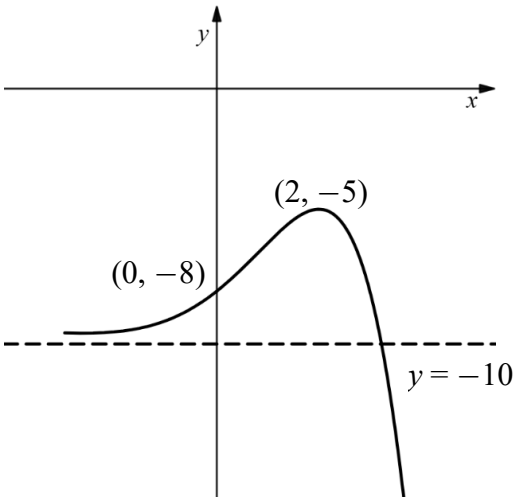
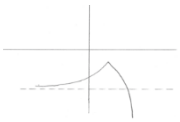
(d)		Shape	B1
		(0, −8) and (2, −5)	B1
		Asymptote	B1
			(3)
			(7 marks)

(d) Notes

There must be a sketch to score any marks.
If the original curve is included on their sketch it can be ignored.
If more than 1 sketch is given, mark the final attempt.

B1: For a reflection of the original curve in the x-axis.
The curve must be in quadrants 3 and 4 only.
There should be a maximum in quadrant 4.

Condone a maximum that is cusp-like e.g.  as long as the intention is clear.

The right hand tail should be below the left hand tail i.e. must at least touch the asymptote if it was drawn.
Condone a right hand tail that starts to bend to the right as long as it does not head back towards the x-axis to create a clear minimum.
The coordinates of the y intercept, the maximum and the position of the asymptote can be ignored for this mark.

B1: For the intercept of $(0, -8)$ and the maximum point $(2, -5)$ correctly labelled that correspond with the sketch.

Allow -8 marked in the correct place and condone $(-8, 0)$ as long as it is the correct place.

Allow the $(2, -5)$ to be indicated by the labels 2 and -5 on the appropriate axes.

Allow to appear away from the sketch but they must be fully correct.
If there is any ambiguity, the sketch takes precedence.

B1: For the asymptote equation of $y = -10$ that corresponds with their sketch.

It must be an **equation** i.e. not just -10 marked on the y-axis.

The curve must be asymptotic to $y = -10$ from above for one of the branches.

See extra document for some example sketches.

Question Number	Scheme	Marks
6(a)	$\frac{\sin DAO}{1.8}=\frac{\sin 0.84}{3.9}\Rightarrow DAO=$ awrt 0.351 (NB $\sin DAO = 0.343681\ldots$)	M1A1
		(2)
(b)	Angle $ADO=\pi-0.84-'0.351'=(1.95)$	M1
	Uses $AO^2=1.8^2+3.9^2-2\times1.8\times3.9\cos'1.95'\Rightarrow AO=...$	M1
	$AO=$ awrt 4.86 (m)	A1
		(3)
	(b) Alternative 1	
	$3.9^2=1.8^2+AO^2-2\times1.8\times AO\cos 0.84$	M1
	$AO^2-2.41AO-11.97=0\Rightarrow AO=4.86,$ ~~$\geqslant 2.46$~~	M1A1
	(b) Alternative 2	
	$1.8^2=3.9^2+AO^2-2\times3.9\times AO\cos"0.351"$	M1
	$AO^2-7.32AO+11.97=0\Rightarrow AO=4.86,$ ~~2.46~~	M1A1
	(b) Alternative 3	
	$ON=1.8\cos 0.84$ or $AN=3.9\cos"0.351"$ (See diagram below for position of N)	M1
	$AO=1.8\cos 0.84+3.9\cos"0.351"=...$	M1
	$AO=$ awrt 4.86 (m)	A1

Notes

(a)

M1: Uses the sine rule in an attempt to find angle DAO which is not their sin DAO.
The sides and angles must be in the correct position within the formula.

A1: Proceeds correctly to obtain $DAO=$ awrt 0.351

Do not be concerned with incorrect labels or notation e.g. $AOD=$ awrt 0.351 if the intention is clear.

For the rest of the question, allow the method marks for the use of what they think is angle *DAO* e.g. even if they use 0.3436…

(b)

M1: States or uses angle $ADO=\pi-0.84-$ their 0.351 (Must be seen in (b))
May be implied by ADO = awrt 1.95 (rads) or by their value.

M1: Uses $AO^2=1.8^2+3.9^2-2\times1.8\times3.9\cos(k\pi-0.84-\text{their } 0.351)$ or

$\frac{AO}{\sin(k\pi-0.84-\text{their } 0.351)}=\frac{3.9}{\sin 0.84}$ with $k = 1$ or 2 in an attempt to find a value for AO.

A1: For $AO=$ awrt 4.86 (m) Units are not required but if any are given they must be correct.

Alternative 1:

M1: Sets up a correct quadratic equation in AO using the cosine rule with angle AOD.

M1: Collects terms, simplifies and solves a 3TQ in AO or their variable.

A1: For $AO=$ awrt 4.86 (m) Units are not required but if any are given they must be correct.

Alternative 2:

M1: Sets up a correct quadratic equation in AO using the cosine rule with angle DAO.

M1: Collects terms, simplifies and solves a 3TQ in AO or their variable.

A1: For $AO=$ awrt 4.86 (m) Units are not required but if any are given they must be correct.

Alternative 3:

M1: Correct attempt at either ON or AN

M1: Complete method to find a value for AO

A1: For $AO =$ awrt 4.86 (m) Units are not required but if any are given they must be correct.

Must come from correct work in part (a) unless they re-start.

(c)	Area of sector $=\frac{1}{2}\times 1.8^2\times(2\pi-0.84)$ $(=\text{awrt } 8.8)$ (NB $2\pi-0.84=5.44318...$) **or** Area of triangle $=\frac{1}{2}\times 1.8\times\text{"4.9"}\times\sin 0.84$ $(=\text{awrt } 3.3)$ Or Area of triangle $=\frac{1}{2}\times 1.8\times 3.9\times\sin(\pi-0.84-\text{"0.351"})$ $(=\text{awrt } 3.3)$	M1
	Total Area $=\frac{1}{2}\times 1.8^2\times(2\pi-0.84)+\frac{1}{2}\times 1.8\times\text{"4.9"}\times\sin 0.84=...$	**d**M1
	= 12.1 (m^2)	A1
		(3)
(d)	Arc $BCD=$ $1.8\times(2\pi-0.84)$ $(=9.8)$	M1
	'9.8'+3.9+"4.86"−1.8=... or e.g. $2\pi\times 1.8-0.84\times 1.8+\text{"4.86"}-1.8+3.9=...$	**d**M1
	Perimeter of shop sign = 16.8 (m)	A1
		(3)
		(11 marks)

Notes

(c)

M1: Correct attempt at the area of sector *DOBCD* **or** the area of triangle *ADO* following through their *AO* from part (b). There may be other methods seen for these areas e.g.

The area of the sector may be seen as $\pi\times 1.8^2-\frac{1}{2}\times 1.8^2\times 0.84$

The area of the triangle may be seen as $\frac{1}{2}\times 1.8\times 3.9\times\sin(\pi-0.84-\text{"0.351"})$ or

$\frac{1}{2}\times(1.8\cos 0.84+3.9\cos\text{"0.351"})\times 1.8\sin 0.84$ or $=\frac{1}{2}\times 3.9\times\text{"4.86"}\times\sin\text{"0.351"}$

dM1: Complete and correct attempt at the area of the shop sign e.g.

$\frac{1}{2}\times 1.8^2\times(2\pi-0.84)+\frac{1}{2}\times 1.8\times\text{"4.9"}\times\sin 0.84$

Depends on the previous mark.

A1: For awrt 12.1 Units are not required but if any are given they must be correct.

Note that it is also possible via Circle + Triangle – Minor sector

e.g. $\pi\times 1.8^2+\frac{1}{2}\times 1.8\times\text{"4.9"}\times\sin 0.84-\frac{1}{2}\times 1.8^2\times 0.84$

In these cases, the scheme can be applied in the same way i.e. M1 for area of Circle – Minor sector or area of triangle and **d**M1 for a complete and correct method Circle + Triangle – Minor sector

Must come from correct work in part (a) unless they re-start.

(d)

M1: Attempt to find the length of the major arc using a correct method.

Accept $1.8\times(2\pi-0.84)$ or equivalent e.g. $2\pi\times 1.8-0.84\times 1.8$

dM1: Complete and correct method for the perimeter.

A1: Awrt 16.8 Units are not required but if any are given they must be correct.

Must come from correct work in parts (a) and (b) unless they re-start.