Question		Working	Answer	Mark	Notes
4	(a)		275	1	B1
	(b)	eg 'it would mean $n^2 = -9$ which is not possible' **or** ' all numbers are greater than 100' oe		1	B1 a correct reason (which needs to refer to a value other than 37) eg • $n^2 = -9$ **or** $n = \sqrt{-9}$ or $7n^2 = -63$ **and** idea this is not possible (eg n^2 cannot be negative or n or $n^2 \geqslant 0$ or needs to be a whole number/positive • numbers cannot be less than 100 • numbers are > 100 or $\geqslant 100$ • numbers are $\geqslant 107$ or > 107 • the smallest value is 107 • the first term is 107 **and** terms increase /don't decrease
					Total 2 marks

Question		Working	Answer	Mark	Notes
5		6 180 000 000 oe eg 6.18×10^9 **or** 61.8×10^8 **or** 20 600 000 oe eg 20.6×10^6 **or** 2.06×10^n where $n \neq 7$ **or** $2\times10^7 + 0.6\times10^6$ or $2\times10^7 + 6\times10^5$ **oe**		2	M1 allow for a correct numerator in any form or for a correct answer in any form or for 2.06×10^n where n is an integer $\neq 7$ or for a correct sum with the fraction removed
			2.06×10^7		A1 Do not ISW mark their answer on the answer line or if no answer on the answer line their final answer.
		cas			**Total 2 marks**

Question		Working	Answer	Mark	Notes
6		$6a^4c$ or $46656a^{24}c^6$ or $36^3a^{24}c^6$ or $6^6a^{24}c^6$		2	M1 for correctly applying the power of 3 or the power of a 0.5 to all 3 terms or for an expression of 3 terms in the form ma^pc^q with 2 of m, p and q correct or $a^{12}c^3$
			$216a^{12}c^3$		A1 ISW Do not allow $6^3a^{12}c^3$
		cas			**Total 2 marks**

Question		Working	Answer	Mark	Notes
7		$\frac{9}{4}[\div]\frac{15}{7}$ oe		3	M1 for writing both mixed numbers as improper fractions. Do not need the division sign. Implied by the 2nd M1
		eg $\frac{9}{4}\times\frac{7}{15}$ oe eg $\frac{135}{60}\times\frac{28}{60}$ oe			M1 for inverting the 2nd fraction and showing multiplying or for writing the improper fractions over a common denominator
			$\frac{63}{60}=1\frac{1}{20}$ or $\frac{21}{20}=1\frac{1}{20}$		A1 dependent on both Method marks being awarded. For completion to the correct answer with full working shown. We need to see the improper fraction followed by the mixed number
		wr			**Total 3 marks**

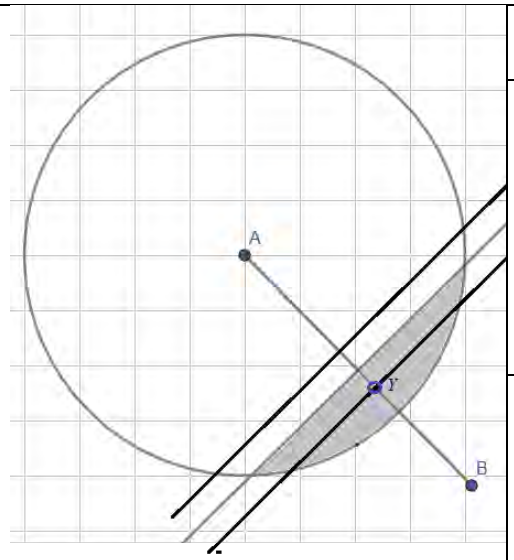
Question		Working	Answer	Mark	Notes
8		$3\times12x^2$ or $36x^2$		3	M1 for differentiating the first term correctly
		$\left[\frac{16}{x^2}=\right]16x^{-2}$			M1 for rewriting the second term as $16x^{-2}$ This can be seen anywhere including in an expression for dy/dx May be implied by $-2\times16x^{-3}$ oe
			$36x^2-32x^{-3}$		A1 oe eg $36x^2-\frac{32}{x^3}$ Need not be simplified eg allow $3\times12x^2-2\times16\times x^{-3}$
		cas			**Total 3 marks**

Question	Working	Answer	Mark	Notes

9		39.5, 40.5, 2.15, 2.25, 0.55, 0.65		3	M1 one correct bound allow $40.4\dot{9}$ for 40.5, $2.24\dot{9}$ for 2.25, $0.64\dot{9}$ for 0.65
		$\frac{UB_a}{LB_c - UB_f}$ where $\frac{(40 < UB_a \leqslant 40.5)}{(2.15 \leqslant LB_c < 2.2) - (0.6 < UB_f \leqslant 0.65)}$			M1 where $40 < UB_a \leqslant 40.5$ and $2.15 \leqslant LB_c < 2.2$ and $0.6 < UB_f \leqslant 0.65$
			$\frac{40.5}{2.15 - 0.65} = 27$		A1 for 26.97 to 27 if all correct figures seen in the equation. Allow $40.4\dot{9}$ for 40.5 and $0.64\dot{9}$ for 0.65
		wr			**Total 3 marks**

Question		Working	Answer	Mark	Notes
10			$y \geqslant -1$	4	B1 oe accept > for $\geqslant$
			$x + 2y \leqslant 8$		B1 oe eg $y \leqslant 4 - \frac{x}{2}$ accept < for $\leqslant$
		eg $y = 2x + 3$ or $y - 2x = 3$ or $y - (1) = 2(x - (-1))$ oe			M1 for the correct equation for the line written in any form. eg with any sign ($= > < \geqslant \leqslant$)
			$y \leqslant 2x + 3$		A1 oe allow equivalent inequality eg $y - 2x \leqslant 3$ or $y - (1) \leqslant 2(x - (-1))$ accept < for $\leqslant$
		SC if $y \leqslant -1$ and $x + 2y \geqslant 8$ and $y \geqslant 2x + 3$ score B2. Allow correct sign without the =			
		cas			**Total 4 marks**

Question	Working	Answer	Mark	Notes

11	(a)		a circle centre *A* with radius 4 cm	1	B1 full circle. Radius 4cm (allow if closer to *Y* than to *B*)
	(b)		a correct bisector with arcs shown	2	B2 for a correct bisector with 2 pairs of arcs Allow if it is only one side of the line *AB* (use overlay) (NB may use the circle as one of the pair of arcs) (B1 for a bisector without the arcs or only one pair drawn or correct arcs without bisector drawn (must cross with in the lines on overlay or would if they were extended))
	(c)		correct region indicated	1	B1 dep on at least B1 being awarded in (b) for the bisector drawn. For the correct region between the bisector and the circle identified. Allow if a partial circle around *A* is drawn which intersects with their bisector twice and at least B1 awarded for the bisector drawn. NB if they do not shade and just label *R* they need to put *R* both sides of the line *AB* (if they have drawn the line *AB*)
					Total 4 marks

Q	Working	Answer	Mark	Notes
12	eg $x^2 + x^2 = 12.6^2$ or $\left[AC^2 =\right](0.5\times12.6)^2 + (0.5\times12.6)^2 \left[= 39.69 + 39.69^2 = 79.38\right]$ or eg $\sin 45 = \frac{AC}{12.6}$ or $\cos 45 = \frac{AC}{12.6}$ or $\cos 45 = \frac{6.3}{AC}$ or $\sin 45 = \frac{6.3}{AC}$ oe		4	M1 for a correct statement using Pythagoras or trigonometry to find side *AB*/*AC* NB do not award for $AB^2 + AC^2 = 12.6^2$ unless made clear *AB* = *AC*. Allow *AB* instead of *AC* May be Implied by the 2nd M1
	$\left[x =\right]\sqrt{\frac{12.6^2}{2}} = \left[\sqrt{\frac{3969}{25}} = 8.909\ldots\right]$ or $\left[AC =\right]\sqrt{(0.5\times12.6)^2 + (0.5\times12.6)^2}$ [= 8.9090…] or $\left[AB / AC =\right]12.6\times\sin 45$ or $12.6\times\cos 45$ $\left[AC / AB =\right]\frac{6.3}{\cos 45}$ or $\frac{6.3}{\sin 45}$			M1 dependent on 1st M1 for a correct method to find *AB* or *AC* Allow for 8.9 or better (actual 8.909545…) or $\frac{63\sqrt{2}}{10}$ Allow 9 if $x^2 = 79.3...$ is seen
	$2\times$"8.909…"$+12.6$			M1 independent of the previous method marks. Allow $\frac{63 + 63\sqrt{2}}{5}$ For using $2\times n + 12.6$ where $6.3 < n < 12.6$ If *n* is incorrect, working must be shown
		30.4		A1 awrt 30.4 (actual 30.41909…)
	cas			**Total 4 marks**

Qu	Working	Ans	Mar	Notes

13	$[QR=]\dfrac{8}{\tan 40}$ **or** $\tan 40=\dfrac{8}{QR}$ or $\tan 50=\dfrac{QR}{8}$ or $\dfrac{QR}{\sin 50}=\dfrac{8}{\sin 40}$ oe $[PR=]\dfrac{8}{\sin 40}$ or $\dfrac{8}{\cos 50}$ $(=12.445\ldots)$ or $\sin 40=\dfrac{8}{PR}$ or $\cos 50=\dfrac{8}{PR}$ oe		4	M1 for a correct method or expression to find *QR* **or** *PR*. Allow any letter(s) for *QR*/*PR* or mislabelling or equivalents eg $[QR=]\ 8\tan 50(=9.534...)$ If no working shown allow for awrt 12 or awrt 10
	eg $[QR=]\dfrac{8}{\tan 40}(=9.534...)$ **AND** $[PR=]\dfrac{8}{\sin 40}$ or $\dfrac{"QR"}{\cos 40}$ $(=12.445\ldots)$ oe **or** $[QR=]\dfrac{8}{\tan 40}(=9.534...)$ **AND** $[PR=]\sqrt{8^2+"9.534..."^2}$ $(=12.445\ldots)$ oe **or** $[PR=]\dfrac{8}{\sin 40}(=12.445\ldots)$ **AND** $[QR=]\sqrt{"12.445..."^2-8^2}(=9.534...)$ oe **or** area of $PTR=0.5\times\pi\times\left(\dfrac{"12.445..."}{2}\right)^2$ $[=60.8...]$ **or** area of $PQR=\dfrac{1}{2}\times 8\times"9.534..."$ **or** $\dfrac{1}{2}\times 8\times"12.445..."\times\sin(90-40)$ **or** $\dfrac{1}{2}\times"12.445..."\times"9.534..."\sin 40$ $[=38.1...]$			M1 dependent on first M1 being awarded for a correct method or expression to find *QR* **AND** *PR* or 0.5*PR*. Allow equivalent expressions eg those allowed for the 1st M1 **NB** $\dfrac{PR}{\sin 90}=\dfrac{QR}{\sin 50}=\dfrac{8}{\sin 40}$ oe gains M1M1 **or** for a correct method to find the area of the semicircle *PTR* or a correct method to find area of *PQR* using their *PR* (from correct working) and *PQ* = 8 Allow numbers written to 1 dp. When finding the areas "12.445" or "9.534" must come from correct working.
	$0.5\times"9.534\ldots"\times 8+0.5\times\pi\times\left(\dfrac{"12.445"}{2}\right)^2$ or $0.5\times 8\times"12.445..."\sin(50)+0.5\times\pi\times\left(\dfrac{"12.445"}{2}\right)^2$ or $0.5\times"12.445..."\times"9.534..."\sin(40)+0.5\times\pi\times\left(\dfrac{"12.445"}{2}\right)^2$			M1 correct method to find the whole area. If working is shown ft their *PR*(diameter) and/or *PQ* if clearly labelled or marked on the diagram or comes from correct working. Allow $\dfrac{"12.445..."}{2}$ or "6.22…" for the radius.
		99		A1 awrt 99 or awrt 98
	cas			**Total 4 marks**

Question	Working	Answer	Mark	Notes

14		eg $6x + 18y = 42$ or $10x + 30y = 70$ $6x + 10y = 20$ $18x + 30y = 60$ or eg $3\left(\frac{14-6y}{2}\right)+5y=10$ or $3x+5\left(\frac{14-2x}{6}\right)=10$		4	M1 For balancing the equations (only condone one arithmetic error in multiplication). **and** correct operation to eliminate selected variable applied to all terms in their 2 equations) **or** writing x or y in terms of the other variable and correctly substituting to gain an equation in one variable
			$x = -1.25$ or $y = 2.75$		A1 oe one correct value dep on M1 Allow fractions eg $-\frac{7}{4}$ and $\frac{11}{4}$
		eg $2\times"-1.25"+6y=14$ oe or $3x+5\times"2.75"=10$ oe			M1 (dep) correct method to find second variable – could start process again or use substitution. Dependent on previous M mark being awarded. If the value used is incorrect you may need to check their answer if full working not shown.
			$x = -1.25$ and $y = 2.75$		A1 oe for both correct values dep on at least one of the method marks being awarded. If switched on the answer line allow if seen correct in working
		wr			**Total 4 marks**

Question	Working	Answer	Mark	Notes

15		$c^2 = \frac{3y+5}{8-y}$ oe or $c\sqrt{8-y} = \sqrt{3y+5}$		4	M1 for either squaring both sides to remove the square root or removing the denominator of the expression.
		$8c^2 - c^2y = 3y + 5$ or $8 - y = \frac{3y}{c^2} + \frac{5}{c^2}$ or $8 - y = \frac{3y+5}{c^2}$ oe			M1 dependent on 1st M1 being awarded. For squaring both sides to remove the square root and removing the terms in *y* from the denominator of the expression and expanding to gain a correct equation. Implies the previous M1
		$8c^2 - 5 = 3y + c^2y$ oe or $-c^2y - 3y = -8c^2 + 5$ oe or $c^2y + 3y = 8c^2 - 5$ oe or $y(-c^2 - 3) = -8c^2 + 5$ oe or $-\frac{3y}{c^2} - y = \frac{5}{c^2} - 8$ oe			M1 for collecting the *y* terms on one side of the equation with the other terms on the other side. Allow one sign error If the 2nd M1 has not been awarded then ft their equation providing the equation has 4 distinct terms with exactly 2 in terms of *y*. Allow one sign error
			$y = \frac{8c^2 - 5}{3 + c^2}$		A1 oe eg $y = \frac{5 - 8c^2}{-c^2 - 3}$ or $y = \frac{8 - \frac{5}{c^2}}{\frac{3}{c^2} + 1}$ oe (NB: if the final answer is missing *y* =…but is otherwise correct , award full marks if *y* = a correct expression has been seen in the working otherwise do not ISW)
		cas			**Total 4 marks**

Question	Working	Answer	Mark	Notes

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