Question Number	Scheme	Marks
5.	(a) $30 = 2y + 2x + \pi x$	M1
	$2y = 30 - 2x - \pi x$	
	$y = 15 - x - \frac{1}{2}\pi x$ oe	A1
	(b) $A = 2xy + \frac{1}{2}\pi x^2$	
	$= x(30 - 2x - \pi x) + \frac{1}{2}\pi x^2$	M1
	$= 30x - 2x^2 - \frac{1}{2}\pi x^2$ *	A1
	(c) $\frac{dA}{dx} = 30 - 4x - \pi x$	M1
	At maximum, $\frac{dA}{dx} = 0 \Rightarrow 30 - 4x - \pi x = 0$	M1
	$\Rightarrow x = \frac{30}{4+\pi}[= 4.201]$	A1
	$\frac{d^2A}{dx^2} = -4 - \pi < 0 \Rightarrow$ maximum	M1 A1
	Maximum area $= 30\left(\frac{30}{4+\pi}\right) - 2\left(\frac{30}{4+\pi}\right)^2 - \frac{1}{2}\pi\left(\frac{30}{4+\pi}\right)^2 = 63$ to 2SF	M1 A1 (11)

Notes for Question 5

(a) M1 for setting up the equation $30 = 2y + 2x + \pi x$ ...Allow with a circle (ie $2\pi x$) and the missing side (4x instead of 2x)

A1cao for re-arranging to get $y = 15 - x - \frac{1}{2}\pi x$ oe

(b) M1 for $A = 2xy + \frac{1}{2}\pi x^2$ and sub **their** expression for y (semicircle or circle πx^2 for M1)

A1cso for $A = 30x - 2x^2 - \frac{1}{2}\pi x^2$ *

NB: Watch for double sign errors in (a) and (b) and deduct A marks as appropriate.

(c)

M1 for differentiating the **given** expression for A wrt x

M1 for equating **their** differential to 0 (NB this is not a dependent M mark)

A1 for obtaining $x = \frac{30}{4+\pi}$

M1 for attempting the second differential

A1 for stating this differential is negative, so a maximum, **providing** the second differential is correct. A **correct** differential with no mention of $\frac{d^2A}{dx^2}$ can get M1A1

Alternatives for the last two marks:

M1 for testing the sign of $\frac{dA}{dx}$ on either side of **their** x. Numerical calculations must be seen. Only one turning point so values chosen need not be close to their x.

A1 for correct results and the conclusion, **providing** $\frac{dA}{dx}$ is correct

OR: M1 Graph of $A = 30x - 2x^2 - \frac{1}{2}\pi x^2$ is a parabola/quadratic opening downwards (must be stated or a sketch shown)

A1 turning point is therefore a maximum.

Then:

M1 for substituting **their positive** x in the **given** expression for A.

A1cao for $A_{max} = 63$ (cm^2) **Must be 2 sf.**