



Route Inspection (Year 1) Exam Questions (Edexcel)

Q1.

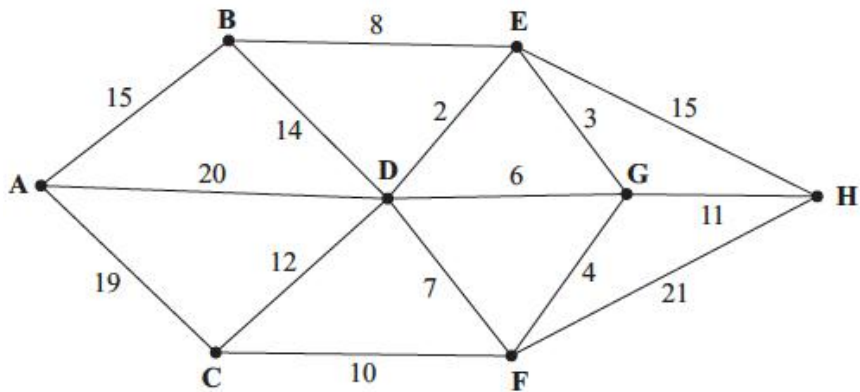


Figure 3

[The total weight of the network is 167]

Figure 3 represents a network of paths. The number on each arc gives the time, in minutes, to travel along that path.

(a) Use Dijkstra's algorithm to find the quickest route from A to H. State your quickest route and the time taken. (5)

Kevin must walk along each path at least once and return to his starting point.

(b) Use an appropriate algorithm to find the time of Kevin's quickest possible route, starting and finishing at A. You should make your method and working clear. (5)

(Total 10 marks)
(Q02 6689/01, Jan 2010)

(a)

Key:

Vertex	Order of labelling	Final value
Working values		

Quickest route: _____

Time taken: _____



Q2.

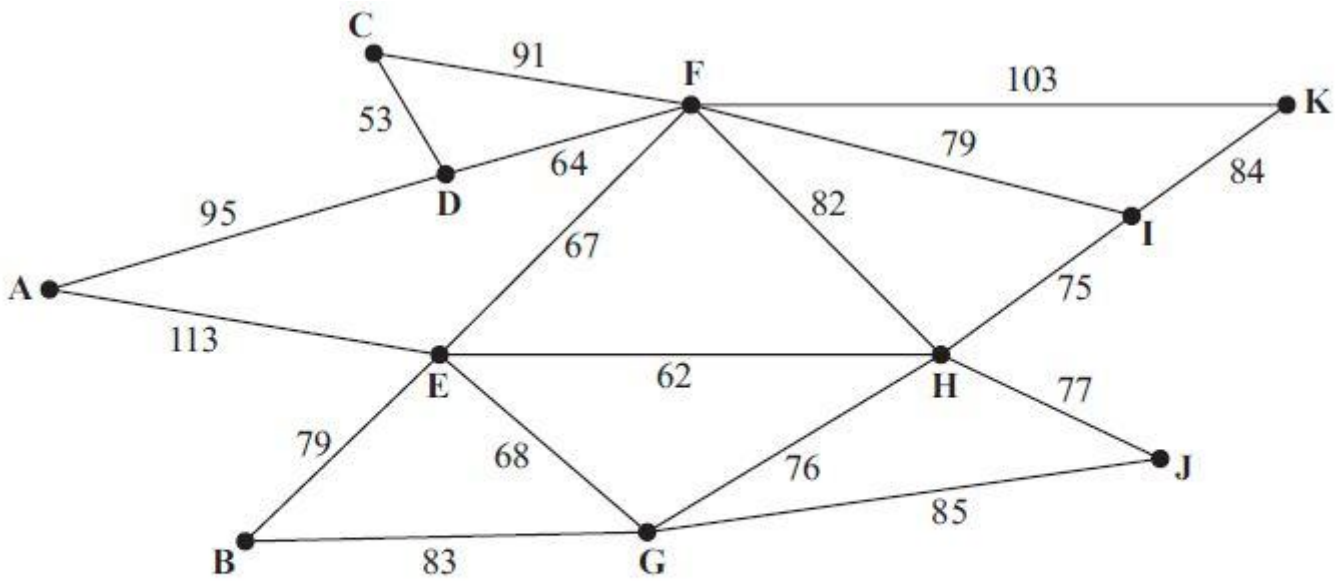


Figure 3

[The total weight of the network is 1436 m]

(a) Explain the term **valency**.

(2)

Figure 3 models a system of underground pipes. The number on each arc represents the length, in metres, of that pipe.

Pressure readings indicate that there is a leak in the system and an electronic device is to be used to inspect the system to locate the leak. The device will start and finish at A and travel along each pipe at least once. The length of this inspection route needs to be minimised.

(b) Use the route inspection algorithm to find the pipes that will need to be traversed twice. You should make your method and working clear.

(5)

(c) Find the length of the inspection route.

(1)

Pipe HI is now found to be blocked; it is sealed and will not be replaced. An inspection route is now required that excludes pipe HI. The length of the inspection route must be minimised.

(d) Find the length of the minimum inspection route excluding HI. Justify your answer.

(2)

(e) Given that the device may now start at any vertex and finish at any vertex, find a minimum inspection route, excluding HI.

(2)

(Total 12 marks)



Q3.

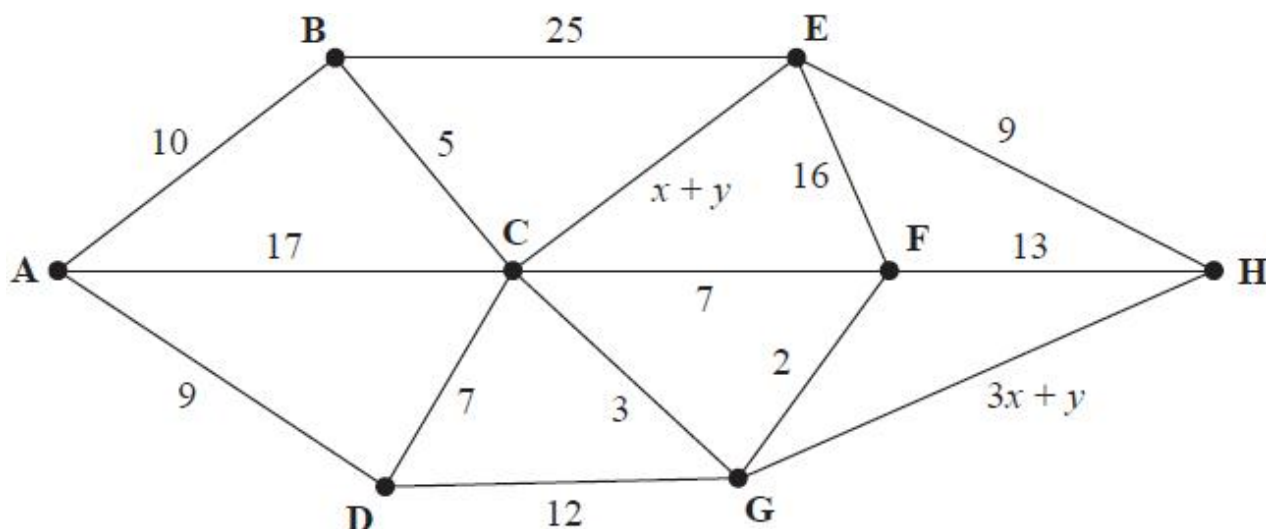


Figure 1

[The total weight of the network is $135 + 4x + 2y$]

The weights on the arcs in Figure 1 represent distances. The weights on the arcs CE and GH are given in terms of x and y , where x and y are positive constants and $7 < x + y < 20$

There are three paths from A to H that have the same minimum length.

(a) Use Dijkstra's algorithm to find x and y .

(7)

An inspection route starting at A and finishing at H is found. The route traverses each arc at least once and is of minimum length.

(b) State the arcs that are traversed twice.

(1)

(c) State the number of times that vertex C appears in the inspection route.

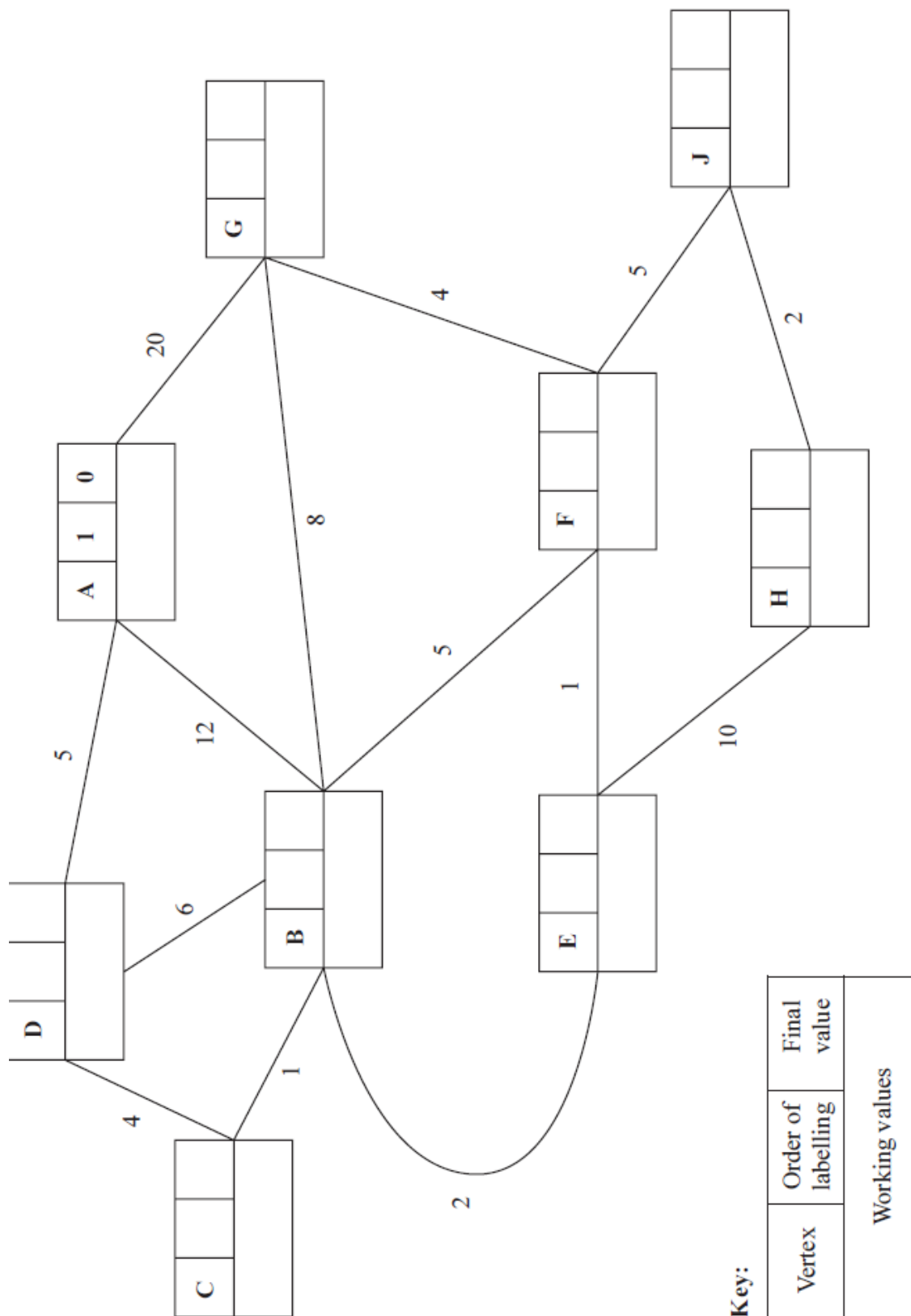
(1)

(d) Determine the length of the inspection route.

(1)

(Total for question = 10 marks)

(Q04 8FM0/27, June 2019)



Shortest path: _____

Length of shortest path: _____



Q4.

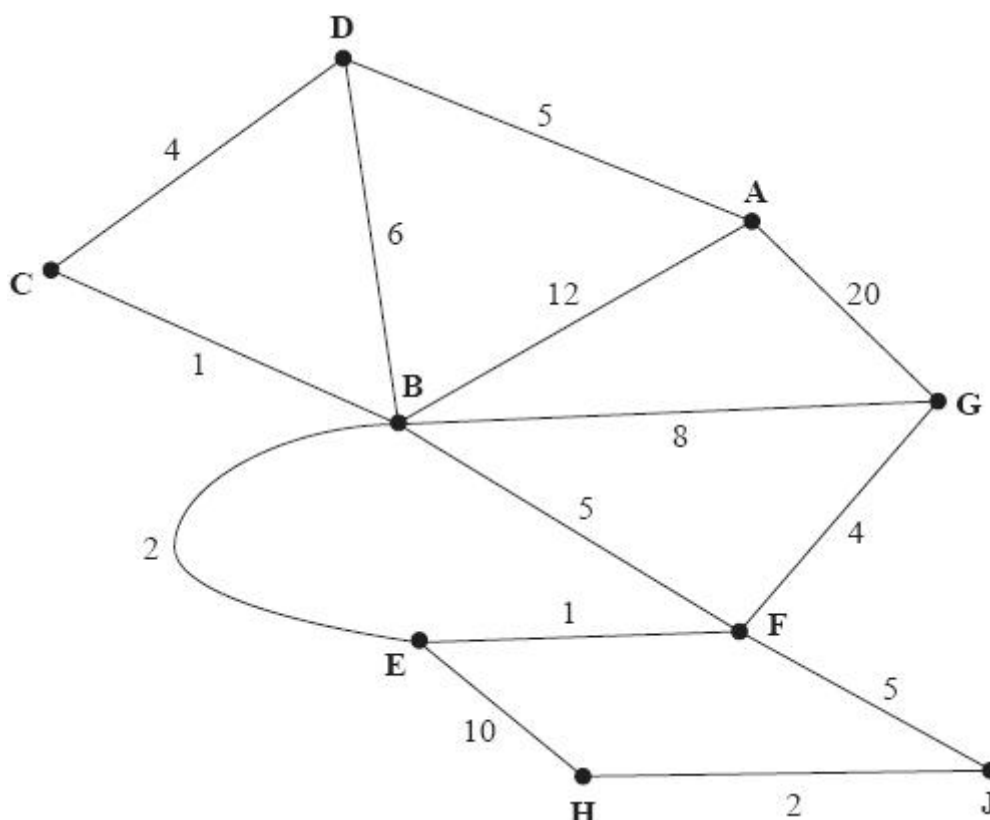


Figure 4

[The total weight of the network is 85]

Figure 4 represents a network of roads. The number on each edge represents the length, in miles, of the corresponding road. Robyn wishes to travel from A to H. She wishes to minimise the distance she travels.

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

(6)

On a particular day, Robyn needs to check each road. She must travel along each road at least once. Robyn must start and finish at vertex A.

(b) Use the route inspection algorithm to find the length of the shortest inspection route. State the edges that should be repeated. You should make your method and working clear.

(5)

The roads BD and BE become damaged and cannot be used. Robyn needs to travel along all the remaining roads to check that there is no damage to any of them. The inspection route must still start and finish at vertex A.

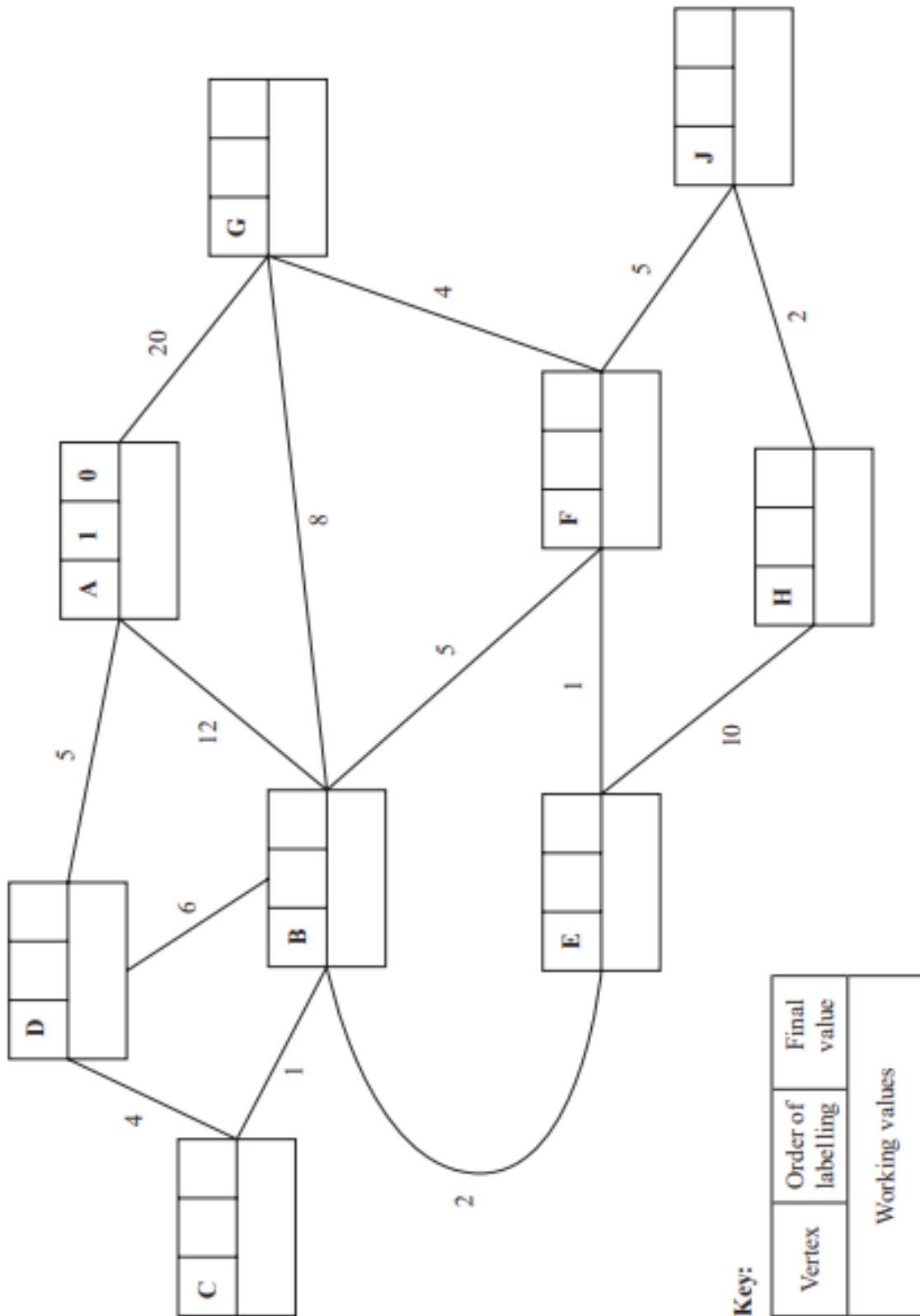
(c) (i) State the edges that should be repeated.

(ii) State a possible route and calculate its length. You must make your method and working clear.

(4)

(Total for question = 15 marks)

(Q03 6689/01, June 2017)



Shortest path: _____

Length of shortest path: _____



Q5.

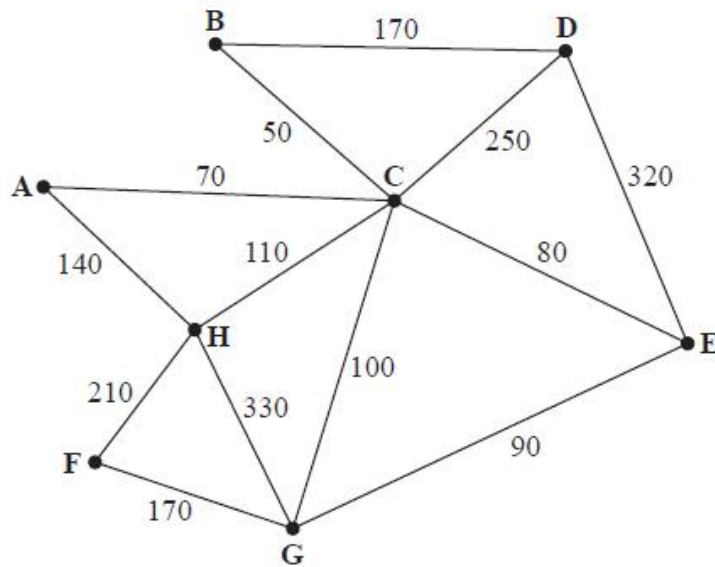


Figure 4

[The total weight of the network is 2090]

(a) Explain why a network cannot have an odd number of vertices of odd valency.

(2)

Figure 4 represents a network of 13 roads in a village. The number on each arc is the length, in metres, of the corresponding road. A route of minimum length that traverses each road at least once needs to be found. The route may start at any vertex and finish at any vertex.

(b) Write down the vertices at which the route will start and finish.

(1)

A new road, AB, of length 130m is built. A route of minimum length that traverses each road, including AB, needs to be found. The route must start and finish at A.

(c) Use the route inspection algorithm to find the roads that will need to be traversed twice. You must make your method and working clear.

(4)

(d) Calculate the length of a possible shortest inspection route.

(2)

It is now decided to start and finish the inspection route at two distinct vertices. A route of minimum length that traverses each road, including AB, needs to be found. The route must start at A.

(e) State the finishing point so that the length of the route is minimised. Calculate how much shorter the length of this route is compared to the length of the route in (d). You must make your method and calculations clear.

(3)

(Total for question = 12 marks)

(Q02 6689/01, June 2015)



Q6.

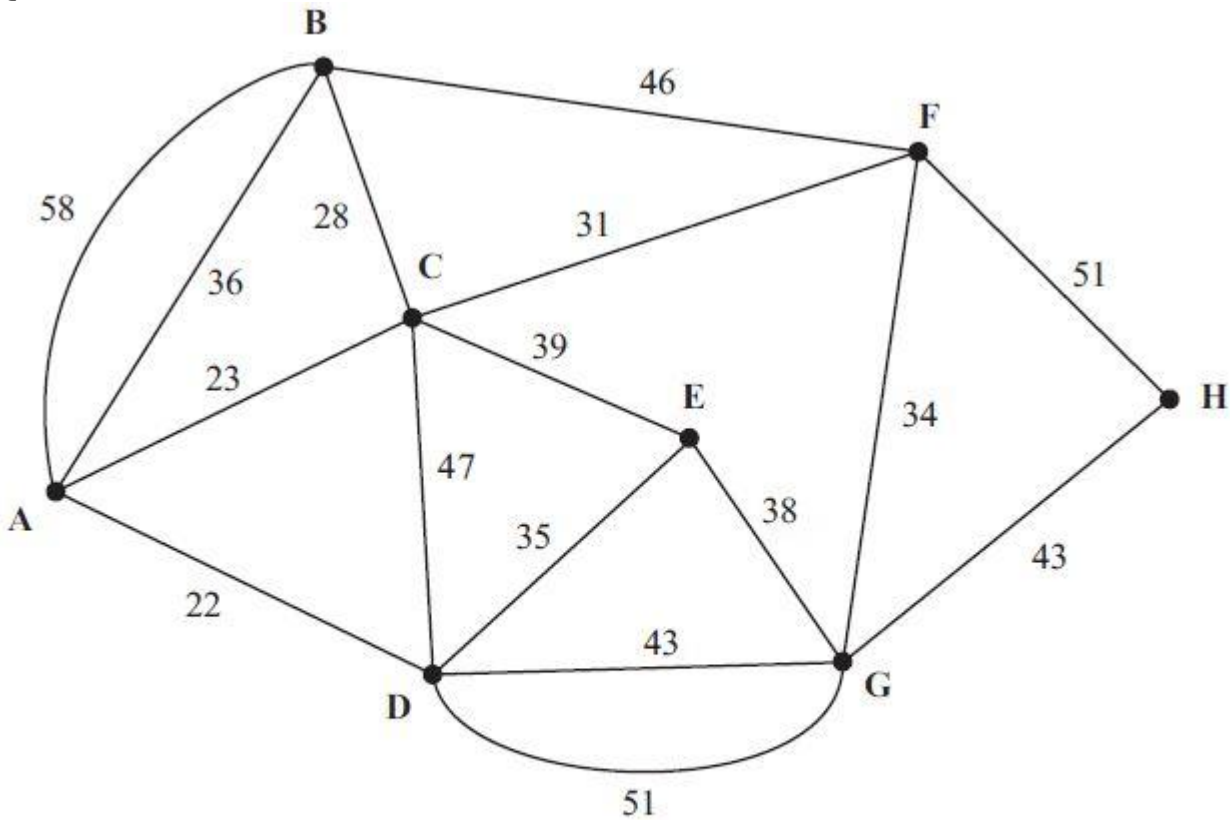


Figure 3

[The total weight of the network is 625 m]

Figure 3 models a network of paths in a park. The number on each arc represents the length, in m, of that path.

Rob needs to travel along each path to inspect the surface. He wants to minimise the length of his route.

- (a) Use the route inspection algorithm to find the length of his route. State the arcs that should be repeated. You should make your method and working clear.

(6)

The surface on each path is to be renewed. A machine will be hired to do this task and driven along each path.

The machine will be delivered to point G and will start from there, but it may be collected from any point once the task is complete.

- (b) Given that each path must be traversed at least once, determine the finishing point so that the length of the route is minimised. Give a reason for your answer and state the length of your route.

(3)

(Total 9 marks)

(Q03 6689/01, June 2009)



Q7.

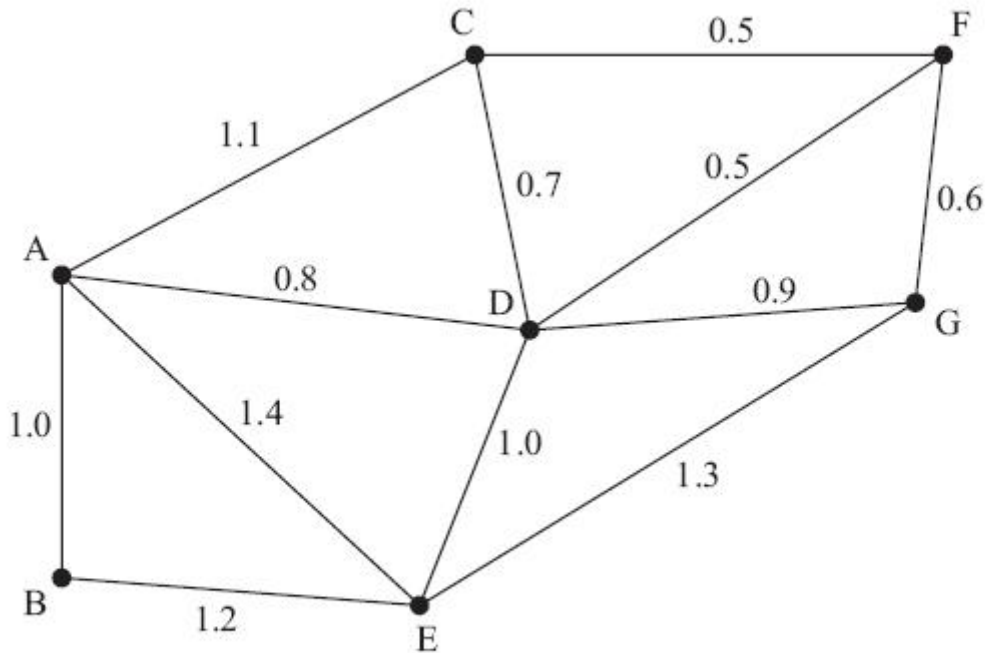


Figure 4

Figure 4 models a network of roads in a housing estate. The number on each arc represents the length, in km, of the road.

The total weight of the network is 11 km.

A council worker needs to travel along each road once to inspect the road surface. He will start and finish at A and wishes to minimise the length of his route.

(a) Use an appropriate algorithm to find a route for the council worker. You should make your method and working clear. State your route and its length.

(6)

A postal worker needs to walk along each road twice, once on each side of the road. She must start and finish at A. The length of her route is to be minimised. You should ignore the width of the road.

(b) (i) Explain how this differs from the standard route inspection problem.

(1)

(ii) Find the length of the shortest route for the postal worker.

(2)

(Total 9 marks)

(Q02 6689/01, Jan 2008)



Q8.



Figure 1

[The total weight of the network is 189]

Figure 1 represents a network of pipes in a building. The number on each arc is the length, in metres, of the corresponding pipe.

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

(5)

On a particular day, Gabriel needs to check each pipe. A route of minimum length, which traverses each pipe at least once and which starts and finishes at A, needs to be found.

(b) Use an appropriate algorithm to find the pipes that will need to be traversed twice.

You must make your method and working clear.

(4)

(c) State the minimum length of Gabriel's route.

(1)

A new pipe, BG, is added to the network. A route of minimum length that traverses each pipe, including BG, needs to be found. The route must start and finish at A.

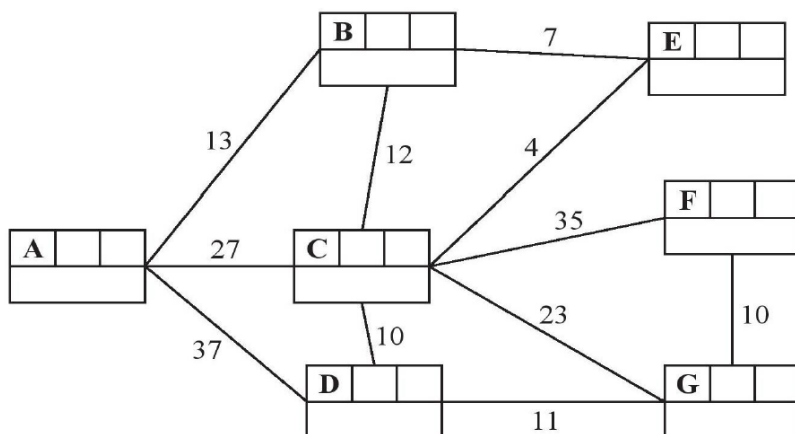
Gabriel works out that the addition of the new pipe increases the length of the route by twice the length of BG.

(d) Calculate the length of BG. You must show your working.

(2)

(Total for question = 12 marks)

(Q01 8FM0/2K/sA, Specimen papers)



Key:

Vertex	Order of labelling	Final value
Working value		

Shortest path:

Length of shortest path: