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8. (i) Prove by induction that, for $n \in \mathbb{Z}^+$

$$\begin{pmatrix} 5 & -8 \\ 2 & -3 \end{pmatrix}^n = \begin{pmatrix} 1+4n & -8n \\ 2n & 1-4n \end{pmatrix}$$

(5)

(ii) A sequence of positive numbers is defined by

$$u_1 = 8, \quad u_2 = 40$$
$$u_{n+2} = 8u_{n+1} - 12u_n \qquad n \geqslant 1$$

Prove by induction that, for $n \in \mathbb{Z}^+$

$$u_n = 6^n + 2^n$$

(5)

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Q8

(Total 10 marks)