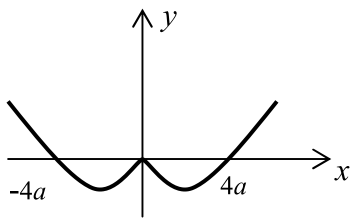
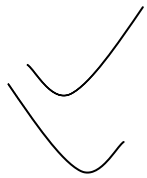
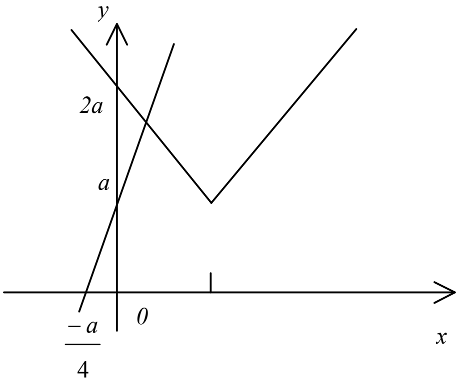
Question Number	Scheme	Marks
1. (*a*)	Using $x^2 - 1 \equiv (x-1)(x+1)$ somewhere in solution	M1
	Using a common denominator e.g. $\frac{x-(x-1)}{(x-1)(x+1)}$	M1
	Clear, sound, complete proof of $f(x) = \frac{1}{(x-1)(x+1)}$	A1 (3)
(*b*)	Range of f is y, where $y > 0$	B2 (2)
	If $y \geq 0$ given allow B1.	
(c)	$gf(x) = g = g\left(\frac{1}{(x-1)(x+1)}\right) = 2(x-1)(x+1)$	M1 A1
	M1 requires correct order and $g(x) = \frac{2}{x}$ used	
	$2(x-1)(x+1) = 70$	M1
	M1 is independent of previous work	
	$x = 6$ (treat -6 extra as ISW)	A1 (4)
		(9 marks)
2.	$\frac{y+3}{(y+1)(y+2)} - \frac{y+1}{(y+2)(y+3)} \equiv \frac{(y+3)^2-(y+1)^2}{(y+1)(y+2)(y+3)}$	M1
	$\equiv \frac{(y^2+6y+9)-(y^2+2y+1)}{(y+1)(y+2)(y+3)} \equiv \frac{4y+8}{(y+1)(y+2)(y+3)}$	M1 A1
	$\equiv \frac{4(y+2)}{(y+1)(y+2)(y+3)} \equiv \frac{4}{(y+1)(y+3)}$ or $\frac{4}{y^2+4y+3}$	M1, A1
		(5 marks)

Question Number	Scheme	Marks
3. (*a*)		
	 $x>0$	B1
	$x<0$	B1 ft
	$(4a, 0)$ & $(-4a, 0)$ and shape at $(0,0)$	B1 (3)
(*b*)	$f(2a) = (2a)^2 - 4a(2a) = 4a^2 - 8a^2 = -4a^2$	B1
	$f(-2a)[= f(2a)$ ($\because$ even function) $] = -4a^2$	B1 (2)
(*c*)	$a = 3$ and $f(x) = 45 \Rightarrow 45 = x^2 - 12x$ $(x > 0)$	M1
	$0 = x^2 - 12x - 45$	
	$0 = (x - 15)(x + 3)$	M1
	$x = 15$ (or -3)	A1
	$\therefore$ Solutions are $x = \pm 15$ only	A1 (4)
		(9 marks)
4. (*a*)	Attempting to reach at least the stage $x^2(x + 1) = 4x + 1$	M1
	Conclusion (no errors seen) $x = \sqrt{\dfrac{4x+1}{x+1}}$ (*)	A1 (2)
	[Reverse process: need to square and clear fractions for M1]	
(*b*)	$x_2 = \sqrt{\dfrac{4+1}{1+1}} = 1.58\ldots$	M1
	$x_3 = 1.68$, $x_4 = 1.70$	A1A1 (3)
	[Max. deduction of 1 for more than 2 d.p.]	
(*c*)	Suitable interval; e.g. [1.695, 1.705] (or "tighter")	M1
	$f(1.695) = -0.037\ldots$, $f(1.705) = +0.0435\ldots$	M1
	Change of sign, no errors seen, so root = 1.70 (correct to 2 d.p.)	A1 (3)
(*d*)	$x = -1$, "division by zero not possible", or equivalent	B1, B1 (2)
	or any number in interval $-1 < x < -\frac{1}{4}$, "square root of neg. no."	
		(10 marks)

Question Number	Scheme	Marks
5. (*a*)		
	V shape right way up	B1
	vertex in first quadrant	B1
	g	B1
	-1 eeoo; $2a,\ a, -\frac{a}{4}$	B2 (1, 0) (5)
(*b*)	$4x + a = (a - x) + a$	M1
	$5x = a, \qquad x = \frac{a}{5}$	M1
	$y = \frac{9a}{5}$	A1 (3)
(*c*)	$\text{fg}(x) = \lvert 4x + a - a\rvert + a = \lvert 4x\rvert + a$	M1 A1 (2)
(*d*)	$\lvert 4x\rvert + a = 3a \quad \Rightarrow \quad \lvert 4x\rvert = 2a$	M1
	$x = \frac{a}{2}, -\frac{a}{2}$	A1, A1 (3)
		(13 marks)
6. (*a*)	$\text{f}(3.1) = 10 + \ln 9.3 - \frac{1}{2}\text{e}^{3.1} = 1.131$	
	$\text{f}(3.2) = 10 + \ln 9.6 - \frac{1}{2}\text{e}^{3.2} = -0.0045$	M1
	Sign change, so $3.1 < k < 3.2$	A1 (2)
(*b*)	$\text{f}'(x) = \frac{1}{x} - \frac{1}{2}\text{e}^x$	(3)
(*c*)	$\text{f}(1) = 10 + \ln 3 - \frac{1}{2}\text{e}$	B1
	$\text{f}'(x) = 1 - \frac{1}{2}\text{e}$	B1
(i)	$y - (10 + \ln 3 - \frac{1}{2}\text{e}) = (1 - \frac{1}{2}\text{e})(x - 1)$	M1
(ii)	$x = 0$: $y = 10 + \ln 3 - \frac{1}{2}\text{e} - 1 + \frac{1}{2}\text{e}$	M1
	$= 9 + \ln 3$	A1 (5)
		(10 marks)

Question Number	Scheme	Marks
7. (*a*)	$\sin x + \sqrt{3}\cos x = R\sin(x + \alpha)$	
	$= R(\sin x\cos\alpha + \cos x\sin\alpha)$	M1
	$R\cos\alpha = 1,\ R\sin\alpha = \sqrt{3}$	A1
	Method for R or α, e.g. $R = \sqrt{(1 + 3)}$ or $\tan\alpha = \sqrt{3}$	M1
	Both $R = 2$ and $\alpha = 60$	A1 (4)
(*b*)	$\sec x + \sqrt{3}\operatorname{cosec} x = 4 \Rightarrow \dfrac{1}{\cos x} + \dfrac{\sqrt{3}}{\sin x} = 4$	B1
	$\Rightarrow \sin x + \sqrt{3}\cos x = 4\sin x\cos x$	M1
	$= 2\sin 2x$ (*)	M1 (3)
(*c*)	Clearly producing $2\sin 2x = 2\sin(x + 60)$	A1 (1)
		(8 marks)