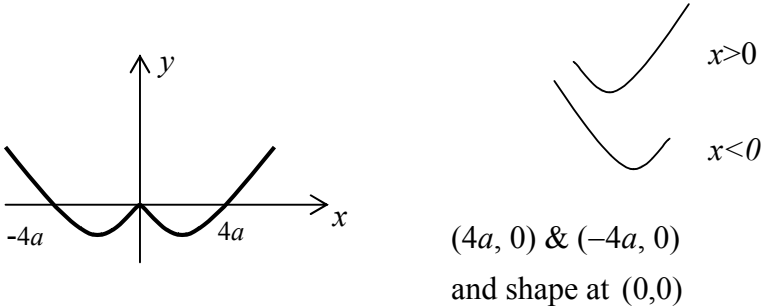
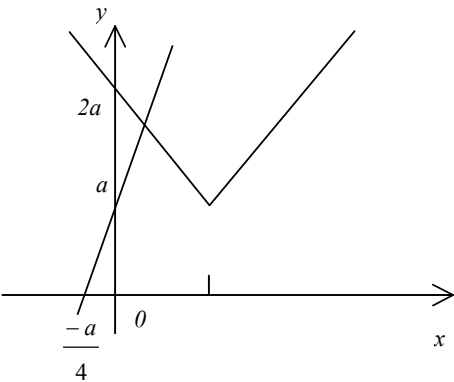


Question Number	Scheme	Marks
<p><b>1.</b> (a)</p> <p>(b)</p> <p>(c)</p>	<p>Using <math>x^2 - 1 \equiv (x - 1)(x + 1)</math> somewhere in solution</p> <p>Using a common denominator e.g. <math>\frac{x - (x - 1)}{(x - 1)(x + 1)}</math></p> <p>Clear, sound, complete proof of <math>f(x) = \frac{1}{(x - 1)(x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

Question Number	Scheme	Marks
<p>3. (a)</p> <div style="text-align: center;">  </div>	<p>(4a, 0) &amp; (-4a, 0) and shape at (0,0)</p> <p>(b) <math>f(2a) = (2a)^2 - 4a(2a) = 4a^2 - 8a^2 = -4a^2</math></p> <p><math>f(-2a) [= f(2a) (\because \text{even function}) ] = -4a^2</math></p> <p>(c) <math>a = 3</math> and <math>f(x) = 45 \Rightarrow 45 = x^2 - 12x</math> (<math>x &gt; 0</math>)</p> <p style="margin-left: 40px;"><math>0 = x^2 - 12x - 45</math></p> <p style="margin-left: 40px;"><math>0 = (x - 15)(x + 3)</math></p> <p style="margin-left: 40px;"><math>x = 15</math> (or -3)</p> <p><math>\therefore</math> Solutions are <math>x = \pm 15</math> only</p>	<p>B1</p> <p>B1 ft</p> <p>B1 (3)</p> <p>B1</p> <p>B1 (2)</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>A1 (4)</p> <p><b>(9 marks)</b></p>
<p>4. (a)</p> <p>(b)</p> <p>(c)</p> <p>(d)</p>	<p>Attempting to reach at least the stage <math>x^2(x + 1) = 4x + 1</math></p> <p>Conclusion (no errors seen) <math>x = \sqrt{\frac{4x + 1}{x + 1}}</math> (*)</p> <p>[Reverse process: need to square and clear fractions for M1]</p> <p><math>x_2 = \sqrt{\frac{4 + 1}{1 + 1}} = 1.58\dots</math></p> <p><math>x_3 = 1.68, \quad x_4 = 1.70</math></p> <p style="text-align: center;">[Max. deduction of 1 for more than 2 d.p.]</p> <p>Suitable interval; e.g. [1.695, 1.705] (or “tighter”)</p> <p><math>f(1.695) = -0.037\dots, \quad f(1.705) = +0.0435\dots</math></p> <p>Change of sign, no errors seen, so root = 1.70 (correct to 2 d.p.)</p> <p><math>x = -1</math>, “division by zero not possible”, or equivalent</p> <p>or any number in interval <math>-1 &lt; x &lt; -1/4</math>, “square root of neg. no.”</p>	<p>M1</p> <p>A1 (2)</p> <p>M1</p> <p>A1A1 (3)</p> <p>M1</p> <p>M1</p> <p>A1 (3)</p> <p>B1, B1 (2)</p> <p><b>(10 marks)</b></p>

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

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