Dijkstra's algorithm

AS Decision Mathematics 1 | Edexcel 8FM0 | 12 questions, 92 marks

Further Maths topic practice

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Name: _____ **Date:** _____ **Score:** _____ **/ 92**

1 The network below shows the weights of the arcs joining six vertices, A to F.

Use Dijkstra's algorithm to find the shortest path from A to F. State the path and its length.

You should show, at each vertex, the order of labelling, the final value and the working values.

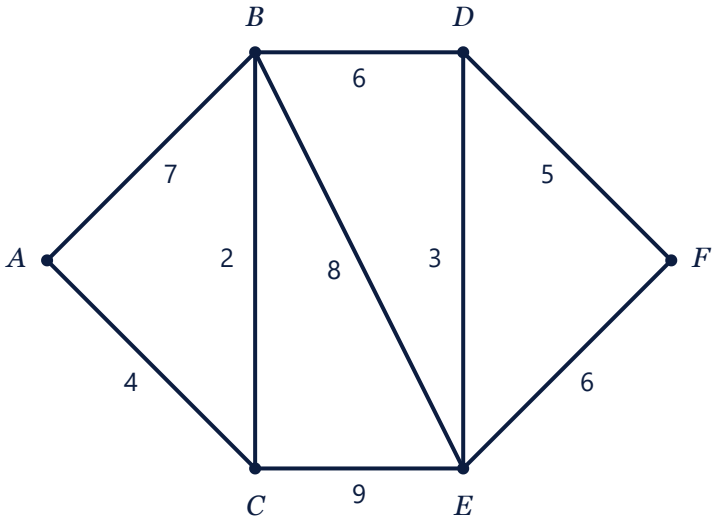


Diagram NOT accurately drawn

(5 marks)

Answer _____

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2 The network below shows footpaths in a country park in the Peak District. The number on each arc is the time, in minutes, to walk along that path.

Priya walks from the car park, S, to the tea room, T.

a. Use Dijkstra's algorithm to find the quickest route from S to T.

b. State the time taken.

You should show, at each vertex, the order of labelling, the final value and the working values.

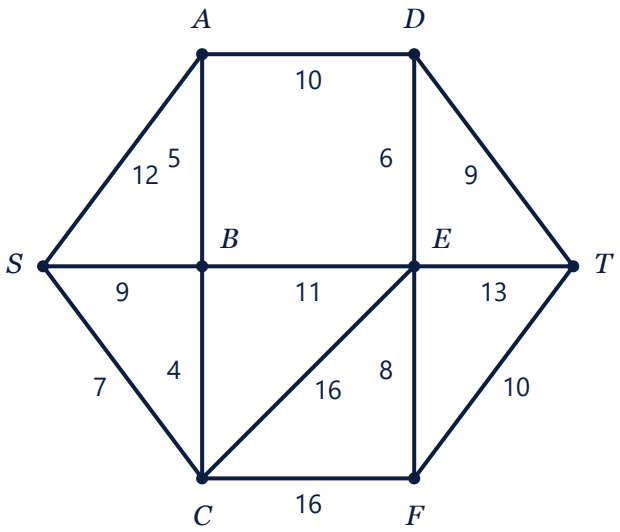


Diagram NOT accurately drawn

(6 marks)

Answer

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3 The network below shows streets in a town centre in Norfolk. The number on each arc is the driving time, in minutes. Arcs with an arrow are one-way streets and may only be used in the direction shown.

a. Use Dijkstra's algorithm to find the quickest route from A to G and state its time.

b. Explain why the quickest route from G back to A is not necessarily the route found in part (a) in reverse.

You should show, at each vertex, the order of labelling, the final value and the working values.

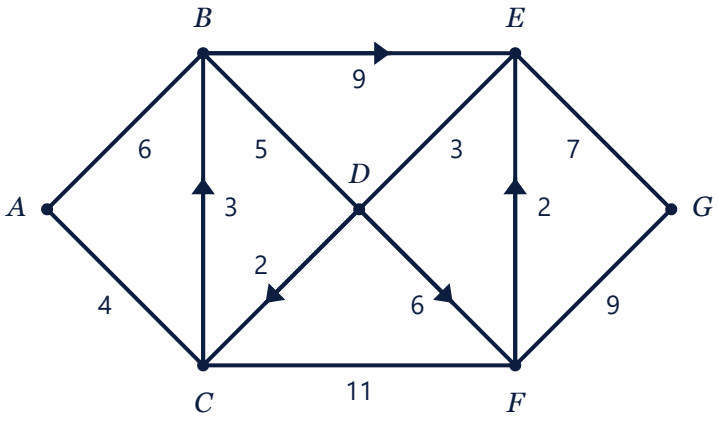


Diagram NOT accurately drawn

(7 marks)

Answer

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4 The network below shows the lengths, in km, of roads between eight towns, A to H, in Yorkshire.

a. Use Dijkstra's algorithm to find the shortest route from A to H. State the route and its length.

Dijkstra's algorithm has order n^2, where n is the number of vertices. A computer takes 0.6 seconds to apply the algorithm to a network with 40 vertices.

b. Estimate the time the computer would take for a network with 250 vertices.

You should show, at each vertex, the order of labelling, the final value and the working values.

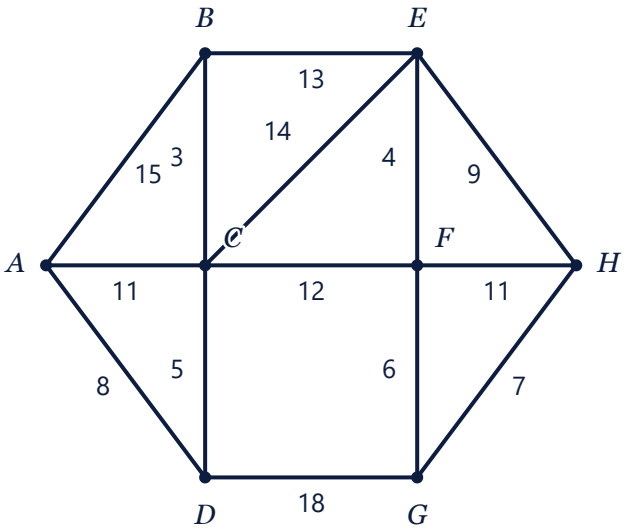


Diagram NOT accurately drawn

(8 marks)

Answer

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5 The network below shows the lengths, in miles, of roads between eight villages, A to H, in Norfolk. Sam drives a mobile library van from A to H and must stop at village C on the way.

a. Apply Dijkstra's algorithm, starting at C, to find the shortest distance from C to every other village.

b. Hence find the shortest route from A to H that passes through C, and its length.

c. The shortest route from A to H with no stop at C is 62 miles. Find how much further Sam drives because of the stop at C.

You should show, at each vertex, the order of labelling, the final value and the working values.

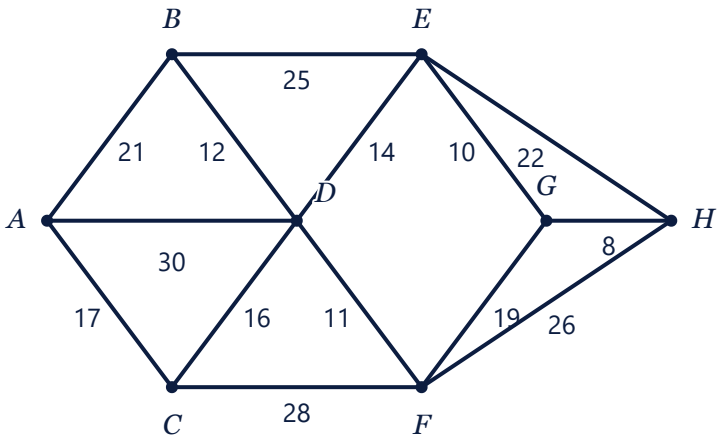


Diagram NOT accurately drawn

(8 marks)

Answer

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6 The table shows the lengths, in km, of the direct cycle routes between seven towns, A to G, in Kent. A dash means there is no direct route.

	A	**B**	**C**	**D**	**E**	**F**	**G**
A	–	24	18	35	–	–	–
B	24	–	9	–	20	–	–
C	18	9	–	14	27	–	–
D	35	–	14	–	–	16	40
E	–	20	27	–	–	8	25
F	–	–	–	16	8	–	19
G	–	–	–	40	25	19	–

Use Dijkstra's algorithm to find the shortest route from A to G and state its length. You may find it helpful to draw the network first.

You should show, at each vertex, the order of labelling, the final value and the working values.

(6 marks)

Answer _____

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7 The network below shows the times, in minutes, for a bus to travel between stops S, A, B, C, D, E, F and T in a city in Wales.

a. Use Dijkstra's algorithm to find the quickest route from S to T and state its time.

One week, stop B is closed for building work and the bus cannot pass through it.

b. Use Dijkstra's algorithm again to find the quickest route from S to T that avoids B.

c. State the increase in journey time.

You should show, at each vertex, the order of labelling, the final value and the working values.

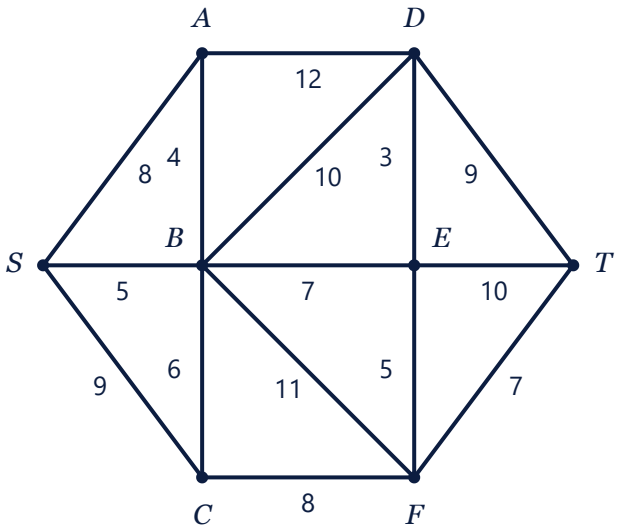


Diagram NOT accurately drawn

(9 marks)

Answer _____

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8 The network below shows the times, in seconds, taken by a warehouse robot to travel between points A to H.

a. Use Dijkstra's algorithm to find the quickest route from A to H and state its time.

A stack of pallets slows the robot down on DF, so the time for DF increases from 16 seconds to 34 seconds.

b. Find the new quickest route from A to H and its time.

c. State how much longer the new quickest route takes.

You should show, at each vertex, the order of labelling, the final value and the working values.

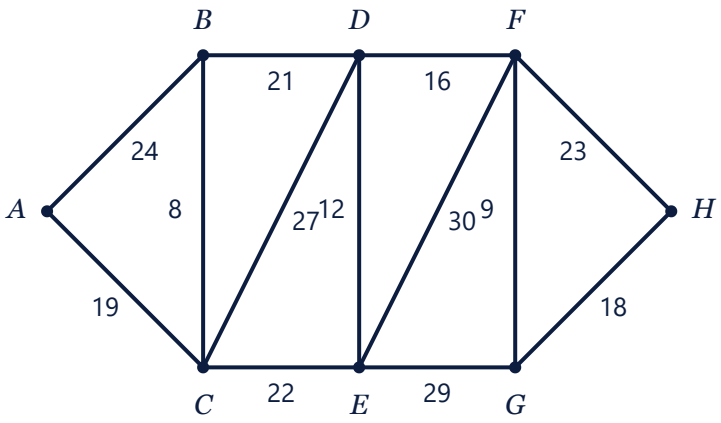


Diagram NOT accurately drawn

(9 marks)

Answer

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9 The network below shows the distances, in hundreds of metres, between seven points, A to G, on a hospital site in Manchester.

a. Use Dijkstra's algorithm to find the shortest distance from A to G.

b. There is more than one shortest route from A to G. State every shortest route.

You should show, at each vertex, the order of labelling, the final value and the working values.

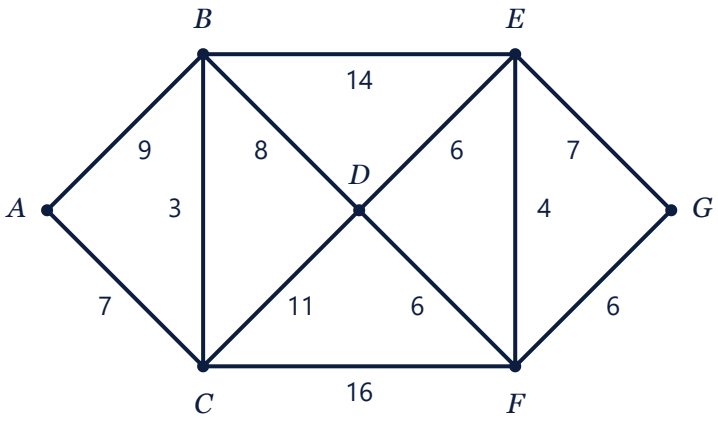


Diagram NOT accurately drawn

(7 marks)

Answer _____

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10 The network below shows the lengths, in km, of tracks in a forest in Hampshire. The length of track CF is x km.

a. Given that $x = 20$, use Dijkstra's algorithm to find the shortest route from A to G and state its length.

b. Find the range of values of x for which CF is on the shortest route from A to G.

You should show, at each vertex, the order of labelling, the final value and the working values.

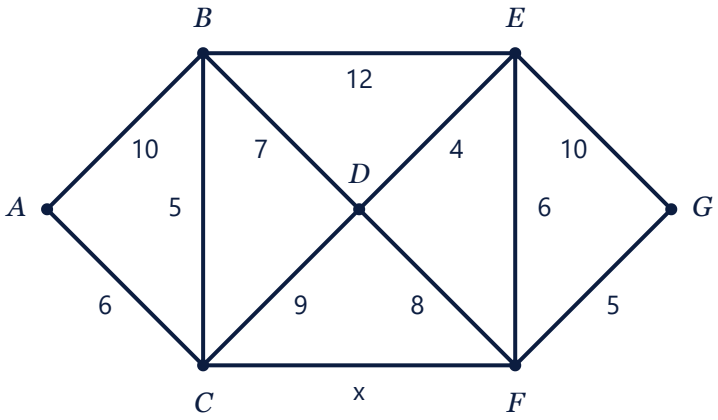


Diagram NOT accurately drawn

(8 marks)

Answer _____

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11 An ambulance is based at a hospital, H, in rural Northumberland. The network below shows the driving times, in minutes, between H and eight villages, A to G and J.

a. Use Dijkstra's algorithm, starting at H, to find the shortest driving time from H to every village.

b. State the quickest route from H to J and its time.

c. The ambulance service aims to reach every village within 30 minutes. State, with a reason, whether this aim is met.

d. Explain why one application of Dijkstra's algorithm is enough to answer parts (b) and (c).

You should show, at each vertex, the order of labelling, the final value and the working values.

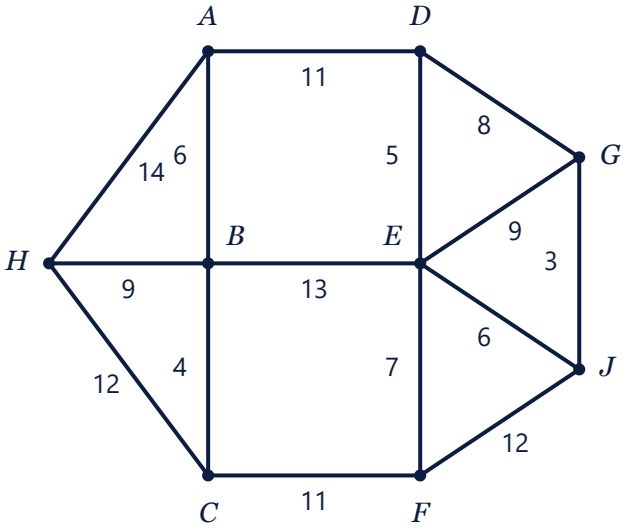


Diagram NOT accurately drawn

(9 marks)

Answer

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12 The network below shows the lengths, in miles, of roads between ten places in Cumbria. A delivery driver starts at the depot, D.

a. Use Dijkstra's algorithm to find the shortest route from D to K and state its length.

On Friday the driver must collect a parcel from E on the way from D to K.

b. Use your answer to part (a) to find the shortest route from D to E.

c. Hence find the shortest route from D to K that passes through E, and its length.

d. Find how many extra miles the driver travels on Friday.

You should show, at each vertex, the order of labelling, the final value and the working values.

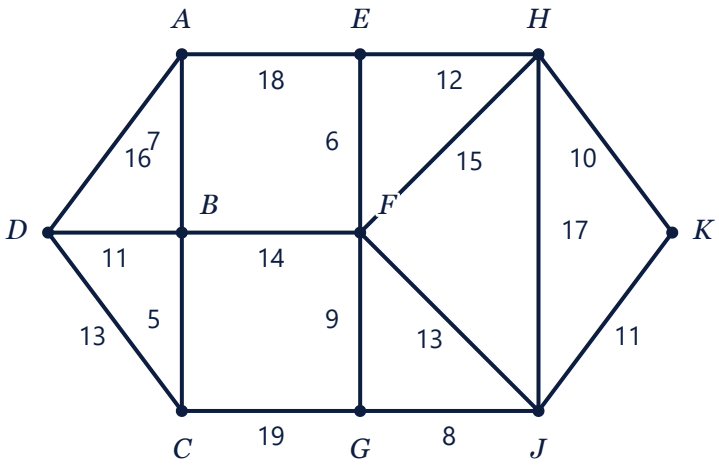


Diagram NOT accurately drawn

(10 marks)

Answer

End of questions | Total 92 marks

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