$)

Question		Working	Answer	Mark	Notes
294			43.9	5	M1 for $\frac{11}{\sin 100}=\frac{9}{\sin D}$ oe M1 for $\sin D=\frac{9\sin 100}{11}$ (=0.80575…) or D = 53.68… M1 for angle DCA= 180 − 100 − "D" (=26.317..) M1 for area of $ABCD$ = 2 × ½ × 11 × 9 × sin"26.317" A1 for 43.8 – 43.9 **OR** M1 for $\frac{11}{\sin 100}=\frac{9}{\sin D}$ oe M1 for $\sin D=\frac{9\sin 100}{11}$ (=0.80575…) or D = 53.68… M1 for (height=) 9 × sin (180 − 100 − "D") or height = 3.990… M1 for area of $ABCD$ = (2 × ½) × 11 × "height" A1 for 43.8 – 43.9 **OR** M1 for $11^2 = AD^2 + 9^2 - 2\times AD\times 9\times\cos 100$ M1 for $AD=\frac{18\cos 100+\sqrt{(18\cos 100)^2-4(1)(-40)}}{2(1)}$ M1 for $AD=\frac{18\cos 100+\sqrt{169.7(69795...)}}{2(1)}$ (= 4.95195(…)) M1 for area of $ABCD = 2\times\frac{1}{2}$ × "4.95195" × 9 × sin100 A1 for 43.8 – 43.9

Question	Working	Answer	Mark	Notes
295			2	M1 for a 5cm by 5 cm square **or** a 5cm by 3 cm rectangle **or** a 5 cm by 2 cm rectangle A1 for correct elevation with dividing line NB: diagrams which appear to have a 3D element get 0 marks
296		115	4	M1 for 360 − 4 × 25 (=260) M1 (dep) for '260'÷4 (=65) M1 for 180 − '65' **or** (360 −2× '65') ÷ 2 A1 for 115 with working **OR** M1 for 360÷4 (=90) M1 (dep) for '90' − 25 (=65) M1 for 180 − '65' **or** (360 − 2×'65') ÷ 2 A1 for 115 with working
297		440	2	M1 for 140 × π oe or 439 A1 for 439.6 – 440
298		80.1	3	M1 for $39^2 + 70^2$ M1 for $\sqrt{"1521" + "4900"}$ or $\sqrt{"6421"}$ A1 for 80.1 - 80.2

Question	Working	Answer	Mark	Notes
299		49.5	4	M1 for $\tan 54 = \frac{\text{height}}{6}$ M1 for (height =) 6 × tan54 (=8.2-8.3) M1 for $\frac{1}{2}$ × '8.258..' × 12 A1 for 49.2 - 50 **OR** M1 for $\cos 54 = \frac{6}{AC}$ M1 for (AC =) $\frac{6}{\cos 54}$ (=10.2(07...)) M1 for $\frac{1}{2}$ × 12 × '10.207' × sin54 A1 for 49.2 - 50 **OR** M1 for $\frac{AC}{\sin 54} = \frac{12}{\sin 72}$ M1 for (AC =) $\frac{12}{\sin 72}$ × sin54 (=10.2(07...)) M1 for $\frac{1}{2}$ × 12 × '10.207' × sin54 A1 for 49.2 – 50

Question	Working	Answer	Mark	Notes
300 (a)		'show'	2	M1 for $\frac{1}{2} \times (x - 4 + x + 5) \times 2$ **or** $2x \times (x - 4) + \frac{1}{2} \times 2x \times 9$ A1 for completion with correct processes seen
(b)		13	3	M1 for $\frac{-1 \pm \sqrt{1^2 - 4 \times 2 \times -351}}{2 \times 2}$ condone incorrect sign for 351 M1 for $\frac{-1 \pm \sqrt{2809}}{4}$ A1 for 13 NB for either M mark accept + only in place of ± **OR** M2 for $(2x + 27)(x - 13)$ (M1 for $(2x \pm 27)(x \pm 13)$) A1 for 13
301		14.4	3	M1 for $\pi \times 6.5^2 \times 11.5$ (=1526.42...) M1 (dep) for $\frac{\text{'1526.42...'}}{\pi \times 5.8^2}$ A1 for 14.4 - 14.5 **OR** M1 for $\frac{5.8}{6.5}$ or $\frac{6.5}{5.8}$ or 0.89(23…) or 1.12(06896…) M1 for $11.5 \div \left(\frac{5.8}{6.5}\right)^2$ or $11.5 \div \left(\frac{6.5}{5.8}\right)^2$ A1 for 14.4 - 14.5
302	180-136-"34.4" =9.504	3.73	5	M1 for $\frac{\sin L}{12.8} = \frac{\sin 136}{15.7}$ M1 for $L = \sin^{-1}\left(\frac{\sin 136}{15.7} \times 12.8\right)$ or **or** $\sin^{-1}0.566...$ A1 for 34.4 - 34.5 M1 for $\frac{LN}{\sin(180 - 136 - '34.4')} = \frac{15.7}{\sin 136}$ or $\frac{\text{LN}}{\sin(180 - 136 - '34.4')} = \frac{12.8}{\sin '34.4'}$ or $(LN^2 =)\ 15.7^2 + 12.8^2 - 2 \times 15.7 \times 12.8 \times \cos(180 - 136 - '34.4')$ A1 for 3.73 - 3.74

Question	Working	Answer	Mark	Notes
*303		Proof	3	M1 for one pair of equal angles or sides with reason M1 for second pair of equal angles or sides with reason C1 for proof completed correctly with full reasons and reason for congruence Acceptable reasons: *AD* common (oe eg both same) Angle *BAD* = angle *CDA* (angles in a semicircle are 90^{o}) Angle *ABO* = angle *DCA* (angles in the same segment are equal) Triangle *ABD* and triangle *DCA* are congruent - ASA **OR** *BD* = *CA* (diameters of the circle) Angle *BAD* = angle *CDA* (angles in a semicircle are 90^{o}.) *AD* common Triangle *ABD* and triangle *DCA* are congruent - RHS **OR** *BD* = *CA* (diameters of the circle) *AD* is common Angle *ADB* = angle *CAD* (base angles of an isosceles triangle are equal.) Triangle *ABD* and triangle *DCA* are congruent - SAS

Question	Working	Answer	Mark	Notes
304		40.5	3	M1 for 1.5×6 or 1.5 ×1.5 M1 for adding area of 5 or 6 faces provided at least 3 are the correct area A1 cao NB: anything that leads to a volume calculation 0 marks.
305		10752	4	M1 for splitting the pentagon (or show the recognition of the "absent" triangle) and using a correct method to find the area of one shape M1 for a complete and correct method to find the total area M1 (dep on at least one prev M1) for multiplying their total area by 2.56 (where total area is a calculation involving at least two areas) A1 cao
306		55	4	M1 for a correct method to find a different angle using 35° M1 for setting up a complete process to calculate angle *x* A1 cao B1 states one of the following reasons relating to their chosen method: Alternate angles are equal; Corresponding angles are equal; Allied angles / Co-interior angles add up to 180; the exterior angle of a triangle is equal to the sum of the interior opposite angles.

Question	Working	Answer	Mark	Notes
307		3.52	3	M1 for $1.35^2 + 3.25^2$ M1 (dep) for $\sqrt{(1.35^2 + 3.25^2)}$ (= $\sqrt{12.385}$) A1 for answer in the range 3.51 to 3.52
*308	Angle *POT* = 180 – 90 – 32 = 58 (angle between radius and tangent = 90^o and sum of angles in a triangle = 180^o) Angle *OST* =angle *OTS* = 58÷2 (ext angle of a triangle equal to sum of int opp angles and base angles of an isos triangle are equal) or (angle at centre = 2x angle at circumference) OR Angle *SOT* = 90 + 32 = 122 (ext angle of a triangle equal to sum of int opp angles) (180 – 122) ÷ 2 (base angles of an isos triangle are equal)	29	5	B1 for angle OTP = 90^o, quoted or shown on the diagram M1 for a method that leads to 180 – (90 + 32) or 58 shown at *TOP* M1 for completing the method leading to "58"÷2 or 29 shown at *TSP* A1 cao C1 for "angle between radius and tangent = 90^o" **and** one other correct reason given from theory used NB: C0 if inappropriate rules listed OR B1 for angle OTP = 90^o, quoted or shown on the diagram M1 for a method that leads to 122 shown at *SOT* M1 for (180 – "122") ÷ 2 or 29 shown at *TSP* A1 cao C1 for "angle between radius and tangent = 90^o" **and** one other correct reason given from theory used NB: C0 if inappropriate rules listed

Question		Working	Answer	Mark	Notes
309		cos y = 2.25 ÷ 6 y = $\cos^{-1}$ (2.25 ÷ 6) OR 6cos 75 = 1.55…	The ladder is not safe because y is not near to 75	3	M1 for cos y = 2.25 ÷ 6 oe M1 for $\cos^{-1}$ (2.25 ÷ 6) C1 for sight of 67-68 and a statement eg this angle is NOT (near to) 75^{o} and so the ladder is not steep enough and so not safe. OR M1 for cos 75 = x ÷ 6 M1 for 6cos 75 C1 for sight of 1.55(29…) and a statement eg that 2.25 NOT (near to) 1.55 and so the ladder is not steep enough and so not safe.
310	(a)		18.2	2	M1 for ½ × 6 × 7 × sin60 A1 for answer in range 18.1 to 18.2
	(b)		6.56	3	M1 for $6^2 + 7^2 - 2 \times 6 \times 7 \times \cos 60$ M1 for correct order of operation eg 36 + 49 – 42 (=43) A1 for answer in range 6.55 to 6.56

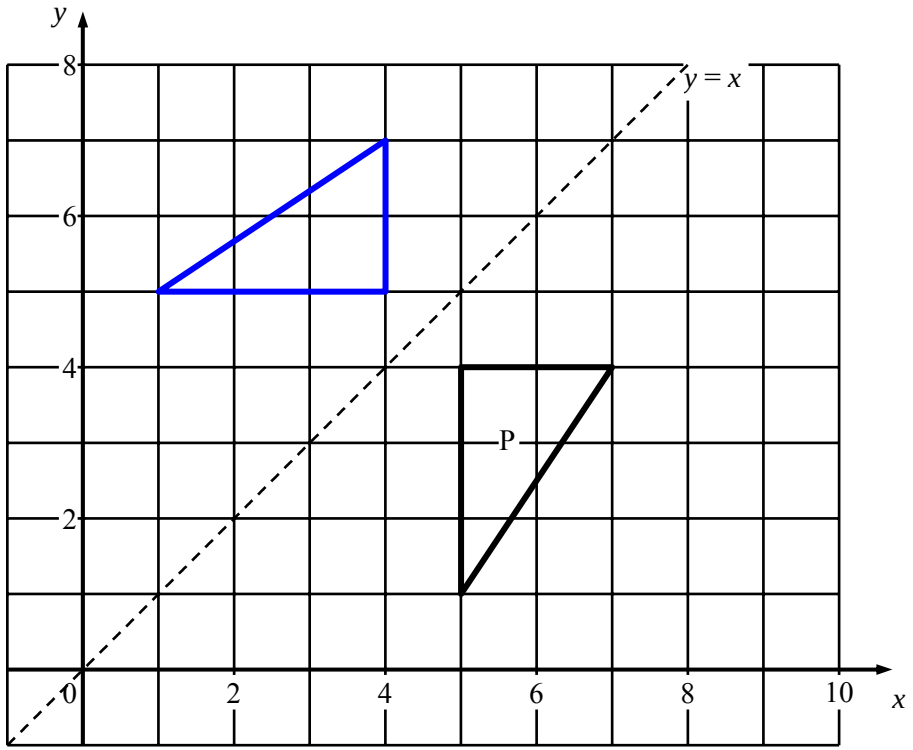
Question		Working	Answer	Mark	Notes
311		$\pi \times 5 \times 1.80$	28.27	3	M1 for use of $\pi \times x$ (with $x = 5$ or $x = 2.5$) **or** $2 \times \pi \times x$ (with $x = 5$ or $x = 2.5$) M1 for $\pi \times 5 \times 1.8(0)$ **or** $2 \times \pi \times 2.5 \times 1.8(0)$ A1 for 28.26 or 28.27 or 28.28 or 28.3(0) or 28.8(0)
312			1180	3	M1 for a correct method to find the area of the cross section M1 (dep) for a complete correct method for the volume of the prism A1 cao **OR** M1 for a correct method to find the volume of one cuboid M1 (dep) for a complete correct method for the volume of the prism A1 cao
313			Translation; $\binom{6}{-1}$	2	B1 for translation B1 for $\binom{6}{-1}$ NB: B0 if more than one transformation given
314	(a)		11.5	3	M1 for $13^2 - 6^2$ or $169 - 36$ or 133 M1 (dep on M1) for $\sqrt{"13^2 - 6^2"}$ **or** $\sqrt{133}$ A1 for answer in the range 11.5 – 11.6
	(b)		47.2	3	M1 for cos $(RPQ) = \frac{17}{25}$ oe **OR** sin $PQR = \frac{17}{25}$ with PQR clearly identified M1 for $(RPQ =+)$ $\cos^{-1}\frac{17}{25}$ oe **OR** $PQR = \sin^{-1}\frac{17}{25}$ with PQR clearly identified A1 for answer in the range 47.1 – 47.2 SC : B2 for an answer of 0.823(033...) **or** 52.3(95...) **or** 52.4

Question		Working	Answer	Mark	Notes
315	(a)	$\frac{1}{2} \times (4 + 12) \times 10$	80	2	M1 for a fully correct method for area of *QRST* A1 cao
	(b)	**For example** $\frac{PT+10}{PT} = \frac{12}{4}$ 3 $PT + 10 = 3PT$ $2PT = 10$	5	3	M1 for a correct scale factor or ratio using two corresponding sides from two similar triangles or two sides within the same triangle (may be seen within an equation) eg. $\frac{12}{4}$oe **or** 4 : 12 oe **or** $\frac{PT}{4}$**or** $\frac{PS}{12}$ **or** $\frac{12}{12-4}$ etc. M1 for a correct equation with *PT* or *PS* as the only variable **or** complete correct method using scale factor A1 cao
316		$\frac{30}{360} \times \pi \times 15^2$	58.8	2	M1 for a correct method to find the area of sector *OAB* A1 for answer in range 58.8 − 58.9125
317			15.0	3	M1 for $8^2 + 8^2 - 2 \times 8 \times 8 \times \cos 140$ M1 (dep) for correct order of evaluation **or** 226.(05...) A1 for answer in range 15.0 − 15.04 **OR** M1 for $\frac{PR}{\text{SIN } 140} = \frac{8}{\sin\left(\left(\frac{180-140}{2}\right)\right)}$ M1 for $PR = \frac{8}{\sin\left(\left(\frac{180-140}{2}\right)\right)} \times \sin 140$ A1 for answer in range 15.0 − 15.04 **OR** M1 for $8 \times \sin 70$ or $8 \times \cos 20$ M1 for $2 \times 8 \times \sin 70$ **or** $2 \times 8 \times \cos 20$ A1 for answer in range 15.0 − 15.04

Question		Working	Answer	Mark	Notes
318		$\frac{1}{3}\times \pi \times 15^2 \times 40$ $-\frac{1}{3}\times \pi \times 7.5^2 \times 20$	8250	4	B1 for 15cm as diameter or 7.5 cm as radius of smaller cone (may be marked on diagram or used in a formula) M1 for a numerical expression for the volume of one cone eg. $\frac{1}{3}\times \pi \times 15^2 \times 40$ (=9424...) **or** $\frac{1}{3}\times \pi \times 7.5^2 \times 20$ (=1178...) M1 for $\frac{1}{3}\times \pi \times 15^2 \times 40$ oe $-\frac{1}{3}\times \times \pi \times 7.5^2 \times 20$ oe A1 for answer in the range 8240 − 8250 **OR** B1 for 2^3 M1 for a numerical expression for the volume of the large cone eg. $\frac{1}{3}\times \pi \times 15^2 \times 40$ (=9424...) M1 volume of frustrum $= \frac{7}{8}\times \frac{1}{3}\times \pi \times 15^2 \times 40$ oe A1 for answer in the range 8240 − 8250
319			$1+\sqrt{5}$	5	M1 for $\frac{1}{2}\times x \times x \times \sin 30°$ oe M1 for $\frac{1}{2}(x-2)(x+1)$ oe **or** $\frac{1}{2}\times (x-2)\times (x+1)\times \sin 90$ M1 (dep on at least one previous M1) for formation of equation from equating areas with x as the only variable A1 for $x^2 - 2x - 4 = 0$ oe in the form $ax^2 + bx + c = 0$ or $ax^2 + bx = c$ A1 cao

Question		Working	Answer	Mark	Notes
320	(a)		Triangle with vertices (1, 5) (4, 5) (4,7)	2	B2 correct reflection (B1 a translation of the correct answer with the final shape above $y = x$ **or** any two correct vertices) SC : B1 for a triangle with vertices at (2, 5) (4, 5) (4, 8)
	(b)		Translation by $\begin{pmatrix} -2 \\ -4 \end{pmatrix}$	2	B1 Translation B1 $\begin{pmatrix} -2 \\ -4 \end{pmatrix}$ NB. Award no marks for a combination of transformations

320.



Question		Working	Answer	Mark	Notes
321		Angle *DEC* = 180 – 41 =139 Angles on a straight line sum to 180° Angle *EDC* = 60 – 38 **or** Angle *ABD* = 180 – 120 – 38 (=22) Co-interior/allied angles of parallel lines sum to 180° **or** Angles in a triangle sum to 180° **and** Alternate angles *x* =)180 – '139' – '22' (=19) Angles in a triangle sum to 180° **OR** Angle *ADC* = 180° – 120° = 60° Co-interior/allied angles of parallel lines sum to 180° Angle *EDC* = 22° Angle *ECD* = 41° – 22° = 19° Exterior angle of triangle equals sum of the two opposite interior angles **OR** Angle *DBC* = 38° Alternate angles Angle *BCE* = 101° Angle sum of a triangle is 180° Angle *BCD* = 120° Opposite angles of a parallelogram are equal Angle *ECD* = 120° – 101° = 19°	*x* = 19° and reasons	4	M1 for *DBC* = 38° **or** *ADC* = 60°(can be implied by *BDC* = 22°) **or** *ABC* = 60° **or** *DCB* = 120° **or** (*ABD* =) 180 – 120 –38 (=22) M1 for (*BDC* =) 60 − 38 (=22) **or** *BDC* = '22' **or** (*DEC* =) 180 − 41 (=139) **or** (*BCE* =) 180 −41 − 38 (=101) M1 (dep on both previous M1) for complete correct method to find *x* **or** (*x* =) 19 C1 for *x* = 19° **AND** Co-interior/allied angles of parallel lines sum to 180° **or** Opposite angles of a parallelogram are equal **or** Alternate angles **AND** Angles on a straight line sum to 180° **or** Angles in a triangle sum to 180° **or** Exterior angle of triangle equals sum of the two opposite interior angles **or** Angles in a quadrilateral sum to 360°

Question		Working	Answer	Mark	Notes
322		17.8 ÷ 160 × 210 = 0.11125 × 210 = 23.3625 g **OR** 210 ÷ 160 × 17.8 = 1.3125 × 17.8 = 23.3625 g **OR** 210 − 160 (=50) $\frac{17.8}{160} \times '50' (= 5.5625)$ 17.8 + 5.5625	23.3(625)	3	M1 17.8 ÷ 160 (=0.11125) **or** 17.8 × 210 (=3738) **or** 210 ÷ 160 (=1.3125) M1 (dep) '0.11125' × 210 **or** '3738'÷160 **or** '1.3125'× 17.8 A1 for answer in range 23.3 - 23.4 **OR** M1 for $\frac{17.8}{160} \times (210 - 160) (= 5.5625)$ M1 (dep) for 17.8 + '5.5625' A1 for answer in range 23.3 - 23.4 **OR** M1 for correct method to find weight of 2 cm **or** 5 cm **or** 10 cm M1 (dep) for complete method A1 for answer in range 23.3 - 23.4

<table>
<tr><th colspan="2">Question</th><th>Working</th><th>Answer</th><th>Mark</th><th>Notes</th></tr>
<tr><td>323</td><td>(a)</td><td></td><td>show</td><td>2</td><td>M1 for $x\times x\times x$ or $2\times5\times x$ or vol of cube = x^3 or vol cuboid = $10x$
A1 correct completion leading to
$x^3-10x=100$</td></tr>
<tr><td></td><td>(b)</td><td><table>
<tr><td>$x=1$</td><td>−9</td></tr>
<tr><td>$x=2$</td><td>−2</td></tr>
<tr><td>$x=3$</td><td>−3</td></tr>
<tr><td>$x=4$</td><td>24</td></tr>
<tr><td>$x=5$</td><td>75</td></tr>
<tr><td>$x=6$</td><td>156</td></tr>
<tr><td>$x=10$</td><td>900</td></tr>
<tr><td>$x=5.1$</td><td>81.(651)</td></tr>
<tr><td>$x=5.2$</td><td>88.(608)</td></tr>
<tr><td>$x=5.3$</td><td>95.(877)</td></tr>
<tr><td>$x=5.4$</td><td>103.(464)</td></tr>
<tr><td>$x=5.5$</td><td>111.(375)</td></tr>
<tr><td>$x=5.6$</td><td>119.(616)</td></tr>
<tr><td>$x=5.7$</td><td>128.(193)</td></tr>
<tr><td>$x=5.8$</td><td>137.(112)</td></tr>
<tr><td>$x=5.9$</td><td>146.(379)</td></tr>
<tr><td>$x=5.35$</td><td>99.6(30375)</td></tr>
<tr><td>$x=5.36$</td><td>100.3(90656)</td></tr>
<tr><td>$x=5.355$</td><td>100.0(101139)</td></tr>
</table></td><td>5.4</td><td>4</td><td>B2 for a trial $5\le x\le6$ evaluated correctly
(B1 for any two trials evaluated correctly for positive values of x)
B1 for a different trial $5.3<x<5.4$ evaluated correctly
B1 (dep on at least one previous B1) for 5.4

Accept trials correct to the nearest whole number (rounded or truncated) if the value of x is to 1 d.p., but correct to 1 d.p. (rounded or truncated) if the value of x is to 2 or more d.p.

NB. Allow 100 for a trial of $x = 5.355$</td></tr>
<tr><td>324</td><td></td><td>$9-3=6$
$10^2-6^2=64$
$BC=8$
$AC^2=9^2+8^2=145$</td><td>12.0</td><td>5</td><td>M2 $10^2-(9-3)^2$ (=64) or $BC=8$
(M1 $9-3$ (= 6) may be seen on diagram)
M1 (indep) $9^2+'BC'^2$ where BC is a numerical value
M1 (dep on previous M1) $\sqrt{81+'64'}$
A1 12.0 – 12.042</td></tr>
</table>

Question		Working	Answer	Mark	Notes
325		$\sin 60^o = \frac{x}{32}$ $x = 32 \times \sin 60$ (=27.712...)	27.7	3	M1 $\sin 60 = \frac{x}{32}$ **or** $\frac{x}{\sin 60} = \frac{32}{\sin 90}$ oe M1 $(x =)\ 32 \times \sin 60$ **or** $(x =)\ \frac{32}{\sin 90} \times \sin 60$ A1 27.7 − 27.72 **OR** M1 $\cos(90 - 60) = \frac{x}{32}$ M1 $(x =)\ 32 \times \cos(90 - 60)$ A1 27.7 − 27.72 Radians : − 9.7539398... Gradians : 25.888554... SC : B2 for an answer in the range (−) 9.75 to (−)9.754 **or** 25.8 to 25.9

Question		Working	Answer	Mark	Notes
326	(a)	Let O be the centre of the base. $OB^2 + OC^2 = 10^2$; $OB^2 = 50$ $AO^2 = AB^2 - OB^2 = 50$ Vol = $\frac{1}{3}\times 10^2 \times \sqrt{50}$ **OR** Let M be the midpt of side BC and let O be the centre of the base. $AM^2+MC^2 = 10^2$; $AM^2 = 75$ $AO^2 = AM^2 - MO^2 = 50$ Vol = $\frac{1}{3}\times 10^2 \times \sqrt{50}$	236	4	M1 correct method to start to find BD or BO using triangle OBC or triangle BCD (oe) Eg. $OB^2 + OC^2 = 10^2$ **or** $BO^2 = 50$ **or** $BO = \sqrt{50}$ (=7.07..) **or** $BO = \frac{\sqrt{200}}{2}$ **or** $10^2 + 10^2 = BD^2$ **or** $BD^2 = 200$ **or** $BD = \sqrt{200}$ (=14.1..) M1 (dep) correct method to find height of pyramid using triangle AOB Eg. $AO^2 = 10^2 - '\sqrt{50}'^2$ **or** $AO^2 = 50$ **or** $AO = \sqrt{50}$ (=7.07..) M1 (indep) $\frac{1}{3}\times 10^2 \times '\sqrt{50}'$ (but **not** $\frac{1}{3}\times 10^2 \times 10$) A1 235 – 236 **OR** M1 correct method to start to find height of a face using triangle AMC (oe) Eg. $AM^2 + 5^2 = 10^2$ **or** $AM^2 = 75$ **or** $AM = \sqrt{75}$ (=8.66...) M1 (dep) correct method to find height of pyramid using triangle AOM Eg. $AO^2 = '\sqrt{75}'^2 - 5^2$ **or** $AO^2 = 50$ **or** $AO = \sqrt{50}$ (=7.07..) M1 (indep) $\frac{1}{3}\times 10^2 \times '\sqrt{50}'$ (but **not** $\frac{1}{3}\times 10^2 \times 10$) A1 235 – 236

Question		Working	Answer	Mark	Notes
326 cont.	(a)				**OR** M1 for $\sin 45 = \frac{x}{10}$ **or** $\cos 45 = \frac{x}{10}$ M1 for $h = 10 \times \sin 45$ **or** $h = 10 \times \cos 45$ (=7.07..) M1 (indep) $\frac{1}{3} \times 10^2 \times$ '7.07...' (but **not** $\frac{1}{3} \times 10^2 \times 10$) A1 235 – 236

Question		Working	Answer	Mark	Notes
326	(b)	Angle $ABO = 45^o$ Angle $DAB = 180 - 45 - 45$ **OR** In ΔBAD, $\cos A = \frac{10^2 + 10^2 - '\sqrt{200}'^2}{2 \times 10 \times 10} = 0$ **OR** In ΔBOA, $\cos B = \frac{'\sqrt{50}'}{10}$ Angle $BAD = 180 - '45' - '45'$ **OR** $\sin A = \frac{'\sqrt{50}'}{10}$ $A = 45$ Angle $BAD = 2 \times '45'$	90	2	M1 Angle $DAB = 180 - 2 \times '45'$ A1 89.98 - 90 **OR** M1 $\cos BAD = \frac{10^2 + 10^2 - '\sqrt{200}'^2}{2 \times 10 \times 10}$ A1 89.98 - 90 **OR** M1 $\sin A = \frac{'\sqrt{50}'}{10}$ A1 89.98 - 90

Question		Working	Answer	Mark	Notes
327		$A = \frac{1}{2} \times x \times 2x \times \sin 30^o$ $A = \frac{1}{2} \times 2x^2 \times 0.5$ **OR** Height = $2x \sin 30^o = x$ $A = \frac{x \times x}{2} = \frac{x^2}{2}$ **OR** Height = $x \sin 30 = \frac{x}{2}$ $A = \frac{1}{2} \times 2x \times \frac{x}{2} = \frac{x^2}{2}$	$x = \sqrt{2A}$ shown	3	M1 $(A =) \frac{1}{2} \times x \times 2x \times \sin 30^o$ A1 $A = x^2 \times 0.5$ **or** $A = \frac{x^2}{2}$ C1 for completion with all steps shown **OR** M1 height = $2x \sin 30$ $(= x)$ A1 $A = x^2 \times 0.5$ **or** $A = \frac{x^2}{2}$ C1 for completion with all steps shown **OR** M1 for height = $x \sin 30$ $(= \frac{x}{2})$ A1 $A = x^2 \times 0.5$ **or** $A = \frac{x^2}{2}$ C1 for completion with all steps shown

Question		Working	Answer	Mark	Notes
328		180 – 47	133	3	M1 for 180 – 47 A1 for 133 C1(dep on M1) for full reasons e.g. angles on a straight line add up to 180^o **and** alternate angles are equal **OR** corresponding angles are equal **and** angles on a straight line add up to 180^o **OR** vertically opposite angles (or vertically opposite angles) are equal **and** allied angles (or co-interior angles) add up to 180^o
329	(a)		Triangle with vertices (2,–1) (4, –1) (4, –4)	2	B2 for triangle with vertices (2,–1) (4, –1) (4, –4) (B1 for triangle in correct orientation **or** rotated 90^o anticlockwise centre *O*
	(b)		Triangle with vertices (7, 2) (13, 2) (7, 11)	3	B3 for triangle with vertices (7, 2) (13, 2) (7, 11) (B2 for 2 vertices correct or enlargement scale factor 3 in wrong position or enlargement, centre (1,2), with different scale factor) (B1 for 1 vertex correct or enlargement, not from (1,2), different scale factor)

Question		Working	Answer	Mark	Notes
330		$\cos x = \frac{6.4}{9.6}$ $x = \cos^{-1}\frac{6.4}{9.6} =$	48.2	3	M1 for $\cos x = \frac{6.4}{9.6}$ or $\cos x = 0.66(6...)$ or $\cos x = 0.67$ M1 for $\cos^{-1}\frac{6.4}{9.6}$ or $\cos^{-1} 0.66(6...)$ or $\cos^{-1} 0.67$ A1 for 48.1 – 48.2 **OR** Correct use of Pythagoras and then trigonometry, no marks until M1 for $\sin x = \frac{'7.155'}{9.6}$ or $\tan x = \frac{'7.155'}{6.4}$ or $\sin x = \frac{'7.155'}{9.6} \times \sin 90$ or $\cos x = \frac{6.4^2 + 9.6^2 - '7.155'^2}{2 \times 6.4 \times 9.6}$ M1 for $\sin^{-1}\frac{'7.155'}{9.6}$ or $\tan^{-1}\frac{'7.155'}{6.4}$ or $\sin^{-1}\left(\frac{'7.155'}{9.6} \times \sin 90\right)$ or $\cos^{-1}\left(\frac{6.4^2 + 9.6^2 - '7.155'^2}{2 \times 6.4 \times 9.6}\right)$ A1 for 48.1 – 48.2 SC B2 for 0.841... (using rad) or 53.5... (using grad)

Question		Working	Answer	Mark	Notes
331		$BD^2 + 12^2 = 16^2$ oe BD= $\sqrt{256-144}$ (=10.58...) sin 40 = $\frac{'10.58'}{CD}$ $CD = \frac{'10.58'}{\sin 40}$	16.5	5	M1 for $BD^2 + 12^2 = 16^2$ oe or $16^2 - 12^2$ or 112 seen M1 for $\sqrt{256-144}$ or $\sqrt{112}$ (=10.58...) M1 for sin 40 = $\frac{'10.58'}{CD}$ or cos 50 = $\frac{'10.58'}{CD}$ M1 for (CD =) $\frac{'10.58'}{\sin 40}$ or $\frac{'10.58'}{\cos 50}$ A1 for 16.4 – 16.5 **OR** M1 for $BD^2 + 12^2 = 16^2$ oe or $16^2 - 12^2$ or 112 seen M1 for $\sqrt{256-144}$ or $\sqrt{112}$ (=10.58..) M1 for (BC =) '10.58'× tan 50 or $\frac{'10.58'}{\tan 40}$ (=12.6…) M1 for $\sqrt{'12.6'^2+'10.58...'^2}$ A1 for 16.4 – 16.5

Question		Working	Answer	Mark	Notes
332		$\frac{AC}{\sin 49} = \frac{8.7}{\sin 64}$ $AC = \frac{8.7}{\sin 64} \times \sin 49$ (= 7.305…) $\frac{1}{2} \times 8.7 \times 7.305... \times \sin(180 - 64 - 49)$	29.3	5	M1 for $\frac{AC}{\sin 49} = \frac{8.7}{\sin 64}$ oe M1 for $(AC =) \frac{8.7}{\sin 64} \times \sin 49$ A1 for 7.3(05…) M1 for $\frac{1}{2} \times 8.7 \times$ '7.305' $\times \sin(180 - 64 - 49)$ A1 for 29.19 – 29.3 **OR** M1 for $\frac{BC}{\sin(180 - 64 - 49)} = \frac{8.7}{\sin 64}$ oe M1 for $(BC =) \frac{8.7}{\sin 64} \times \sin'67'$ A1 for 8.9(10...) M1 for $\frac{1}{2} \times 8.7 \times$ '8.910' $\times \sin 49$ A1 for 29.19 – 29.3 **OR** (*X* is point such that *AX* is perpendicular to *BC*) M1 for *AX* = 8.7×sin 49 (= 6.565…) **or** *XB* = 8.7×cos 49 (= 5.707...) M1 for *XB* = 8.7×cos 49 (= 5.707...) **and** *CX* = '6.565' ÷ tan 64 oe (= 3.202…) A1 for 8.9(10...) **or** 5.7(07...) and 3.2(02...) M1 for ½ × '6.565…' × ('5.707' + '3.202') oe A1 for 29.19 – 29.3

Question		Working	Answer	Mark	Notes
333	(a)		$\mathbf{b} - \mathbf{a}$	1	B1 for $\mathbf{b} - \mathbf{a}$ or $-\mathbf{a} + \mathbf{b}$
	(b)	$\overrightarrow{OP} = \overrightarrow{OA} + \overrightarrow{AP}$ $\overrightarrow{AP} = \frac{3}{4} \times (\mathbf{b} - \mathbf{a})$ $\overrightarrow{OP} = \mathbf{a} + \frac{3}{4} \times (\mathbf{b} - \mathbf{a})$ OR $\overrightarrow{OP} = \overrightarrow{OB} + \overrightarrow{BP}$ $\overrightarrow{BP} = \frac{1}{4} \times (\mathbf{a} - \mathbf{b})$ $\overrightarrow{OP} = \mathbf{b} + \frac{1}{4} \times (\mathbf{a} - \mathbf{b})$	$\frac{1}{4}(\mathbf{a} + 3\mathbf{b})$	3	B1 for $\frac{3}{4} \times$ '$(\mathbf{b} - \mathbf{a})$' M1 for $(\overrightarrow{OP} =)\ \overrightarrow{OA} + \overrightarrow{AP}$ or $(\overrightarrow{OP} =)\ \overrightarrow{OA} + \frac{3}{4}\overrightarrow{AB}$ or $\mathbf{a} \pm \frac{3}{4} \times$ '$(\mathbf{b} - \mathbf{a})$' A1 for $\frac{1}{4}(\mathbf{a} + 3\mathbf{b})$ or $\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$ **OR** B1 for $\frac{1}{4} \times$ '$(\mathbf{a} - \mathbf{b})$' M1 for $(\overrightarrow{OP} =)\ \overrightarrow{OB} + \overrightarrow{BP}$ or $(\overrightarrow{OP} =)\ \overrightarrow{OB} + \frac{1}{4}\overrightarrow{BA}$ or $\mathbf{b} \pm \frac{1}{4} \times$ '$(\mathbf{a} - \mathbf{b})$' A1 for $\frac{1}{4}(\mathbf{a} + 3\mathbf{b})$ or $\frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$