Matrices and networks - Practice test 1

Name: _____ Date: _____

10 questions | 40 marks | 65 minutes

An original mixed chapter paper. Show calculations, state units and justify network decisions using the supplied information.

A scientific calculator may be used.

1. A delivery matrix is $D = \begin{pmatrix} 12 & 5 & 8 \\ 7 & 10 & 3 \end{pmatrix}$. Rows are Shop North/South; columns are chairs, desks and lamps. [4 marks]

(a) State its order and total number of entries. [2 marks]

(b) Interpret d_{23} and find the total number of lamps delivered. [2 marks]

2. Let $A = \begin{pmatrix} 4 & -2 \\ 1 & 5 \end{pmatrix}$ and $B = \begin{pmatrix} 3 & 6 \\ -2 & 1 \end{pmatrix}$. [4 marks]

(a) Calculate $A + B$. [2 marks]

(b) Calculate $2A - B$. [2 marks]

3. Let $A=\begin{pmatrix}2 & 1\\ 0 & 3\end{pmatrix}$ and $B=\begin{pmatrix}1 & 4\\ 2 & 0\end{pmatrix}$. [4 marks]

(a) Calculate AB. [2 marks]

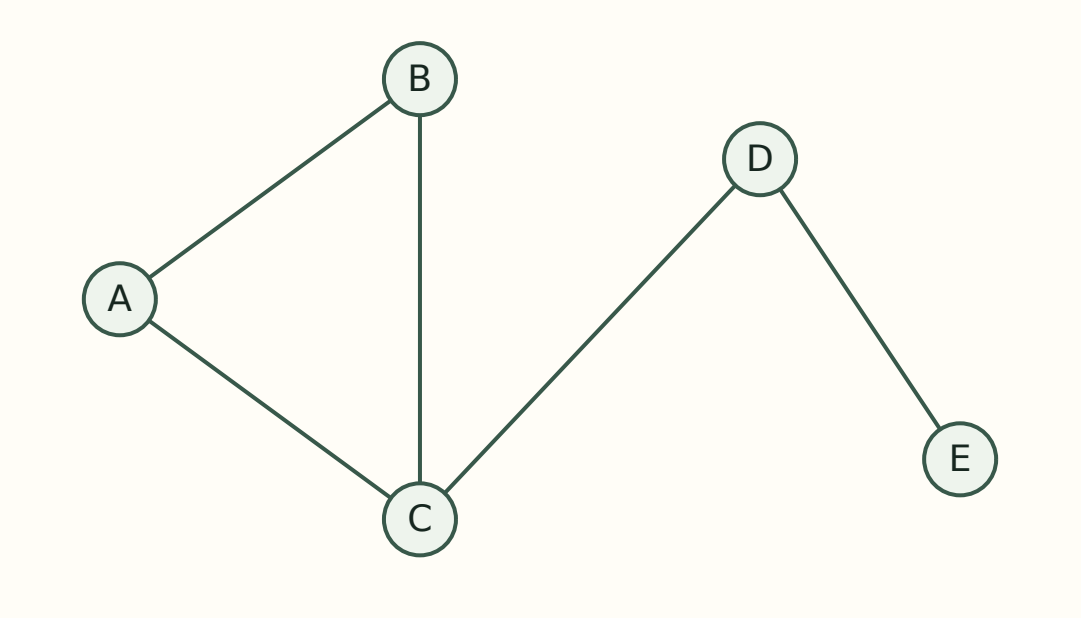
(b) Calculate BA and compare it with AB. [2 marks]

4. Two cafes order muffins and juice in quantities $Q=\begin{pmatrix}8 & 5\\ 6 & 9\end{pmatrix}$. Unit prices are $P=\begin{pmatrix}3\\ 4\end{pmatrix}$ dollars. [4 marks]

(a) Calculate QP and interpret it. [2 marks]

(b) One delivery fee of 6 dollars applies to each cafe. Find the combined payment. [2 marks]

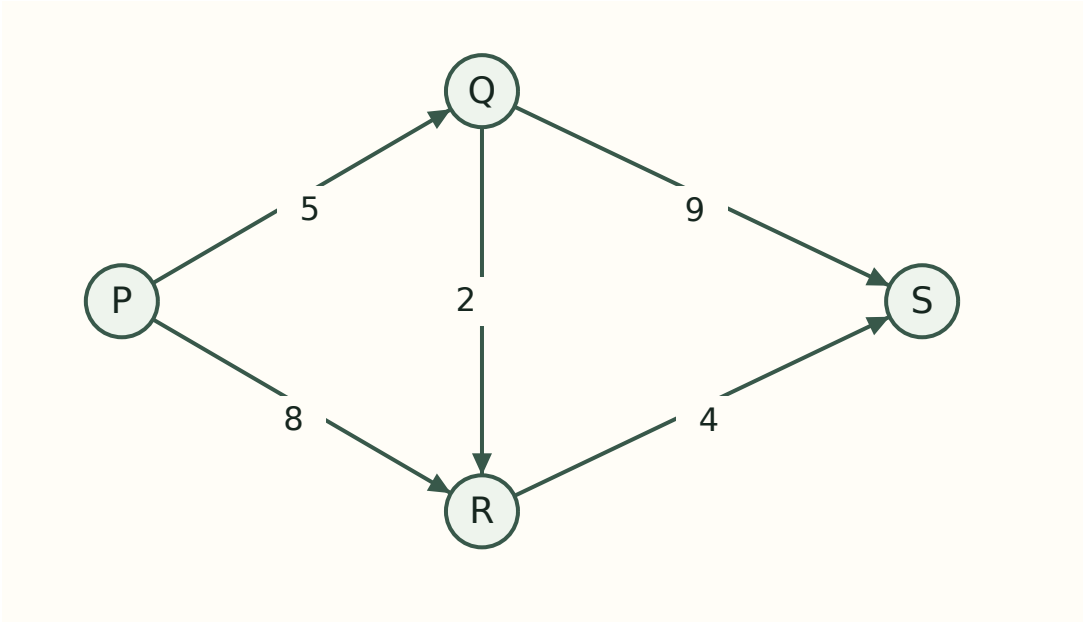
5. Use the undirected network shown. [4 marks]



(a) Find all vertex degrees and check them against the edge count. [2 marks]

(b) Identify the bridges and explain why they matter. [2 marks]

6. Edge weights in the directed network are minutes. [4 marks]



(a) Find the duration of P→Q→R→S. [2 marks]

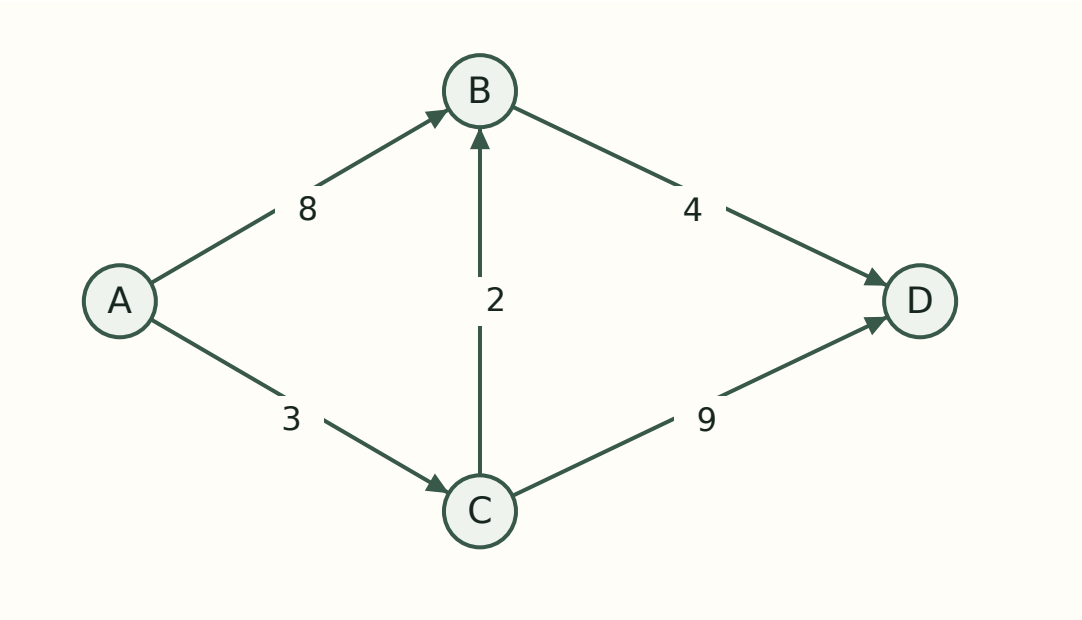
(b) Can S→R→Q→P be used for the return journey? Explain. [2 marks]

7. An adjacency matrix has rows/columns A, B, C: $N=\begin{pmatrix}0&1&1\\0&0&1\\1&0&0\end{pmatrix}$. Rows are starts. [4 marks]

(a) Find $(N^2)_{AC}$ and list the associated walk. [2 marks]

(b) Find $(N^2)_{AA}$ and explain why it does not prove there is a direct loop at A. [2 marks]

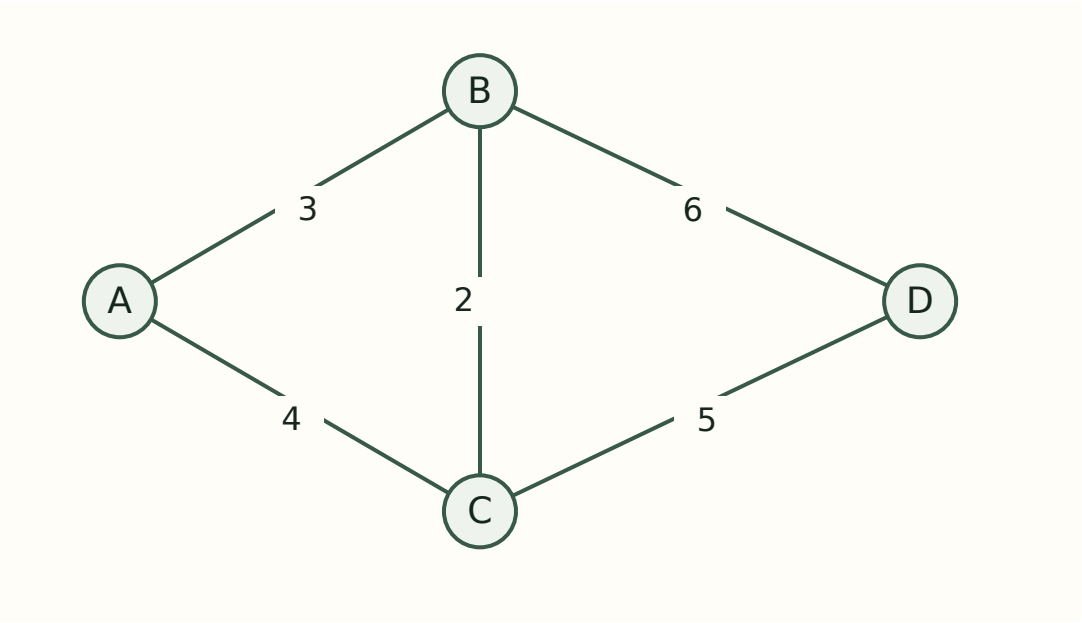
8. Use the directed weighted graph. [4 marks]



(a) Find a shortest A-to-D path and its weight. [2 marks]

(b) An accident closes C→B. Find a shortest remaining path. [2 marks]

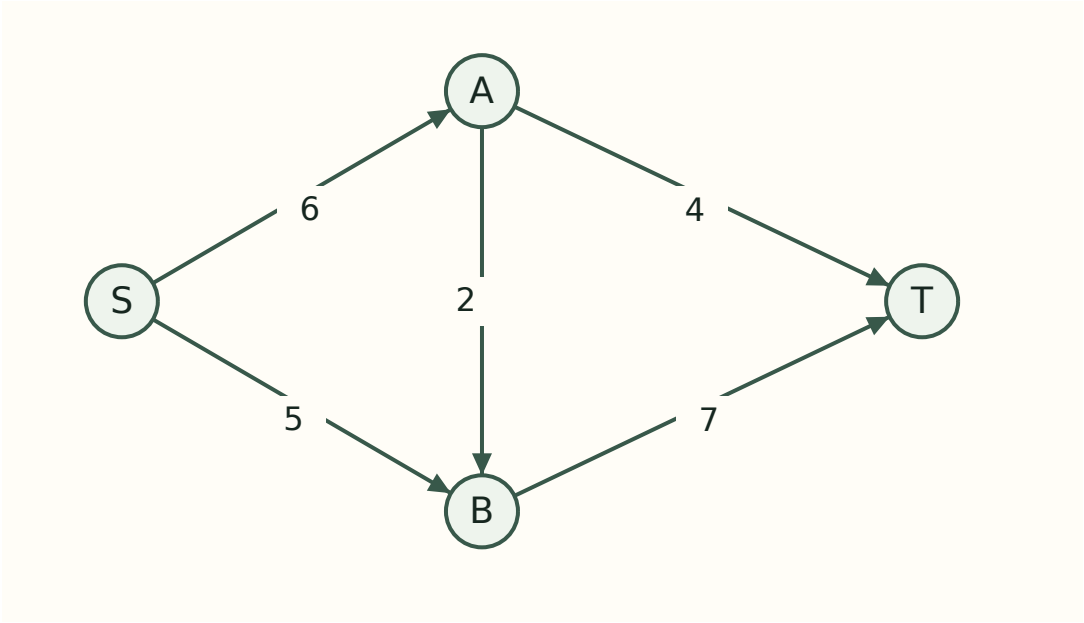
9. The undirected weights are cable costs in hundreds of dollars. [4 marks]



(a) Use Prim's algorithm from A to find a minimum spanning tree. [2 marks]

(b) State the installation cost and explain why adding B-D would stop the result being a tree. [2 marks]

10. Capacities are litres per second. [4 marks]



(a) Give a feasible flow of 11 L/s, listing each edge flow. [2 marks]

(b) Use a cut to prove this is a maximum. [2 marks]