Question Number	Scheme	Marks
8a	$x\left(x^3-\frac{7}{2}x-5\right)=\frac{15}{2}-5x$ $\Rightarrow 2x^4-7x^2-15=0$ *	M1 A1*
		(2)
b	$(2x^2+3)(x^2-5)=0\Rightarrow\left(x^2=\right)...$	M1
	$\left(x=\right)\ \ (\pm)\sqrt{5}$	B1
	$y=\frac{15}{2\times"\pm\sqrt{5}"}-5=...$ or $y=\left("\pm\sqrt{5}"\right)^3-\frac{7}{2}\left("\pm\sqrt{5}"\right)-5$	M1
	$\left(-\sqrt{5},-\frac{3}{2}\sqrt{5}-5\right)\quad\left(\sqrt{5},\frac{3}{2}\sqrt{5}-5\right)$ $PQ=\sqrt{("2\sqrt{5}")^2+("3\sqrt{5}")^2}=...$	dM1
	$PQ=\sqrt{65}$	A1cao
		(5)
		(7 marks)

(a)

M1: Sets up a correct equation in x. Invisible brackets may be implied by further work.

e.g. $x^4-\frac{7}{2}x^2-5x=\frac{15}{2}-5x$

A1*: Multiplies out and rearranges the equation to achieve the given answer with no errors seen including invisible brackets. Condone the implied = 0 in their working, provided it is present in their final answer. There must be at least one stage of intermediate working between their starting equation and proceeding to the given answer.

$x^4-\frac{7}{2}x^2-5x=\frac{15}{2}-5x\Rightarrow 2x^4-7x^2-15=0$ is M1A0*

(b) **Work for (b) may be seen in (a) which can score**

M1: Attempts to solve the quadratic equation in x^2 by either

- factorising
- completing the square
- quadratic formula

Usual rules apply. Do not be too concerned by the labelling e.g. it is acceptable to use a different variable as well as condoning $y=x^2$ and $x=x^2$

This mark cannot be awarded from directly using a calculator and stating the roots.

B1: At least one of $\sqrt{5}$ and $-\sqrt{5}$ (and no others)

M1: **Note that if they do not square root their solution to the quadratic in x^2 then this mark cannot be scored (and no further marks).**

Attempts to substitute in $\pm\sqrt{"5"}$ (which must be of the form $+k\sqrt{b}$ and $-k\sqrt{b}$ where k may be 1) into either of the equations of the curves and proceeds to find irrational expressions for the y coordinates of P and Q of the form $\pm5\pm n\sqrt{"5"}$ (which may be the same for both). They cannot be decimals.

May be seen as e.g. $\left(-\sqrt{5},\frac{-3\sqrt{5}-10}{2}\right)\quad\left(\sqrt{5},\frac{3\sqrt{5}-10}{2}\right)$

dM1: A full attempt to find the length *PQ*. It is dependent on the previous method mark.

- They must be using $(k\sqrt{b}, \pm 5 \pm n\sqrt{b})$, $(-k\sqrt{b}, \pm 5 \pm n\sqrt{b})$ or equivalent.
- Look for an expression for *PQ* of the form e.g.
  $$\sqrt{\left((k\sqrt{b} - -k\sqrt{b})\right)^2 + \left((\pm 5 \pm n\sqrt{b}) - (\pm 5 \pm n\sqrt{b})\right)^2}$$
- They must be attempting to find $(x_2 - x_1)^2$ for their *x* coordinates which would lead to $\pm 2k\sqrt{b}$ but condone ambiguity in the location of negatives when calculating $(y_2 - y_1)^2$.

  e.g. $x = \pm\sqrt{5}$: $\sqrt{\left((\sqrt{5} - -\sqrt{5})\right)^2 + \left(-\frac{10+3\sqrt{5}}{2} - \frac{-10+3\sqrt{5}}{2}\right)^2}$ scores B1M1dM1

  e.g. $x = \pm\sqrt{11}$ $\sqrt{\left((-\sqrt{11} - \sqrt{11})\right)^2 + \left(\frac{110+15\sqrt{11}}{22} - \frac{-110-15\sqrt{11}}{22}\right)^2}$ scores B0M1dM1

  (as their $(x_2 - x_1)^2$ is correct for their $\pm\sqrt{"5"}$ and we condone sign errors when finding $(y_2 - y_1)^2$ using their *y* coordinates of *P* and *Q*)
- If the subtractions are not shown then they must achieve either of the following:
  - $\sqrt{(2k\sqrt{b})^2 + (2n\sqrt{b})^2}$ (*n* does not have to be an integer) or equivalent
  - $\sqrt{(2k\sqrt{b})^2 + 0^2}$ (where the *y* coordinates were the same)
    (They must have still found the *y* coordinates to score this mark)

Do not condone invisible brackets unless it does not affect the processing. This mark may be implied by their answer.

A1: $\sqrt{65}$ cao (**this cannot be scored if the first method mark has not been scored**)

Question Number	Scheme	Marks
9a	$0.72 = OP \times 0.6 \Rightarrow OP = 1.2$ **or** $\frac{0.72}{0.6} = 1.2$ **or** $0.72 = 1.2 \times 0.6 \Rightarrow OP = 1.2$ *	B1*
		(1)
b	$\frac{1}{2} \times (x+1.2)^2 \times 0.6$	B1
	$\frac{1}{2} \times (x+1.2)^2 \times 0.6 - \frac{1}{2} \times 1.2^2 \times 0.6 = 90 \Rightarrow 5x^2 + 12x - 1500 = 0$ *	M1A1*
		(3)
c	$x =$ awrt 16.2 $\left(= \frac{-6 + 4\sqrt{471}}{5} \right)$	B1
	Perimeter $= 0.72 + "16.2" + "16.2" + 0.6 \times ("16.2" + 1.2) =$ awrt 43 / awrt 44 m (see notes)	M1A1
		(3)
		(7 marks)

(a)

B1*: Either

- forms an equation using $l = r\theta$ with $l = 0.72$ and $\theta = 0.6$ and concludes $OP = 1.2$ e.g. $0.72 = r \times 0.6 \Rightarrow r = 1.2$
- states $\frac{0.72}{0.6} = 1.2$
- forms the equation using $0.72 = 1.2 \times 0.6$ and concludes that $OP = 1.2$

Condone the use of *r* or any other variable instead of *OP*. Condone lack of units or incorrect units.

Allow the angle to be in degrees instead or attempts to find the diameter first, but they must not round the value at any point in their working.

e.g. $0.72 = \frac{\frac{0.6}{\pi} \times 180}{360} \pi d \Rightarrow d = 2.4 \Rightarrow r = 1.2$ scores B1 (exact angle used)

e.g. $\frac{0.72}{\left(\frac{34.4}{360}\right)} = 2\pi r \Rightarrow r = 1.2$ scores B0 (34.4 is a rounded angle)

(b)

B1: Correct expression for the area of sector *OPQRSO*

$\frac{1}{2} \times (x+1.2)^2 \times 0.6$ Missing brackets may be implied by further work.

May appear within an equation e.g. $\frac{1}{2} \times 0.6\left[(x+1.2)^2 - 1.2^2\right] = 90$

Condone incorrect equations i.e. $\frac{1}{2} \times (x+1.2)^2 \times 0.6 = 90$

M1: Proceeds from an equation of the form $...(x \pm 1.2)^2 \times 0.6 - ... \times 1.2^2 \times 0.6 = 90$ or equivalent, (i.e. both should be positive but may be missing e.g. ½) and attempts to multiply out the brackets. Condone slips and invisible brackets.