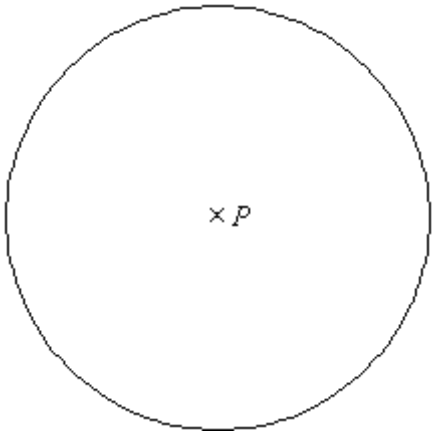
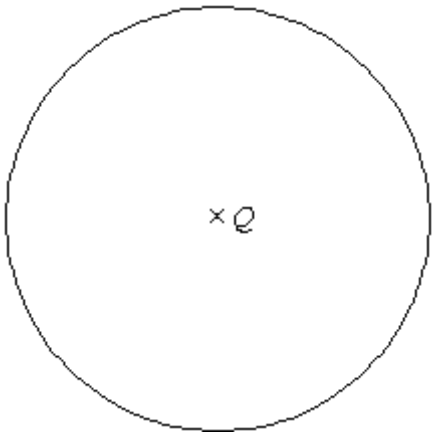
Q1.



(a) In the circle, centre P, draw a radius.

(1)



(b) In the circle, centre Q, draw a chord.

(1)
(Total 2 marks)

Q2.

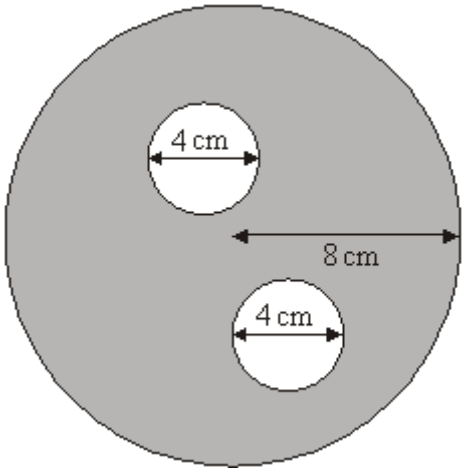


Diagram **NOT** accurately drawn

The diagram shows two small circles inside a large circle.
The large circle has a radius of 8 cm.

Each of the two small circles has a diameter of 4 cm.

(a) Write down the radius of each of the small circles.

..... cm

(1)

(b) Work out the area of the region shown shaded in the diagram.
Give your answer correct to one decimal place.

..... cm^2

(4)
(Total 5 marks)

Q3.

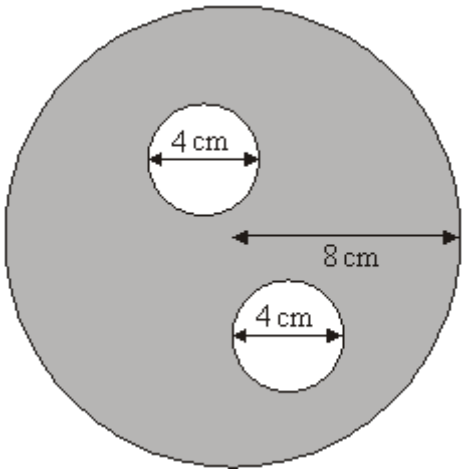


Diagram **NOT** accurately drawn

The diagram shows two small circles inside a large circle.
The large circle has a radius of 8 cm.

Each of the two small circles has a diameter of 4 cm.

(a) Write down the radius of each of the small circles.

..... cm

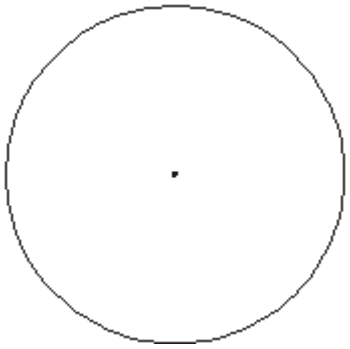
(1)

(b) Work out the area of the region shown shaded in the diagram.
Give your answer correct to one decimal place.

..... cm^2

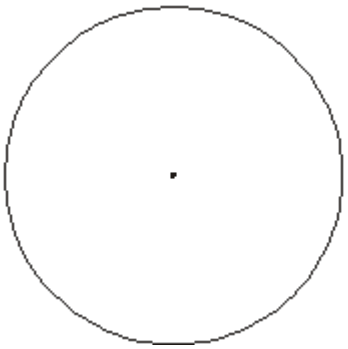
(4)
(Total 5 marks)

Q4. (a) In the circle below, draw a diameter.



(1)

(b) In the circle below, draw a sector.
Shade your sector.

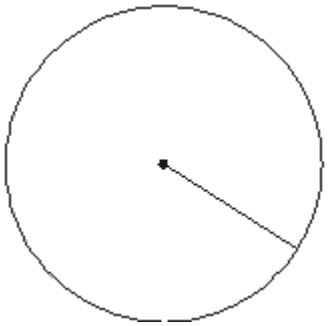


(1)
(Total 2 marks)

Q5. Here are some words which describe parts of a circle.

Radius	Diameter	Sector
Chord	Tangent	Segment

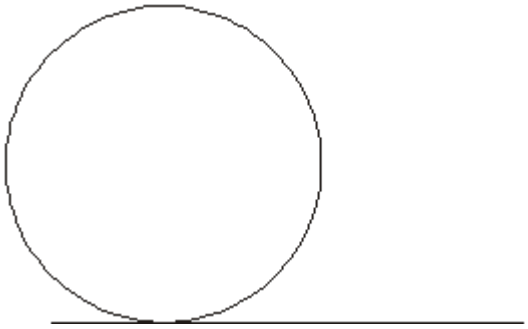
(a) Write down the mathematical name of the straight line shown in this diagram.
Use one of the words from the box.



.....

(1)

(b) Write down the mathematical name of the straight line shown in the diagram.
Use one of the words from the box.



.....

(1)
(Total 2 marks)

Q6.

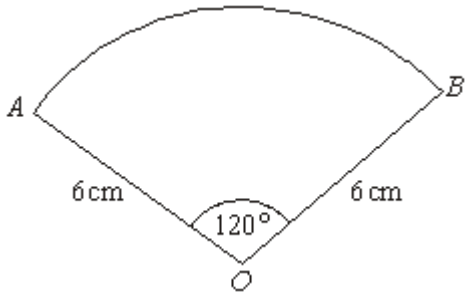


Diagram **NOT** accurately drawn

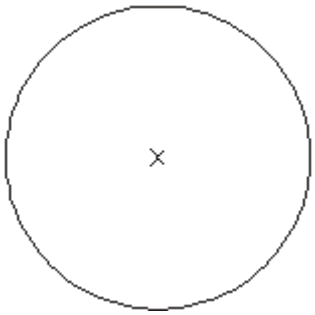
The diagram shows a sector of a circle, centre O.
The radius of the circle is 6 cm.
Angle AOB = 120°.

Work out the **perimeter** of the sector.
Give your answer in terms of π in its simplest form.

..... cm

(Total 3 marks)

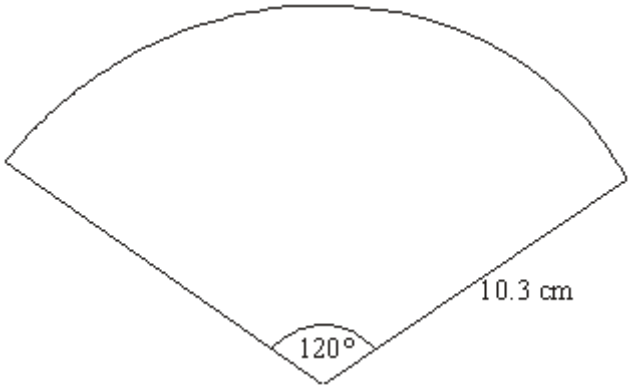
Q7. In the circle, draw a diameter.



(Total 1 mark)

Q8.

Diagram **NOT** accuartely drawn



The diagram shows a net.
The net is a sector of a circle.
The radius of the circle is 10.3 cm and the angle at the centre of the circle is 120º.

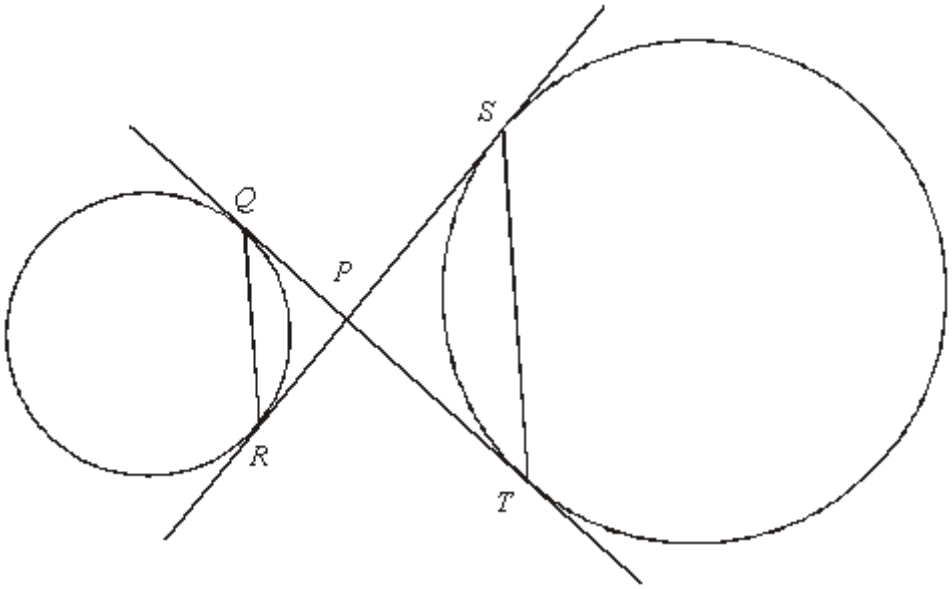
The net is used to make a cone.

Calculate the vertical height of the cone.
Give your answer correct to 3 significant figures.

..... cm

(Total 4 marks)

Q9.



Q and *R* are two points on the circumference of a circle.
S and *T* are two points on the circumference of another circle.

QT and *SR* are tangents to both circles.
P is the point of intersection of the two tangents.

Prove that *QR* is parallel to *ST*.

(Total 5 marks)

Q10.

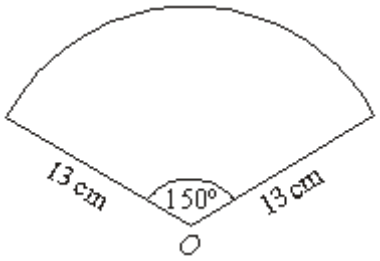


Diagram **NOT** accurately drawn

The diagram shows a sector of a circle, centre *O*.
The radius of the circle is 13 cm.
The angle of the sector is 150°.

Calculate the area of the sector.
Give your answer correct to 3 significant figures.

..... cm^2

(Total 2 marks)

Q11.

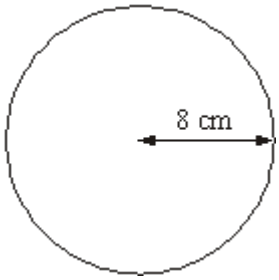


Diagram **NOT** accurately drawn

The radius of this circle is 8 cm.

Work out the circumference of the circle.
Give your answer correct to 2 decimal places.

..... cm

(Total 2 marks)

Q12.

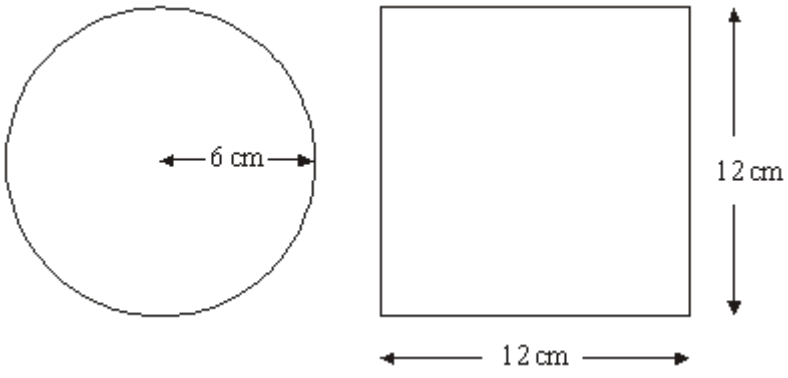


Diagram **NOT** accurately drawn

A circle has a radius of 6 cm.

A square has a side of length 12 cm.

Work out the difference between the area of the circle and the area of the square.
Give your answer correct to one decimal place.

..... cm^2

(Total 4 marks)

Q13.

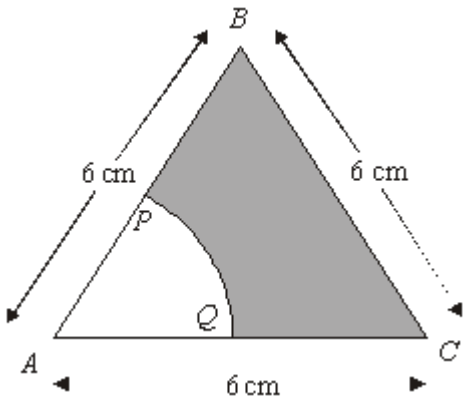


Diagram **NOT** accurately drawn

The diagram shows an equilateral triangle ABC with sides of length 6 cm.

P is the midpoint of AB.
Q is the midpoint of AC.
APQ is a sector of a circle, centre A.

Calculate the area of the shaded region.
Give your answer correct to 3 significant figures.

..... cm^2

(Total 4 marks)

Q14. Here is a tile in the shape of a semicircle.

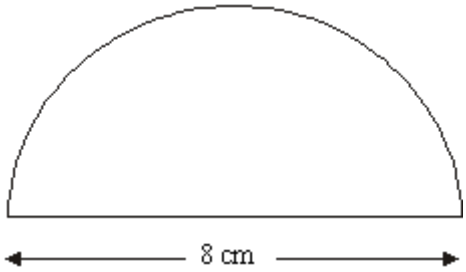


Diagram **NOT** accurately drawn

The diameter of the semicircle is 8 cm.

Work out the perimeter of the tile.
Give your answer correct to 2 decimal places.

..... cm

(Total 3 marks)

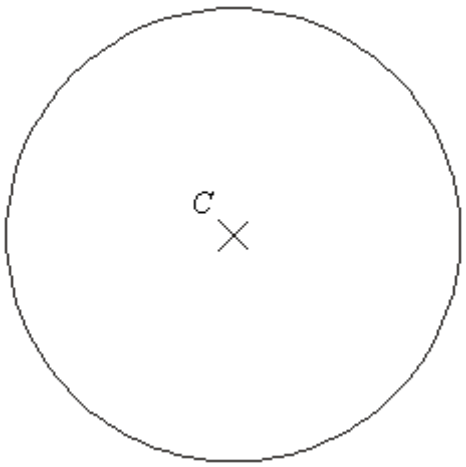
Q15. (a) The point O has been marked with a cross (✕).

Draw a circle with radius 4 cm and centre O.

(1)

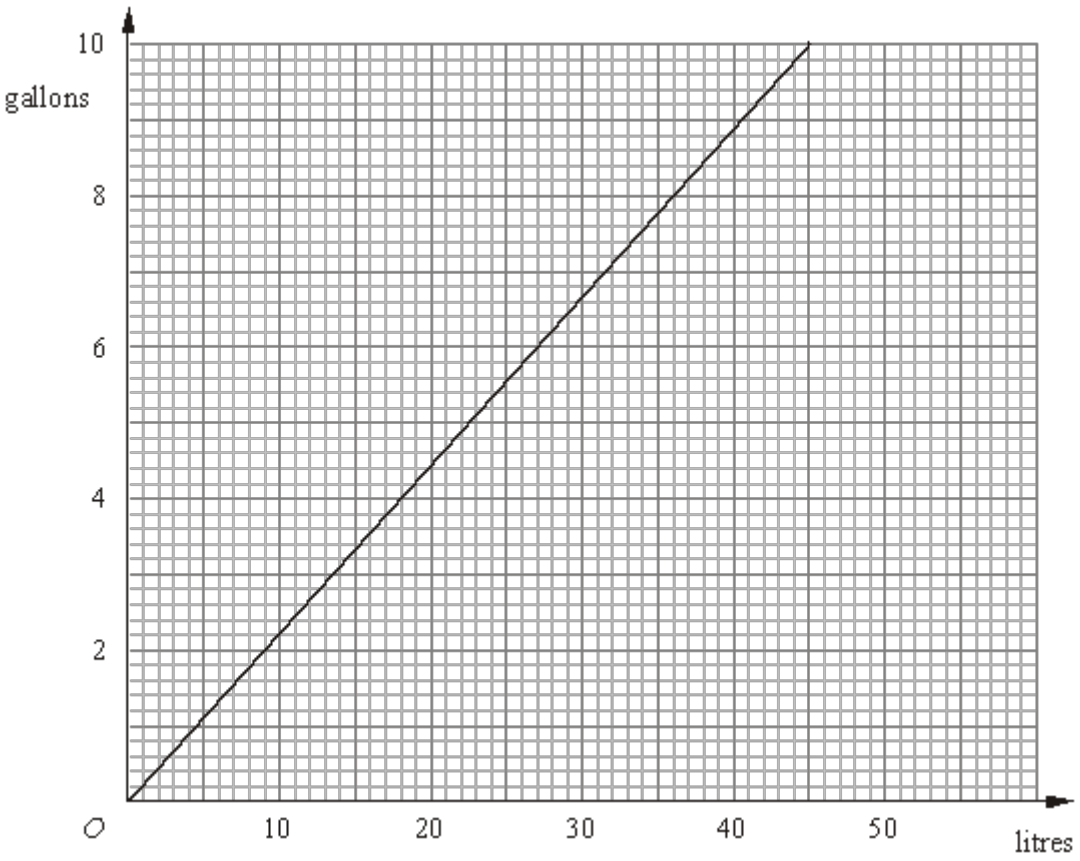
(b) Here is a circle centre C.

Draw a diameter in the circle.



(1)
(Total 2 marks)

Q16. The graph can be used to convert between gallons and litres.



The diagram shows a central heating oil tank.

The oil tank is in the shape of a cylinder of length 180 cm and radius 60 cm.

The oil tank contains 200 gallons of oil.

(a) Is the oil tank more or less than $\frac{1}{2}$ full?

.....

(5)

The oil has a density of 0.85 g/cm^3.

(b) Work out, in kg, the mass of the oil in the tank.

..... kg

(3)
(Total 8 marks)

M1.

	Answer	Mark	Additional Guidance
(a)	draw radius	1	**B1** (do not accept diameter) Ignore extras if correct
(b)	draw chord	1	**B1** (accept diameter) Ignore extras if correct
			Total for Question: 2 marks

M2.

	Working	Answer	Mark	Additional Guidance
(a)		2	1	**B1** cao
(b)	$\pi \times 8^2 - 2 \times \pi \times 2^2$	175.9	4	**M1** $\pi \times 8^2$ (= 201.06…) may be implied by 201 **M1** $\pi \times 2^2$ (= 12.566…) may be implied by 12.5 or 12.6 **M1**(dep on at least **M1**) for "201…" – 2 × "12.56..." **A1** 175.8 – 176
				Total for Question: 5 marks

M3.

	Working	Answer	Mark	Additional Guidance

(a)		2 cm^2	1	**B1** cao
(b)	$\pi \times 8^2 - 2 \times \pi \times 2^2$	175.9 cm	4	**M1** $\pi \times 8^2$ (= 201.06…) May be implied by 201 **M1** $\pi \times 2^2$ (= 12.566…) May be implied by 12.5 **or** 12.6 **M1** (dep on at least **M1**) "201…" – 2 × "12.56.." **A1** 175.8 – 176 inclusive
				Total for Question: 5 marks

M4.

	Answer	Mark	Additional Guidance
(a)	diameter	1	**B1** for a diameter drawn
(b)	Sector	1	**B1** for sector drawn (ignore shading)
			Total for Question: 2 marks

M5.

	Answer	Mark	Additional Guidance
(a)	Radius	1	**B1** ignore spelling
(b)	Tangent	1	**B1** ignore spelling
			Total for Question: 2 marks

M6.

Working	Answer	Mark	Additional Guidance
$\frac{120}{360} \times \pi \times 2 \times 6$	$4\pi + 12$	3	**M1** for $\frac{120}{360} \times \pi \times 2 \times 6$ oe allow 3.14, 3.142, $\frac{22}{7}$ for π **A1** for 4π or anything in the closed interval [12.56, 12.57], or $12\frac{4}{7}$ oe or $\frac{a\pi}{b}$ where a and b are integers with $a = 4b$ **A1** $4\pi + 12$ or $\pi 4 + 12$ oe SC (**B2** for a fully correct, but unsimplified expression for the perimeter, including $\left(\frac{2\pi r}{3}\right) + 12$ or $\left(\frac{2\pi r}{3}\right) + 2r$ Or for any value in the closed interval [24.56, 24.57])
			Total for Question: 3 marks

M7.

Answer	Mark	Additional Guidance
Diameter drawn	1	**B1** for a diameter drawn
		Total for Question: 1 mark

M8.

Working	Answer	Mark	Additional Guidance

$\frac{120}{360} \times 2\pi \times 10.3 = 21.572$ "21.572"÷ 2π = 3.4333 $\sqrt{(10.3^2 - 3.433^2)}$	9.71	4	

	Total for Question: 4 marks

M9.

	Working	Answer	Mark	Additional Guidance
QWC (i, ii, iii)	PS = PT and PQ = PR (equal tgts from a point) Let angle SPT = *x*	Proof	5	**B1** for PS = PT or PQ = PR **B1** for equal tangents from a point

	Total for Question: 5 marks

M10.

Working	Answer	Mark	Additional Guidance
$\frac{150}{360} \times \pi \times 13^2$ $= 0.41\dot{6} \times 530.9291585\ 360$ $= 221.22\ldots$	221	2	**M1** for $\frac{150}{360} \times \pi \times 13^2$ or $\pi \times 13^2 \div 2.4$ oe **A1** 220 – 222
			Total for Question: 2 marks

M11.

Working	Answer	Mark	Additional Guidance
$C = 2 \times \pi \times 8$	50.24-50.29	2	**M1** $C = 2 \times \pi \times 8$ or $\pi \times 16$ oe **A1** 50.24-50.29
			Total for Question: 2 marks

M12.

Working	Answer	Mark	Additional Guidance
$\pi \times 6^2$ $12^2 - \pi \times 6^2$	30.9	4	**M1** for 12^2 or 144 seen **M1** for $\pi \times 6^2$ or 113. … seen **M1** (dep on **M2**) for "12^2" – "$\pi \times 6^2$" **A1** for 30.88 – 31
			Total for Question: 4 marks

M13.

Working	Answer	Mark	Additional Guidance
$\frac{1}{2} \times 6 \times 6 \times \sin 60$ $-\frac{60}{360} \times \pi \times 3^2$ = 15.588 – 4.712	10.8 – 10.9	4	**M1** for $\frac{1}{2} \times 6 \times 6 \times \sin 60$ or for $0.5 \times 6 \times \sqrt{6^2 - 3^2}$ or 15.5 – 15.6 or 14.5 – 14.6 or ±5.48(65...) **M1** for $\frac{60}{360} \times \pi \times 3^2$ (= 4.712…) **M1** (dep on 1 previous M1) for 'area of triangle' – 'area of sector' **A1** for 10.8 – 10.9 SC: B3 for 10.1 – 10.2 or 9.84 – 9.85
			Total for Question: 4 marks

M14.

Working	Answer	Mark	Additional Guidance
(0.5 × 3.14... × 8) + 8	20.56 – 20.58	3	**M2** for (0.5 × π × 8) or $\pi \times 4$ or ($\pi \times 8 + 8$) or (0.5 × π × 8 + 8) oe

			(**M1** for $\pi \times 8$ or $2\pi \times 4$; for a value 25.1-25.2 inclusive unless seen with incorrect working eg πr^2) **A1** for 20.56 – 20.58 (**SC**: **B2** if M0 scored for 12.56 – 12.58)
			Total for Question: 3 marks

M15.

	Answer	Mark	Additional Guidance
(a)	circle drawn	1	**B1** for a circle drawn within guidelines (see overlay)
(b)	diameter drawn	1	**B1** for line through C and touching circle at both ends
			Total for Question: 2 marks

M16.

		Working	Answer	Mark	Additional Guidance
FE	(a)	1 gallon = 4.54 litres, 200 gallons = 908 litres = 908000 cm^3 Vol of tank $60^2 \times x \times \pi \times 180$ = 2035752.04..cm^3 908000 < 1017876.02 **OR**	No	5	Response may convert into gallons, litres, or cm^3 Calculations may be performed in different orders **M1** Using formulae to find volume of tank **B1** Converts between litres and cubic

		Vol of tank $60^2 \times \pi \times 180 =$ $2035752.04..cm^3$ Half vol of tank $= 1017876.02\ cm^3$ = 1017.876…litres 1017.876 ÷ 4.54 = 224 gallons 224 > 200			centimetres **M1** reads off graph for 1l, 2l , 4l, 5l or 10 litres within tolerance (4.4 – 4.6) **A1** Answer in cm^3, litres or gallons **C1** Decision and reason **QWC: Decision should be stated, with appropriate supporting statement**
	(b)	"908000" cm^3 × 0.85 g/cm^3 = 771800 g	771.8	3	**M1** "908000" × 0.85 **M1**(dep) 771800 ÷ 1000 **A1** 770 – 772
					Total for Question: 8 marks

E1. This question was well understood with 53% of candidates obtaining the correct answer for part (a) and 39% of candidates for part (b). Diameters were a key element in this question, in part (a) diameters were not allowed even though they might be considered to be two radii; though they were accepted in part (b) since a diameter does join two points on a circumference.

E2. In part (a) most candidates were able to write down the correct radius although some wrote down '4' or worked out either the circumference or the area. In part (b) those candidates who knew the formula for the area of a circle were usually quite successful and many achieved the correct answer. A common error was for candidates to subtract the area of only one small circle from the area of the large circle. Some candidates worked out the circumference of each circle rather than the area. Many had little or no idea what was required and did not attempt to work out the area or tried to work it out without using π.

E3. Apart from part (a) this question was not well answered. Problems included failure to recall the formula for calculating the area of a circle, substitution of the diameter rather than the radius, doubling rather than squaring, and subtraction of the area of a single small circle, rather two. There was also some premature rounding which placed otherwise correct answers outside the acceptable range. Consequently there were very few cases where full marks were awarded.

E4. Another well-understood question with most candidates gaining both marks though many radii were seen for (a) and segments for part (b). Candidates were expected to draw diameters within 2mm of the circumference for part (a) and semicircles were awarded the mark in (b).

E5. Candidates struggled with this question that is often tested in this paper and frequently made mistakes with the names of parts of a circle. Only 30% of candidates could write both parts correctly and a further 40% could write one part correctly, usually the tangent.

E6. The sector is, of course, in this case one third of its circle so the fraction demand was reasonable for a higher tier paper, although some candidates assumed it was a quarter of a circle.. Many candidates used the area formula and thus scored no marks. Of those that used the correct formula many could not simplify completely the expression for the arc length. Those that did get the arc length, did, however often go on to add 12 to get an expression for the perimeter although a few spoiled things at the end by writing $12 + 4\pi = 16\pi$.

E7. It was disappointing to see that just over a half of the candidates were able to draw a diameter in the circle. As it was not the intention to assess accurate drawing in this question, freehand drawing was usually accepted as long as the intention was clear.

Unfortunately, many candidates drew a radius or more than one radius and some drew a radius and a diameter. This could not be accepted unless the diameter was labelled. Some candidates attempted to draw a freehand circle inside the given circle given whilst other candidates did not attempt the question at all.

E10. The most common successful approach was to multiply πR^2 by 150/360, although a few candidates did the equivalent by dividing by 2.4. Common errors included assuming the sector was one third of a circle or just working out the area of a circle. Some candidates halved the given 13 and thought that the radius was 6.5 cm.

E11. This was the first question, in which the majority of the candidates were clearly out of their depth, unless they were working towards grade C standard. This was also the first question with a significant number of non-attempts. There was a preponderance of area formulae, and much confusion about whether to use 8 or 16 in either the area or circumference formula. Other problems occurred where candidates used an incorrect value for π, and rounded answers to the nearest whole number without working shown.

E12. **Foundation**

There was a wide variety of incorrect answers to this question although most candidates were able to score at least one mark, generally for sight of 12 × 12 (although it was disturbing to note how many candidates wrote 12 × 12 = 48 even when they could use a calculator and that 42% of the candidates scored no marks at all!). 108 was a common incorrect answer from 144 – 6^2. A significant number were not able to find the area of the square, let alone the area of the circle. Many candidates realised they had to use π for the area of the circle but then used the formula for the circumference of the circle. As a result it was not uncommon to see an answer of 106.3. Others squared π or used π in their attempt at finding the area of the square! However just over 20% of the candidates did score all 4 available marks which was pleasing to see.

Higher

Most students managed to correctly find the area of the square as 12squared or 12 × 12, a common error was to double 12 instead of squaring. Others found the perimeter rather than the area. A significant number of candidates either used 6squared or 2 × pi × 6 for the area of the circle. For the final method mark, some candidates didn't realise they had to subtract. Most who gained the 3 method marks also gained the accuracy mark. The transcription error of 133(..) instead of 113(..) was frequently seen and led to some candidates losing the final accuracy mark. The correct answer was seen from about 57% of candidates.

E13. This question was reported by many as being a good discriminator.

The most efficient way to tackle the question was to realise that the angle of the sector was 60.This enabled the candidates to use the $\frac{1}{2}ab\sin C$ formula for the triangle. However many candidates resorted to the cosine rule to find it or decided because it was a sixth of the circle they needed to use sin 6. A number of candidates were able to calculate one of the areas correctly; more frequently the sector, and then the subtraction carried out. The most common error was to use half base × height for the triangle area, using 6 as the height. Some did use Pythagoras to find the height but often made errors. Quite a few found one or other of the two areas and offered this as their answer.

E14. Specification A

Foundation

Very few correct answers were seen. The errors made by candidates were many and common, including incorrect choice of formula to use (πr^2 quoted and used incorrectly) use of 8 as a radius, incorrect values of π used (though given on the front of the paper), failure to divide by 2, and leaving the answer as the arc, without adding on the straight edge to give the total perimeter.

Higher

A significant number of candidates were unable to gain any marks in this question, this was frequently due to the formula for the area of a circle being used. Common errors were forgetting to halve the circumference, confusing the radius with the diameter or most commonly forgetting to add on the diameter. Many candidates just found the length of the arc rather than the perimeter of the shape.

Specification B

Foundation

The penultimate question on the paper proved to be a challenge for most of the students with nearly 80% of the students failing to make a valid start on this question. Finding half the circumference of a circle was recognised as in $\pi \times 8$ and then dividing this result by 2. It was the next stage that seemed to lie outside the experience of the student as they failed to grasp that they needed to add on the diameter in order to find the perimeter of the tile. There were a number of candidates who used πr^2 to find the perimeter, scoring no marks. Others showed $\pi \times 4$ but then proceeded to divide this by 2, clearly showing they did not know which formula to use.

Higher

Successful candidates saw that they had to find half the circumference and then add on the diameter to get the base. The others unusually fell into 3 categories and gained 2, 1 or 0 marks as appropriate. Firstly, there were those who found the arc length correctly, but did not add on the base (2marks). Secondly, there were those who found the circumference of the full circle, but then did nothing else (1 mark). Thirdly, were the candidates who either confused perimeter with area or confused the formula for the circumference of a circle with the formula for its area. (0 marks).

E15. In part (a) it was obvious that many candidates did not have a compass, and therefore wasted this mark. Those who did have a compass usually presented an accurate circle. In part (b) it was surprising the number of candidates who failed to draw a diameter. A common error was predictably the drawing of a radius, but many drew the diameter as a chord, perhaps through the letter C rather than the centre X, or left the question blank.