

Question 1	
<p>QUESTION 1</p> <p>A solution of the equation $z^2 = ai$, where $a \in R$, is $z = -2 - 2i$.</p> <p>The other solution is</p> <p>(A) $-8i$</p> <p>(B) $-2 + 2i$</p> <p>(C) $2 + 2i$</p> <p>(D) $8i$</p>	<p>Simple Familiar Technology Active 2022</p>
Question 2	
<p>QUESTION 6</p> <p>The Cartesian equation of a sphere is given by $x^2 + y^2 + z^2 + 2x - 2y = 7$.</p> <p>The centre and radius of the sphere are</p> <p>(A) $(-1, 1, 0)$ and 3 respectively.</p> <p>(B) $(-1, 1, 0)$ and 9 respectively.</p> <p>(C) $(1, -1, 0)$ and 3 respectively.</p> <p>(D) $(1, -1, 0)$ and 9 respectively.</p>	<p>Simple Familiar Technology Active 2021</p>
Question 3	
<p>QUESTION 8</p> <p>The imaginary part of $\left(\text{cis}\left(\frac{\pi}{8}\right)\right)^{-2}$ is</p> <p>(A) -6.83</p> <p>(B) -0.71</p> <p>(C) 0.71</p> <p>(D) 1.17</p>	<p>Simple Familiar Technology Active 2021</p>

Question 4																																															
<p>QUESTION 11 (5 marks)</p> <p>Teams A, B, C, D and E participated in a competition with the following results:</p> <ul style="list-style-type: none"> • A defeated D. • B defeated A, C and E. • C defeated A and E. • D defeated B, C and E. • E defeated A. <p>To rank the teams at the end of the competition, the organisers constructed a dominance matrix, N, that is partially completed.</p> <p>a) By allocating 1 to represent 'defeated' and 0 to represent either 'was defeated by' or 'no result', complete matrix N. [1 mark]</p>	<p>Simple Familiar Technology Active 2020</p>																																														
<div style="display: flex; justify-content: center; align-items: center;"> <div style="margin-right: 10px;"> <p style="margin: 0;">Losing teams</p> <table style="border-collapse: collapse;"> <tr><td style="padding: 0 5px;">A</td><td style="padding: 0 5px;">B</td><td style="padding: 0 5px;">C</td><td style="padding: 0 5px;">D</td><td style="padding: 0 5px;">E</td></tr> </table> </div> <div style="margin-right: 10px;"> <p style="margin: 0;">Winning teams</p> <table style="border-collapse: collapse;"> <tr><td style="padding: 0 5px;">A</td></tr> <tr><td style="padding: 0 5px;">B</td></tr> <tr><td style="padding: 0 5px;">C</td></tr> <tr><td style="padding: 0 5px;">D</td></tr> <tr><td style="padding: 0 5px;">E</td></tr> </table> </div> <div style="margin-right: 10px;"> <p style="margin: 0;">$N =$</p> </div> <div style="border: 1px dashed black; padding: 10px;"> <table style="border-collapse: collapse; text-align: center;"> <tr><td style="border: none;"></td><td style="border: none;">A</td><td style="border: none;">B</td><td style="border: none;">C</td><td style="border: none;">D</td><td style="border: none;">E</td></tr> <tr><td style="border: none;">A</td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td></tr> <tr><td style="border: none;">B</td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td></tr> <tr><td style="border: none;">C</td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td></tr> <tr><td style="border: none;">D</td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td></tr> <tr><td style="border: none;">E</td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td><td style="border: 1px dashed black; width: 30px; height: 20px;"></td></tr> </table> </div> </div>	A	B	C	D	E	A	B	C	D	E		A	B	C	D	E	A						B						C						D						E						<p>The organisers need to rank the teams into individual places from first to fifth place.</p> <p>They decide to use the ranking model $N + N^2$ to achieve this.</p> <p>b) Use the model $N + N^2$ to rank the teams. [2 marks]</p> <p>c) Use the result from 11b) to identify a limitation of the organisers' ranking model. [1 mark]</p> <p>d) State a mathematical refinement the organisers could consider to overcome the limitation of the ranking model identified in 11c). [1 mark]</p>
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Question 5																																															
<p>QUESTION 14 (5 marks)</p> <p>The Tasmanian thornbill is a species of bird that has an average life span of three years. Female thornbills do not reproduce in their first year, but produce an average of four female offspring in each of their second and third years. The survival rate of each age group is estimated as 25% in their first year and 30% in their second year.</p> <p>A Leslie matrix, L, modelling the population distribution of the Tasmanian thornbill, has been partially completed.</p> $L = \begin{bmatrix} 0 & 4 & 4 \\ x & 0 & 0 \\ 0 & y & 0 \end{bmatrix}$ <p>a) State the values of x and y. [1 mark]</p> <p>At the start of 2021, a study began into the population of Tasmanian thornbills. The study:</p> <ul style="list-style-type: none"> • estimated that the initial female population was 510 in their first year, 480 in their second year and 420 in their third year • found that the ratio of male to female was approximately 1:2. <p>b) Estimate the total population of Tasmanian thornbills at the start of 2025. [4 marks]</p>	<p>Simple Familiar Technology Active 2021</p>																																														