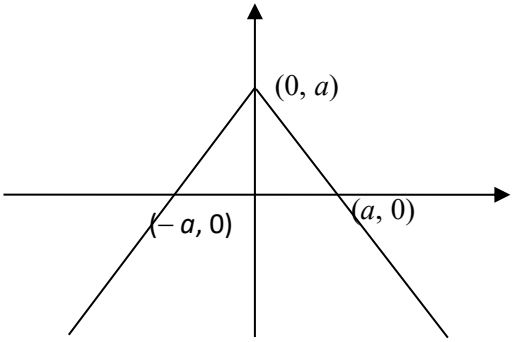
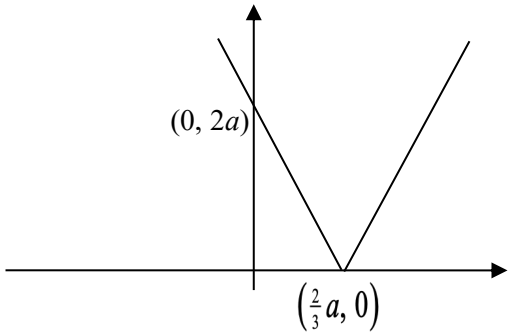
Question Number	Scheme		Marks
8(a) (i)		Correct $\wedge$ shape, any position	B1
		Correct diagram with intercepts correctly placed	B1
(ii)		Correct $\vee$ shape, any position	B1
		Correct diagram with intercepts correctly placed	B1
			(4)
(b)	$a-x=3x-2a \Rightarrow x=...$ **or** $a-x=-3x+2a \Rightarrow x=...$		M1
	$x=\frac{3}{4}a$ **or** $x=\frac{1}{2}a$		A1
	$a-x=3x-2a \Rightarrow x=...$ **and** $a-x=-3x+2a \Rightarrow x=...$		dM1
	$x=\frac{3}{4}a$ **and** $x=\frac{1}{2}a$		A1
			(4)
			(8 marks)

Notes

(a)(i)

B1: For a correct $\wedge$ shape in any position. Condone if not quite symmetric.

B1: Fully correct sketch, and must continue below the x axis, with correct intercepts in terms of a either marked on the graph or correctly stated. No need for the 0 coordinate if labelled on the graph. Condone coordinates the wrong way round (eg $(a,0)$ instead of $(0, a)$) only if they are in the correct positions on the graph. Condone if not quite symmetric.

(ii)

B1: For a correct v shape in any position, condone if it does not cross the y axis. Condone if not quite symmetric. Condone a Y shape as benefit of doubt as an attempt to form the graph.

B1: Fully correct sketch, must continue into second quadrant with same conditions for intercepts as above. Condone if not quite symmetric.

If multiple graphs are drawn on the same axes in (a), if they are labelled score for the graph labelled with correct function/part number. If there is no labelling you may apply bod for the first B only.

(b)

M1: Attempts to solve either correct equation. Must come from correct modulus work (bod if no incorrect work is seen). Watch out for

$a - |x| = |3x - 2a| \Rightarrow a - |x| = 3|x| - 2|a| \Rightarrow 3a = 4x \Rightarrow x = \frac{3}{4}a$ which obtains a correct answer from incorrect work.

A1: One correct value from a correct equation.

dM1: Attempt to solve both correct equations, which may be amidst other work – again both must come from correct work.

A1: Both values correct and no other values. Any other values must have been rejected.

NB: Attempts via squaring may be seen. This will work since both solutions are positive (can be deduced from the sketch) and so $x > 0$ gives $|x| = x$. Score as follows

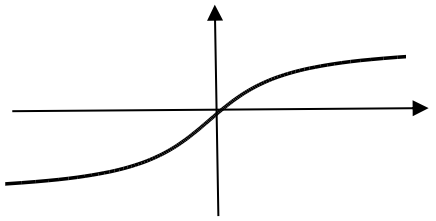
M1: Attempts to square producing a correct equation.

$x > 0 \Rightarrow |x| = x \Rightarrow (a - |x|)^2 = (3x - 2a)^2 \Rightarrow a^2 - 2ax + x^2 = 9x^2 - 12ax + 4a^2$

A1: Solves to produce at least one correct solution $\Rightarrow 8x^2 - 10ax + 3a^2 \Rightarrow x = \frac{3}{4}a$ or $x = \frac{1}{2}a$

dM1: Attempts to solve their correct equation (look for factorisation or formula attempts, though may contain errors simplifying an initially correct equation).

A1: $x = \frac{3}{4}a$ **and** $x = \frac{1}{2}a$ and no other x values. Ignore any y values found for these coordindates.

Question Number	Scheme		Marks
9 (a)		Curve thro (0,0) in quad 1 and 3 and is increasing	M1
		Gradient $\to 0$ as $x \to \pm\infty$	A1
			(2)
(b)	$3\arctan(x+1)-\pi=0 \Rightarrow \arctan(x+1)=\frac{\pi}{3} \Rightarrow x+1=\tan\left(\frac{\pi}{3}\right)$		M1
	$\Rightarrow (x+1)=\tan\left(\frac{\pi}{3}\right) \Rightarrow x=\tan\left(\frac{\pi}{3}\right)-1=\sqrt{3}-1$		A1
			(2)
(c)	$f(x)=\pm\left(\arctan x-4+\frac{1}{2}x\right) \Rightarrow f(5)=\mp 0.126..,\ f(6)=\pm 0.405\ldots$		M1
	Since f(x) is continuous and changes sign over the interval (5,6), so there is a root in this interval [so $5<\alpha<6$]		A1
			(2)
(d)	$x_1=8-2\arctan 5$		M1
	x_1 = cao 5.2532, α = awrt 5.2358		A1, A1
			(3)
			(9 marks)

Notes

(a)

M1: Any mostly increasing curve (allowing tolerance of slight curvature at the ends) through (0,0) and that lies entirely in quadrants 1 and 3 with no clear vertical asymptote(s).

A1: Fully correct sketch with the correct curvature. Asymptotes need not be drawn but the curve must be flattening out at either end. Do not allow for curves that clearly turn back on themselves.

(b)

M1: Proceeds to $\arctan(x+1)=\frac{\pi}{3}$ codoning sign/coefficient slip rearranging and attempts to take tan of both sides. Accept seeing $\pm\sqrt{3}$ or $\pm\frac{1}{\sqrt{3}}$ (awrt 1.73 or 0.577) as evidence if method not shown.

A1: $\sqrt{3}-1$ only. A0 if other solutions are given.

(c)

M1: Substitutes $x=5$ and $x=6$ into $\pm\left(\arctan x-4+\frac{1}{2}x\right)$ and achieves one value correct to at least 1 sf rounded or truncated (evidence of clearly incorrect values that happen to round to 1s.f. is M0). A tighter range may be used, but must include the root.

A1: For achieving

- both values correct (to at least one s.f. as per the M)
- a correct reason e.g. change of sign (accept <0, >0 shown) **and** reference to being a continuous function (condone poor spelling)
- a minimal conclusion, e.g. root, or so $5<\alpha<6$

(d)

M1: Applies the iteration formula once to achieve a correct expression for x_1 or awrt 5.3 or awrt 5.2 before finding the root.

A1: 5.2532 cao A1: awrt 5.2358 provided the M is scored.