16		eg $8\times4.5=3CP$ or $\frac{8}{3}=\frac{CP}{4.5}$ or $\frac{8}{3}=\frac{x+(x+3)}{4.5}$ $\frac{8}{3}=\frac{r+(r-3)}{4.5}$ oe		4	M1 for forming a correct equation. Using the chord theorem.
		$[CP=]\frac{8\times4.5}{3}[=12]$ or $r=\frac{8\times4.5+3}{3\times2}[=7.5]$ or $x=\frac{8\times4.5-3}{3\times2}[=4.5]$			M1 for a correct expression for *CP* May be seen on diagram
		[circumference =] $\pi\times(\text{"12"}+3)$ oe $2\times\pi\times\text{"7.5"}$ or $2\pi\times(\text{"4.5"}+3)$			M1 ft their *CP* if it comes from correct working or is clearly labelled or on the diagram. Allow 3.14… or $\frac{22}{7}$ for π
			47.1		A1 awrt 47.1 or 15π
		cas			**Total 4 marks**

Question	Working	Answer	Mark	Notes

17	(a)	$\left[\overrightarrow{OB} =\right]\begin{pmatrix}3\\-2\end{pmatrix}-\begin{pmatrix}5\\-9\end{pmatrix}$ or $\begin{pmatrix}3\\-2\end{pmatrix}+\begin{pmatrix}-5\\9\end{pmatrix}$ or		2	M1 for a correct method to find $\overrightarrow{OB}$ or may be implied by one correct value ie $\begin{pmatrix}-2\\...\end{pmatrix}$ or $\begin{pmatrix}...\\7\end{pmatrix}$ or for $\begin{pmatrix}7\\-2\end{pmatrix}$ Must be seen on (a)
			$\begin{pmatrix}-2\\7\end{pmatrix}$		A1
	(b)	$\sqrt{("-2")^2+"7"^2}\ [=7.28...]$ oe		2	M1 allow use of 2 rather than –2 and –7 rather than 7. May be implied by a correct answer or awrt 7.28 Condone missing brackets around negative values. Only ft their values from (a) or $\overrightarrow{OB}$ found in (b) if working shown (allow $\pm$ their values)
			$\sqrt{53}$		A1 ft their answer (as a simplified surd) to (a) or $\overrightarrow{OB}$ found in (b) Do not ISW. This mark implies the M1 If no working is shown you may need to check.
		cas			**Total 4 marks**

Question	Working	Answer	Mark	Notes

18	(a)		$30 < h \leqslant 40$	1	B1 condone $\leqslant$ for $<$ and vice versa
	(b)	$5 \times 2 + 15 \times 26 + 25 \times 10 + 35 \times 24 + 45 \times 18$ (= 2300) $10 + 390 + 250 + 840 + 810$ (= 2300)		4	M2 for at least 3 correct products using midpoints with intention to add. (M1 for at least 3 products using frequency and a value within the interval with the intention to add. (allow use of upper/lower class bound) **or** for at least 3 correct products using midpoints without adding)
		$\frac{"10 + 390 + 250 + 840 + 810"}{80}\left[=\frac{"2300"}{80}\right]$			M1 dep on at least M1 being awarded
			28.75		A1oe allow $\frac{115}{4}$ or 28.7 or 28.8 or (29 from correct working)
		cas			**Total 5 marks**

Question		Working	Answer	Mark	Notes
19		$2x+3+5x-12+3x+1=32$ oe eg $10x-8=32$		5	M1 for setting up an equation. Implied by $x = 4$
		$x=\frac{32+8}{10}\left[=4\right]$ oe or 7**T** vanilla = 13 oe			M1 rearranging to find a correct expression for x or for 7T vanilla
		$\frac{80}{360}\times 45\ (=10)$ oe			M1 Correct method to find the number for vanilla for **8Y eg** $45-\frac{280}{360}\times 45$
		$3\times"4"+1-"10"$ or			M1 dependent on the 1st and 3rd M1 being awarded. Allow an answer of 3 or a correct method to find their difference. Ft their value of x and 10 if clearly labelled or come from correct working.
			3		A1 dependent on 1st and 3rd method mark being awarded. **NB** the number 3 can be gained from incorrect working, so need to check it. If no working is shown then award 5/5
					Total 5 marks

Question	Working	Answer	Mark	Notes

20	(a)	$7+3y=2(4y-7-5)$ oe or $7+3y+2\times5=2(4y-7)$ oe or $\frac{7}{2}+\frac{3}{2}y+5=4y-7$ oe		3	M1 for dealing with the fraction (of 0.5) correctly. Condone missing brackets if they have recovered.
		$3y-8y=-14-10-7$ oe eg $5y=31$ or $\frac{7}{2}+5+7=4y-\frac{3}{2}y$ oe			M1ft previous stage as long as at least 4 terms to deal with – for collecting terms in y on one side and number terms the other side
		wr	6.2		A1 dep on both the previous 2 Marks being awarded oe eg $\frac{31}{5}$
	(b)	$-35=8x-2\times-4.5$ oe or $x=\frac{A+2w}{8}$		2	M1 for a correct substitution into the given formula or for a correct rearrangement of the formula to make x the subject
		cas	–5.5		A1 oe eg $\frac{-44}{8}$ or $\frac{-11}{2}$
					Total 5 marks

Que	Working	Ans	M	Notes

21	eg $\{2\pi r^2$ **and** $2\pi(3r)^2\}$ **or** $\left\{2\pi\left(\frac{R}{3}\right)^2 \text{ and } 2\pi R^2\right\}$ **or** $2R^2+R^2+2r^2-r^2$ **or** $2\pi R^2+\pi R^2+2\pi r^2-\pi r^2$ **or** $2(3)^2+(3)^2+2(1)^2-(1)^2$ **or** $2\pi(3)^2+\pi(3)^2+2\pi(1)^2-\pi(1)^2$ oe		5	M1 surface areas of both hemispheres seen (need not be added and may be part of an equation) Or for a correct formula for the total surface area. Allow $\{2\pi(nr)^2$ **and** $2\pi(mr)^2\}$ or $2(m)^2+m^2+2(n)^2-(n)^2$ or $2\pi(m)^2+\pi m^2+2\pi(n)^2-\pi(n)^2$ where $m=3n$ Allow use of other letters May be implied by the 2nd M1
	$2\pi r^2+2\pi(3r)^2+\pi(3r)^2-\pi r^2=567\pi$ oe or $2\pi R^2+2\pi\left(\frac{R}{3}\right)^2+\pi R^2-\pi\left(\frac{R}{3}\right)^2=567\pi$ oe or $2(3)^2+(3)^2+2(1)^2-(1)^2:567$ $2\pi(3)^2+\pi(3)^2+2\pi(1)^2-\pi(1)^2:567\pi$			M1 a correct equation for the surface area of the solid eg $2(nr)^2+2(3nr)^2+(3nr)^2-(nr)^2=567$ or $28\pi r^2=567\pi$ or $28r^2=567$ or $2R^2+2\left(\frac{R}{3}\right)^2+R^2-\left(\frac{R}{3}\right)^2=567$ Allow $2x^2+2(y)^2+(y)^2-x^2=567$ $2(y)^2+(y)^2+2(x)^2-(x)^2:567$ where $y=3x$ This implies the 1st M1
	$[r=]$ 4.5 **or** $[R=]$ 13.5			M1 for a correct value of the radius for either hemisphere. This implies the 2nd M1
	$\frac{1}{2}\times\frac{4}{3}\pi\times"4.5"^3+\frac{1}{2}\times\frac{4}{3}\pi\times"13.5"^3 \left[=\frac{243}{4}\pi+\frac{6561}{4}\pi\right]$			M1 a fully correct method to find the volume of the solid dep on at least one of the previous Method marks being awarded and is equivalent to $\frac{1}{2}\times\frac{4}{3}\pi\times"m"^3+\frac{1}{2}\times\frac{4}{3}\pi\times"3m"^3$ where m is a number (award 4 marks for 1701π)
	wr	5340		A1 awrt to 5340 dependent on at least the 3rd M1 mark being awarded from correct working (5343.8….)
				Total 5 marks

Question		Working	Answer	Mark	Notes
22	(a)	$5\sqrt{2}+11\sqrt{2}$ [$=16\sqrt{2}$] or $\sqrt{50+242+2\sqrt{50\times242}}=\left[\sqrt{512}\right]$		2	M1 writing $\sqrt{50}$ and $\sqrt{242}$ in the form $c\sqrt{2}$ and adding or for $16\sqrt{2}$ or for using $\sqrt{\left(\sqrt{50}+\sqrt{242}\right)^2}$ and multiplying out or $\sqrt{512}$
		cas	$8\sqrt{8}$		A1cao allow $a = 8$
	(b)	$\frac{12}{\sqrt{5}-1}\times\frac{\sqrt{5}+1}{\sqrt{5}+1}$ or $\frac{12}{\sqrt{5}-1}\times\frac{-\sqrt{5}-1}{-\sqrt{5}-1}$		3	M1 multiply numerator and denominator by $\sqrt{5}+1$ or $-\sqrt{5}-1$
		$\frac{12\left(\sqrt{5}+1\right)}{5-1}$ or $\frac{12\left(\sqrt{5}+1\right)}{4}$ or $\frac{12\sqrt{5}+12}{5-1}$ or $\frac{12\sqrt{5}+12}{4}$ or $\frac{12\left(-\sqrt{5}-1\right)}{-5+1}$ or $\frac{12\left(-\sqrt{5}-1\right)}{-4}$ or $\frac{-12\sqrt{5}-12}{-5+1}$ or $\frac{-12\sqrt{5}-12}{-4}$			M1 dep on previous M mark being awarded. denominator may be 4 terms which need to all be correct eg. $\frac{12\left(\sqrt{5}+1\right)}{5+\sqrt{5}-\sqrt{5}-1}$
		wr	$3\sqrt{5}+3$		A1 dep on both the previous marks being awarded. Allow $y = 3$ and $x = 5$ or $3+3\sqrt{5}$ do not allow $3\left(\sqrt{5}+1\right)$ and do not ISW
					Total 5 marks

Question	Working	Answer	Mark	Notes