

	Give 1 mark for each •	Illustration(s) for awarding each mark
1(a)	<b>ans: Proof</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> knows to find determinant</li> <li>•<sup>2</sup> correct algebra</li> <li>•<sup>3</sup> conclusion</li> </ul>	<b>(3 marks)</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> <math>x-2 \begin{vmatrix} x-1 &amp; 3 \\ 1 &amp; 2 \end{vmatrix} + \begin{vmatrix} 1 &amp; 3 \\ 2 &amp; x \end{vmatrix} + 2 \begin{vmatrix} 1 &amp; x-1 \\ 2 &amp; 1 \end{vmatrix}</math></li> <li>•<sup>2</sup> <math>(x-2)(x^2-x-3) + (x-6) + 2(3-2x)</math></li> <li>•<sup>3</sup> <math>x^3 - 3x^2 - 4x + 6</math></li> </ul>
	<b>(b) ans: <math>x = 1</math></b> <ul style="list-style-type: none"> <li>•<sup>1</sup> knows to let <math>\det(A) = 0</math></li> <li>•<sup>2</sup> solves cubic equation</li> <li>•<sup>3</sup> answer</li> </ul>	<b>(3 marks)</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> nested calculation</li> <li>•<sup>2</sup> <math>(x-1)(x^2 - 2x - 6) = 0</math></li> <li>•<sup>3</sup> <math>x = 1, x^2 - 2x - 6</math> has no solution</li> </ul>
2(a)	<b>ans: <math>\text{gcd} = 37</math></b> <ul style="list-style-type: none"> <li>•<sup>1</sup> method</li> <li>•<sup>2</sup> remaining steps</li> <li>•<sup>3</sup> answer</li> </ul>	<b>(3 marks)</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> <math>592 = 1 \times 407 + 185</math></li> <li>•<sup>2</sup> <math>407 = 2 \times 185 + 37; 185 = 5 \times 37 + 0</math></li> <li>•<sup>3</sup> <math>\text{gcd} = 37</math></li> </ul>
	<b>(b) ans: <math>x = 3, y = 2</math></b> <ul style="list-style-type: none"> <li>•<sup>1</sup> method</li> <li>•<sup>2</sup> complete process</li> </ul>	<b>(2 marks)</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> <math>37 = 407 - 2(185); 37 = 407 - 2(592 - 407)</math></li> <li>•<sup>2</sup> <math>37 = 3 \times 407 - 2 \times 592</math></li> </ul>
3	<b>ans: Proof</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> prove true for <math>n = 1</math></li> <li>•<sup>2</sup> assume true for <math>n = k</math></li> <li>•<sup>3</sup> considers <math>n = k + 1</math></li> <li>•<sup>4</sup> simplifies</li> <li>•<sup>5</sup> statement</li> </ul>	<b>(5 marks)</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> LHS = RHS = 1</li> <li>•<sup>2</sup> <math>\frac{k}{2}(19k-17)</math></li> <li>•<sup>3</sup> <math>\sum_{r=1}^k (19r-18) + (19(k+1)-18)</math></li> <li>•<sup>4</sup> <math>\frac{k+1}{2}(19(k+1)-17)</math></li> <li>•<sup>5</sup> valid for <math>n=1 \dots\dots\dots</math></li> </ul>
4.	<b>ans: <math>x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \frac{x^5}{5}</math></b> <ul style="list-style-type: none"> <li>•<sup>1</sup> finds <math>f(0)</math> and <math>f'(0)</math></li> <li>•<sup>2</sup> finds <math>f''(0)</math></li> <li>•<sup>3</sup> finds values for higher order derivatives</li> <li>•<sup>4</sup> method</li> <li>•<sup>5</sup> final statement</li> </ul>	<b>(5 marks)</b> <ul style="list-style-type: none"> <li>•<sup>1</sup> <math>f(0) = 0</math> and <math>f'(0) = 1</math></li> <li>•<sup>2</sup> <math>f''(0) = -1</math></li> <li>•<sup>3</sup> 2, -6 and 24</li> <li>•<sup>4</sup> <math>f(x) \approx f(0) + f'(0)x + \frac{f''(0)x^2}{2!} + \dots</math></li> <li>•<sup>5</sup> <math>\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \frac{x^5}{5}</math></li> </ul>

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5(a)	<p>ans: <math>\frac{\sqrt{75}}{2} = \frac{5\sqrt{3}}{2}</math></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> finds direction vectors</li> <li>•<sup>2</sup> use vector product correctly</li> <li>•<sup>3</sup> knows how to find the area</li> <li>•<sup>4</sup> finds area</li> </ul>	<p style="text-align: right;">(4 marks)</p> <ul style="list-style-type: none"> <li>•<sup>1</sup> <math>\vec{PQ} = \begin{pmatrix} -1 \\ 2 \\ -1 \end{pmatrix}</math> and <math>\vec{PR} = \begin{pmatrix} 1 \\ 5 \\ 2 \end{pmatrix}</math></li> <li>•<sup>2</sup> <math>\vec{PQ} \times \vec{PR} = \begin{vmatrix} i &amp; j &amp; k \\ -1 &amp; 2 &amp; -1 \\ 1 &amp; 5 &amp; 2 \end{vmatrix} = 9i + j - 7k</math></li> <li>•<sup>3</sup> <math>A = \frac{1}{2} 9i + j - 7k </math></li> <li>•<sup>4</sup> <math>\frac{\sqrt{75}}{2} = \frac{5\sqrt{3}}{2}</math></li> </ul>
(b)	<p>ans: <math>9x + y - 7z = 17</math></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> knows to use vector product for normal</li> <li>•<sup>2</sup> uses coefficients of <math>n</math> for equation of plane</li> <li>•<sup>3</sup> finds value of <math>k</math></li> </ul>	<p style="text-align: right;">(3 marks)</p> <ul style="list-style-type: none"> <li>•<sup>1</sup> <math>n = 9i + j - 7k</math></li> <li>•<sup>2</sup> <math>9x + y - 7z = k</math></li> <li>•<sup>3</sup> <math>k = 9(2) + (-1) - 7(0) = 17</math></li> </ul>
(c)	<p>ans: <math>(-15, -9, -23)</math></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> writes equation in parametric form</li> <li>•<sup>2</sup> subst. parametric into equation of plane</li> <li>•<sup>3</sup> finds <math>t</math></li> <li>•<sup>4</sup> finds point of intersection</li> </ul>	<p style="text-align: right;">(4 marks)</p> <ul style="list-style-type: none"> <li>•<sup>1</sup> <math>x = 1 + 2t; y = t - 1; z = 1 + 3t</math></li> <li>•<sup>2</sup> <math>9(1 + 2t) + (t - 1) - 7(1 + 3t) = 17</math></li> <li>•<sup>3</sup> <math>t = -8</math></li> <li>•<sup>4</sup> <math>x = -15; y = -9; z = -23</math></li> </ul>
6	<p>ans: <math>x = -7</math> or <math>x = 2</math></p> <ul style="list-style-type: none"> <li>•<sup>1</sup> correct strategy</li> <li>•<sup>2</sup> correct re-arrangement</li> <li>•<sup>3</sup> correct fixed points</li> </ul>	<p style="text-align: right;">(3 marks)</p> <ul style="list-style-type: none"> <li>•<sup>1</sup> <math>x = \frac{14 - 5x}{x}</math></li> <li>•<sup>2</sup> <math>x^2 + 5x - 14 = 0</math></li> <li>•<sup>3</sup> <math>x = -7</math> or <math>x = 2</math></li> </ul>

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7	<p>ans: <math>y = 8e^{-\frac{1}{2}x} - 2xe^{-\frac{1}{2}x} + 3x - 8</math></p> <ul style="list-style-type: none"> <li>●<sup>1</sup> correct auxiliary equation</li> <li>●<sup>2</sup> solves auxiliary equation</li> <li>●<sup>3</sup> correct CF</li> <li>●<sup>4</sup> correct format of PI</li> <li>●<sup>5</sup> correct PI</li> <li>●<sup>6</sup> correct general solution</li> <li>●<sup>7</sup> correct 1<sup>st</sup> derivative</li> <li>●<sup>8</sup> correct 2<sup>nd</sup> derivative</li> <li>●<sup>9</sup> correct A value</li> <li>●<sup>10</sup> correct B value</li> </ul>	<p style="text-align: right;">(10 marks)</p> <ul style="list-style-type: none"> <li>●<sup>1</sup> <math>4m^2 + 4m + 1 = 0</math></li> <li>●<sup>2</sup> <math>m = -\frac{1}{2}</math></li> <li>●<sup>3</sup> <math>y = Ae^{-\frac{1}{2}x} + Bxe^{-\frac{1}{2}x}</math></li> <li>●<sup>4</sup> <math>y = Cx + D</math></li> <li>●<sup>5</sup> <math>y = 3x - 8</math></li> <li>●<sup>6</sup> <math>y = Ae^{-\frac{1}{2}x} + Bxe^{-\frac{1}{2}x} + 3x - 8</math></li> <li>●<sup>7</sup> <math>\frac{dy}{dx} = -\frac{1}{2}Ae^{-\frac{1}{2}x} + Be^{-\frac{1}{2}x} - \frac{1}{2}Bxe^{-\frac{1}{2}x} + 3</math></li> <li>●<sup>8</sup> <math>\frac{d^2y}{dx^2} = \frac{1}{4}Ae^{-\frac{1}{2}x} - \frac{1}{2}Be^{-\frac{1}{2}x} - \frac{1}{2}Be^{-\frac{1}{2}x} + \frac{1}{4}Bxe^{-\frac{1}{2}x}</math></li> <li>●<sup>9</sup> <math>A = 8</math></li> <li>●<sup>10</sup> <math>B = -2</math></li> </ul> <div style="border: 1px solid black; width: fit-content; margin: 20px auto; padding: 5px; text-align: center;"> <p>Total: 45 marks</p> </div>