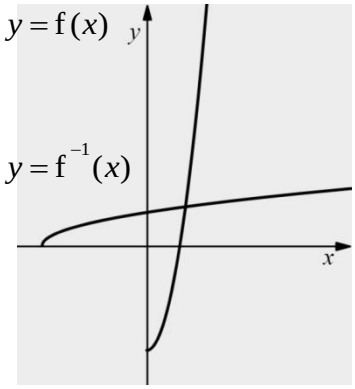
Question Number	Scheme	Marks
4.(a)	$f \geqslant -5$	B1 **(1)**
(b)	 Curve starting on negative x-axis and passing through positive y-axis, in quadrants 1 and 2 only. Shape and position correct.	M1 A1 **(2)**
(c)	$2x^2 - 5 = x$ or $2x^2 - 5 = \sqrt{\frac{x+5}{2}}$ or $x = \sqrt{\frac{x+5}{2}}$ or $2\left(2x^2-5\right)^2 - 5 = x$	B1
	Full attempt to solve $2x^2 - x - 5 = 0 \Rightarrow x = ...$ exact	M1
	$x = \frac{1+\sqrt{41}}{4}$	A1
		(3) **6 marks**

Notes

(a) Mark the question as a whole - if (c) answered as (b) allow the marks.

B1 Correct range. Accept $y \geqslant -5$, $f(x) \geqslant -5$, $f \in [-5, \infty)$ or correct formal set notation but not just $x \geqslant -5$.

(b) Note: if a sketch is redrawn score for the sketch of the inverse only.

M1 For a curve starting on the negative x- axis and passing through the positive y - axis, in quadrants 1 and 2 only.

A1 Correct shape (curvature) and position. Must be increasing (not bending back on itself) with decreasing gradient, though be tolerant with pen slips at the end. Do not penalise incorrect intercepts.

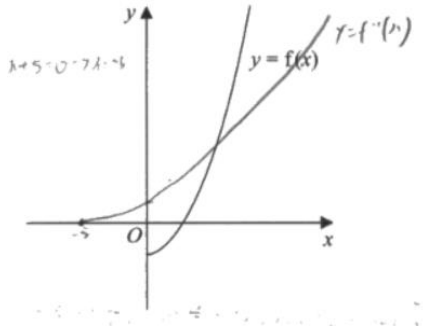
(c)

B1 Sets up a correct equation for the solution, as shown in scheme or equivalents. Should be an equation but allow "=0" implied if there is an attempt to solve. Just $2x^2 - x - 5$ is B0 with no further working.

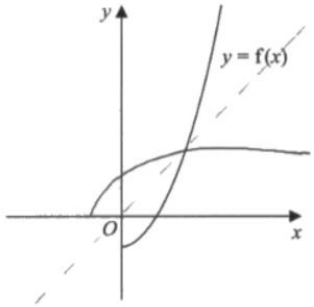
M1 Full attempt to solve a correct equation leading to exact answers.Attempts via $f(x) = f^{-1}(x)$ (oe) will lead a quartic $\left(8x^4 - 40x^2 - x + 45 = 0 \text{ if correct}\right)$ but will likely not lead to exact answers.
Note exact answers following a quadratic is fine, but method should be shown for a quartic.
Decimal answer only is M0.

A1 $x = \frac{1+\sqrt{41}}{4}$ ONLY.

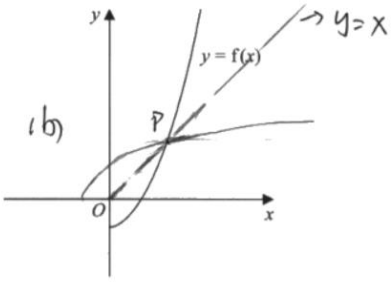
Some examples of curves for question 4(b).



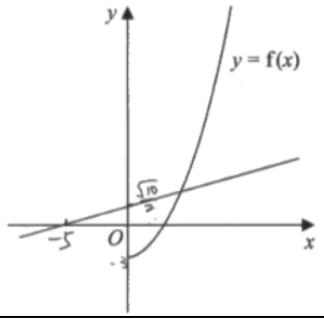
M1A0: Meets conditions for M1 but gradient not decreasing.



M1A1bod: Curve slips downward at the end due to slip of pen. This is a borderline case.



M1A1bod: Gradient is decreasing on the whole.



M0A0: Does not start on negative *x*-axis. Curvature would be unacceptable.

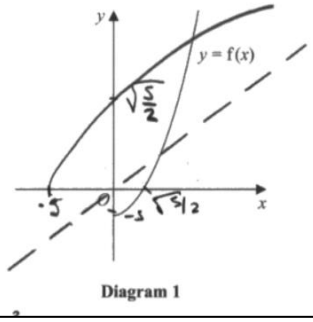
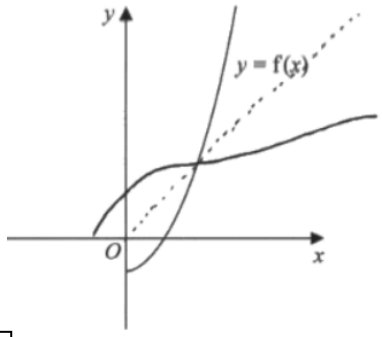
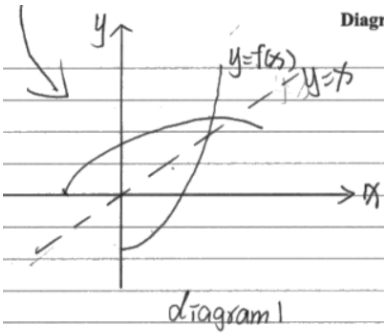


Diagram 1

M1A1bod: Position and curvature correct – ignore possible $y = x$ line, mark the curve.



M1A0: Meets condition for M1 but curvature out of tolerance, gradient increases after intersection.



M1A0: Curve is clearly going downward on the right-hand side.

Question Number	Scheme	Marks
5 (i)	States $x = 2$	B1
	$\sqrt{3}\sec x + 2 = 0 \Rightarrow \cos x = -\dfrac{\sqrt{3}}{2} \Rightarrow x = ...$	M1
	$x = \dfrac{5\pi}{6}$	A1
		(3)
(ii)	Attempts to use $\cos 2\theta = 1 - 2\sin^2\theta$	M1
	$6\sin^2\theta + 10\sin\theta - 3 = 0$	A1
	$\sin\theta = \dfrac{-5 \pm \sqrt{43}}{6} \left(= -1.926..., 0.2595...\right) \Rightarrow \theta = \arcsin(...)$	M1
	$\theta = 15.0°, 165°$	A1
		(4)
		(7 marks)

Notes

(i)

B1 States $x = 2$. May be seen anywhere in (i) and don't be concerned where it comes from.

M1 For a correct process to solve $\sqrt{3}\sec x + 2 = 0$ E.g. $\sec x = \dfrac{1}{\cos x} \Rightarrow \cos x = -\dfrac{\sqrt{3}}{2} \Rightarrow x = ...$ Allow slips in rearranging but must attempt to solve $\cos x = k, |k| < 1$ or $\sec x = k, |k| > 1$ Degree value ($150°$) following a correct equation implies the M mark. Note some may use $\sec^2 x = 1 + \tan^2 x$ and form a quadratic in tan *x*. These will need a correct identity, correct method to solve a quadratic (which may be by calculator) and attempt to solve $\tan x = k,\ k \neq 0$

A1 $x = \dfrac{5\pi}{6}$ and no other extra solutions in the range. Accept awrt 2.62 (and isw).

Note that $\sqrt{3}\sec x + 2 = 0 \rightarrow x = \dfrac{5\pi}{6}$ can score M1A1 as no incorrect work is seen, method implied.

Question required working to be shown $x = \dfrac{5\pi}{6}$ without seeing at least $\sqrt{3}\sec x + 2 = 0$ extracted first is M0A0.

(ii)

M1 Attempts to use $\cos 2\theta = \pm 1 \pm 2\sin^2\theta$ to form a quadratic equation in $\sin\theta$. If using alternative forms for the identity, must also use $\cos^2\theta = 1 - \sin^2\theta$ before gaining this mark.

A1 Correct 3 term quadratic equation $6\sin^2\theta + 10\sin\theta - 3 = 0$ or a multiple of this. Alternatively may be scored for $6\sin^2\theta + 10\sin\theta = 3$ if followed by completing the square on LHS to solve.

M1 Full attempt to find one value for θ from a quadratic in sinθ. Must involved

- correct method to solve the quadratic in sinθ (usual rules, may use calculator) to produce a value for sinθ
- use of arcsin(..) to reach the value for θ (you may need to check the values if arcsin(…) is not shown). Radian answers can imply the mark (awrt 0.263, 2.88 if correct).

May be scored from an incorrect identity as long as a quadratic is achieved. Accept arcsin expression for the M

A1 θ =awrt $15.0°, 165°$ and no other solutions in the range. Accept just $15°$ for $15.0°$ (but not awrt $15°$ if it does not round to $15.0°$)

Condone a different variable used than θ throughout.