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VCE Specialist Mathematics ½

Graph Theory I [5.3]

Test Solutions

20 Marks. 1 Minute Reading. 16 Minutes Writing.

Results:

Test Questions	_____ / 20

Section A: Test Questions (20 Marks)

Question 1 (4 marks)

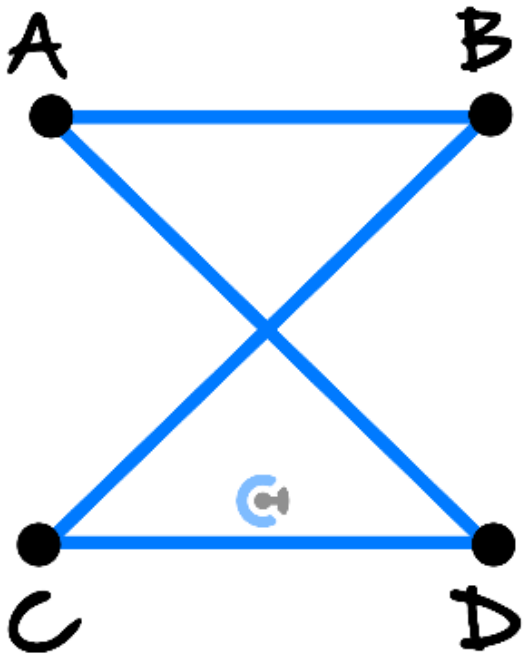
Tick whether the following statements are **true** or **false**.

Statement	True	False
a. A graph consists of a set of objects called **vertices** together with a set of unordered pairs of vertices, called **edges**.	✓	
b. The number of edges that are directly connected to a particular vertex is the "degree" of the vertex and is generally denoted as $\deg(V)$, where V is the vertex.	✓	
c. A **simple graph** is one in which pairs of vertices are always connected by one edge. They don't have to be connected.		✓
d. A **connected** graph is a graph where it is possible to reach all vertices by moving along edges.	✓	
e. A **complete** graph is a simple graph in which each vertex is connected to every other vertex.	✓	
f. The number of edges in a complete graph K_n is given by the formula: $\frac{n(n+1)}{2}$. It's $n-1$ instead of $n+!$		✓
g. In graph theory, an isomorphism is where the corresponding vertices in both graphs are connected by the same edges.	✓	
h. A subgraph is a graph whose vertices and edges are all contained within the original graph.	✓	

Space for Personal Notes

Question 2 (2 marks)

Write the vertex sets and edge sets for the graph below.



Vertex set: $\{A, B, C, D\}$

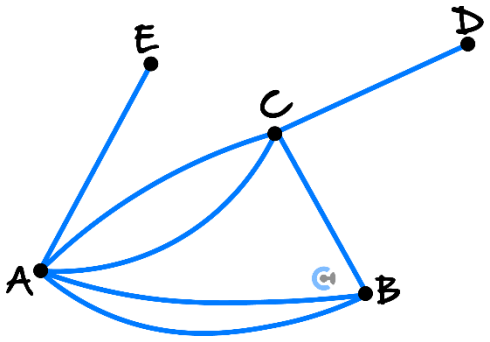
Edge set: $\{AB, AD, BC, CD\}$

Space for Personal Notes

Question 3 (4 marks)

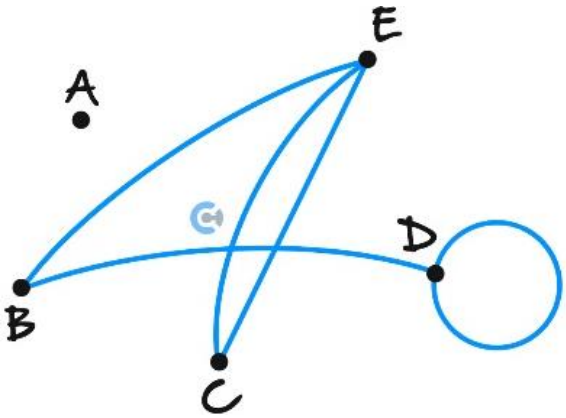
Identify the degree of each vertex in the following graphs.

a. (2 marks)



$\deg(A) = 5; \deg(B) = 3; \deg(C) = 4;$
$\deg(D) = 1; \deg(E) = 1$

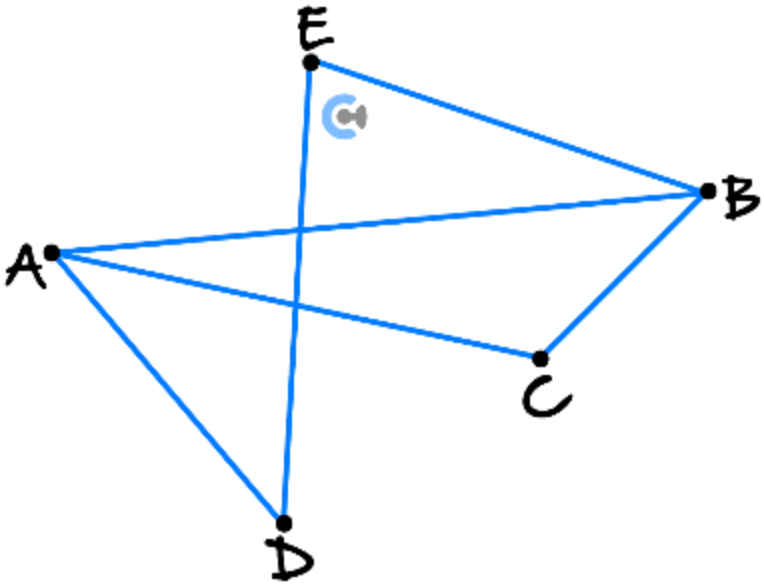
b. (2 marks)



$\deg(A) = 0; \deg(B) = 2; \deg(C) = 2;$
$\deg(D) = 3; \deg(E) = 3$

Question 4 (2 marks)

Construct the adjacency matrix for the given graph.



$$\begin{bmatrix} 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \end{bmatrix}$$

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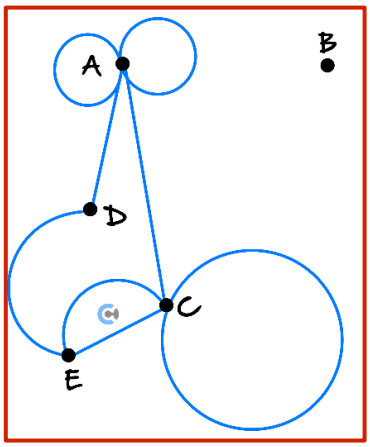
Question 5 (3 marks)

Draw graphs to represent the following adjacency matrices.

$$\begin{bmatrix} 2 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 2 \\ 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 2 & 1 & 0 \end{bmatrix}$$



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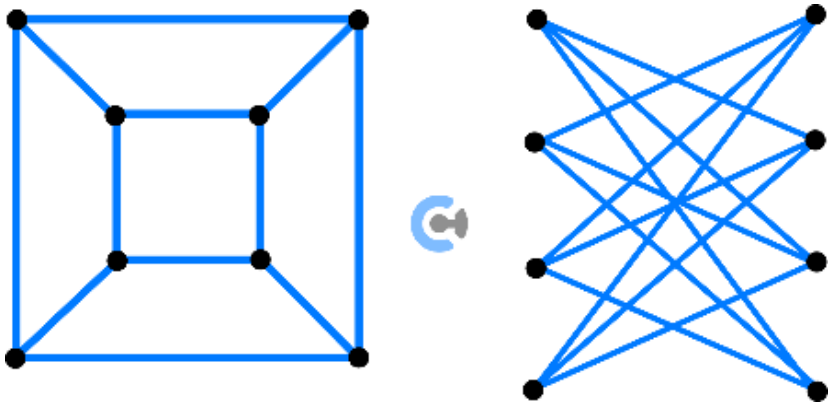
Question 6 (2 marks)

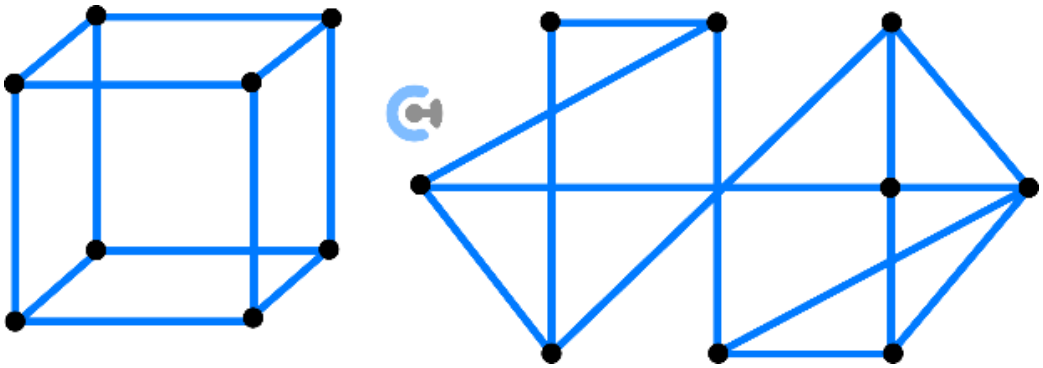
For each of the following pairs of graphs, determine whether the graphs are isomorphic.

a. (1 mark)



Isomorphic

b. (1 mark)

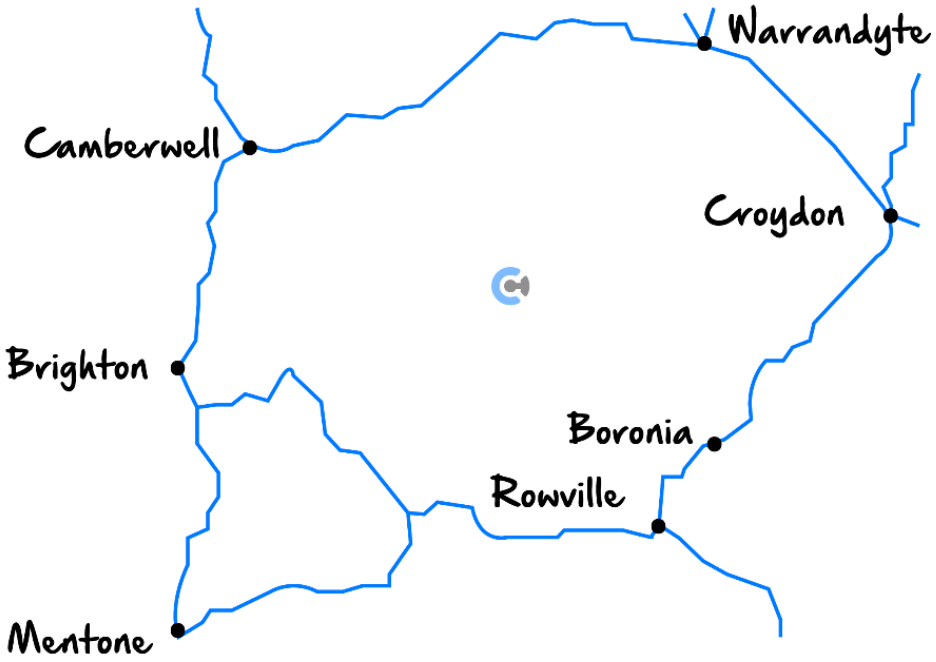


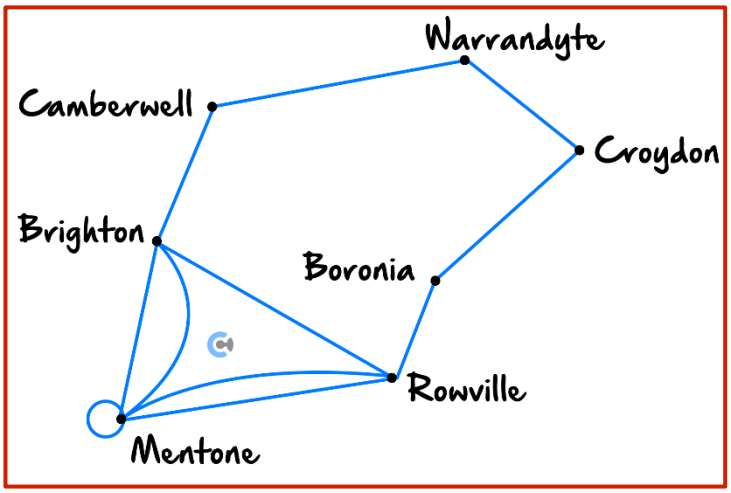
Non isomorphic

Space for Personal Notes

Question 7 (3 marks)

Using the map below, represent the paths between the towns as a graph.





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