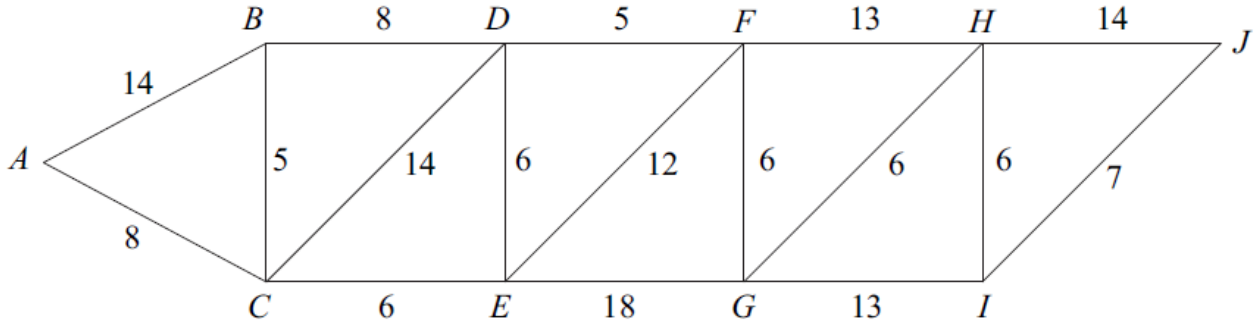
Decision 1: Dijkstra's Algorithm

Past Paper Questions
2006 - 2013

Name:

5 [**Figure 1**, printed on the insert, is provided for use in this question.]

The network shows the times, in minutes, to travel between 10 towns.



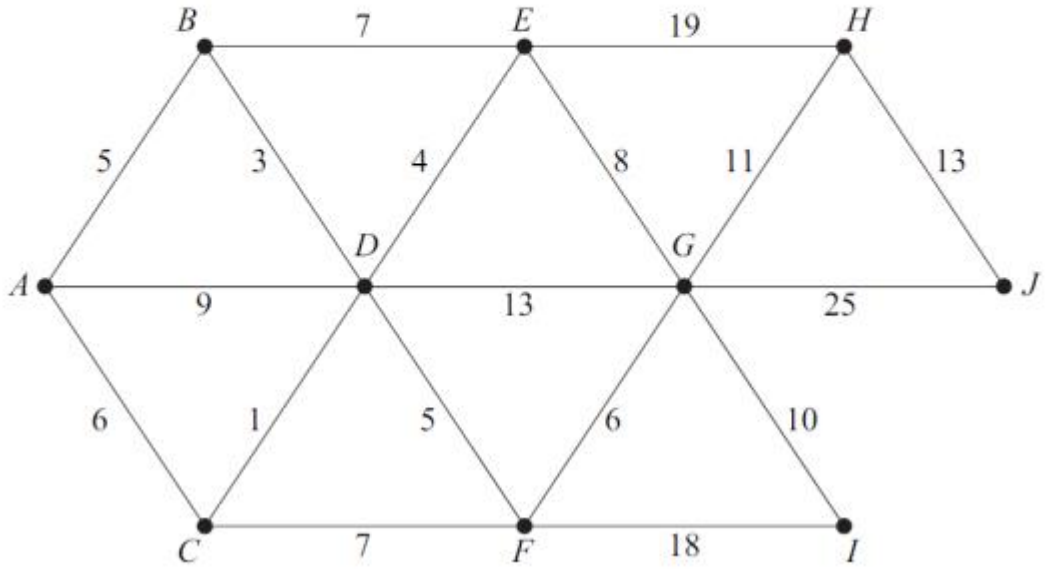
(a) Use Dijkstra's algorithm on **Figure 1** to find the minimum time to travel from A to J.
(6 marks)

(b) State the corresponding route. *(1 mark)*

June 2006

3 [**Figure 1**, printed on the insert, is provided for use in **part (b)** of this question.]

The diagram shows a network of roads. The number on each edge is the length, in kilometres, of the road.

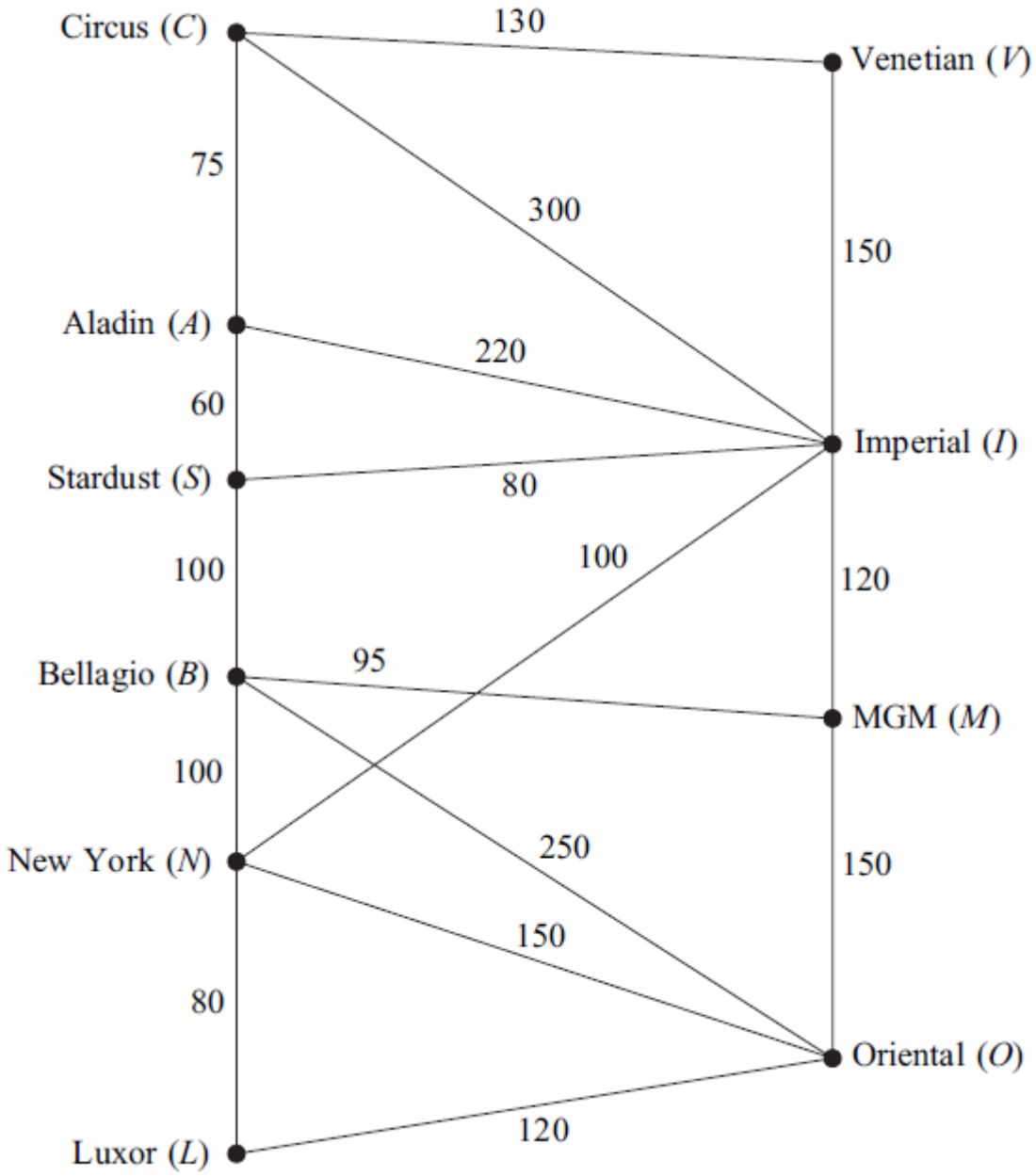


(b) (i) Use Dijkstra's algorithm on **Figure 1** to find the shortest distance from A to J.
(6 marks)

(ii) A new road, of length x km, is built connecting I to J. The minimum distance from A to J is reduced by using this new road. Find, and solve, an inequality for x.
(2 marks)

7 [**Figure 2**, printed on the insert, is provided for use in this question.]

The network shows the times, in seconds, taken by Craig to walk along walkways connecting ten hotels in Las Vegas.



The total of all the times in the diagram is 2280 seconds.

(a) (i) Craig is staying at the Circus (C) and has to visit the Oriental (O).

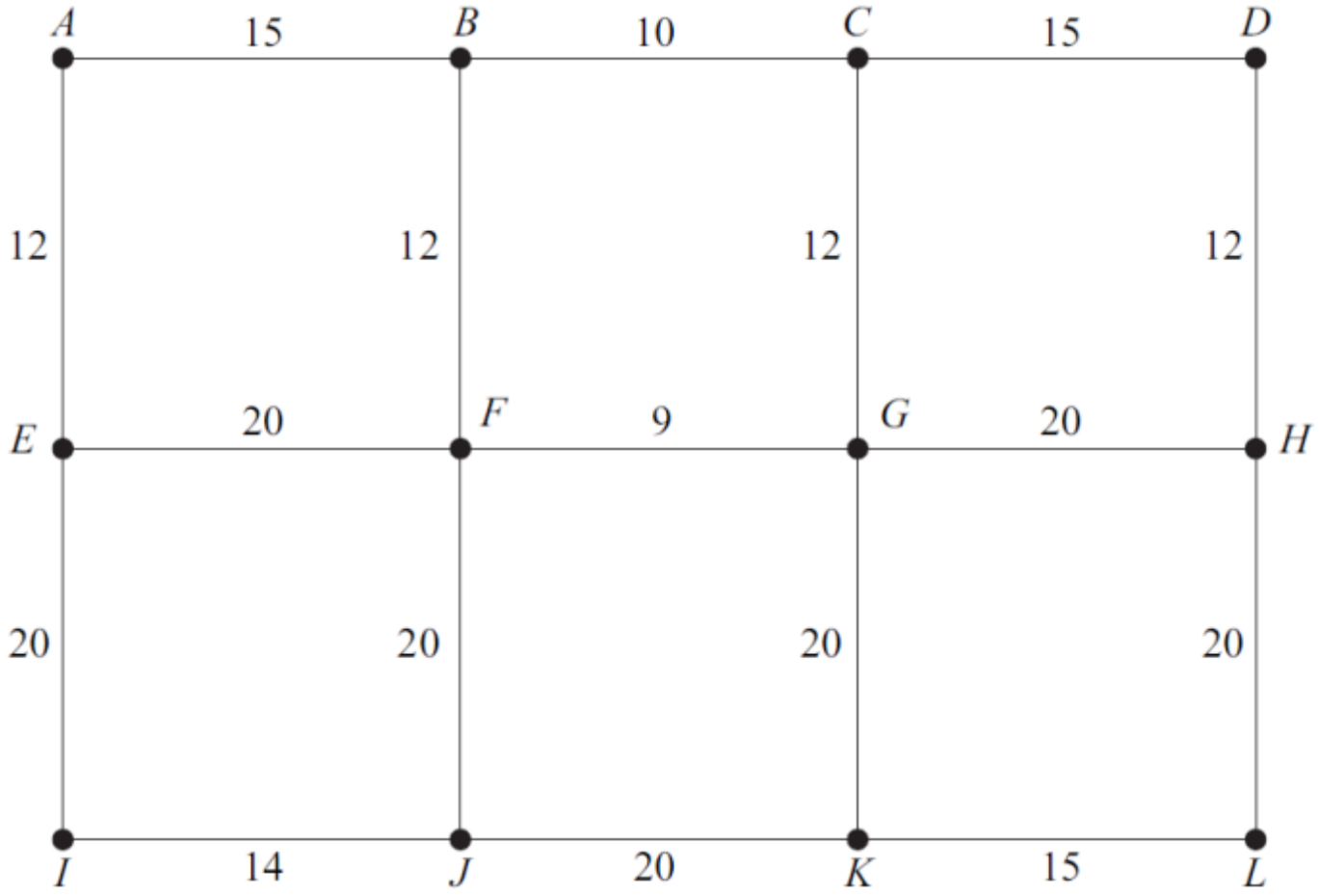
Use Dijkstra's algorithm on **Figure 2** to find the minimum time to walk from C to O. *(6 marks)*

(ii) Write down the corresponding route. *(1 mark)*

June 2007

3 [**Figure 1**, printed on the insert, is provided for use in this question.]

The following network represents the footpaths connecting 12 buildings on a university campus. The number on each edge represents the time taken, in minutes, to walk along a footpath.



(a) (i) Use Dijkstra's algorithm on **Figure 1** to find the minimum time to walk from A to L. *(7 marks)*

(ii) State the corresponding route. *(1 mark)*

(b) A new footpath is to be constructed. There are two possibilities:

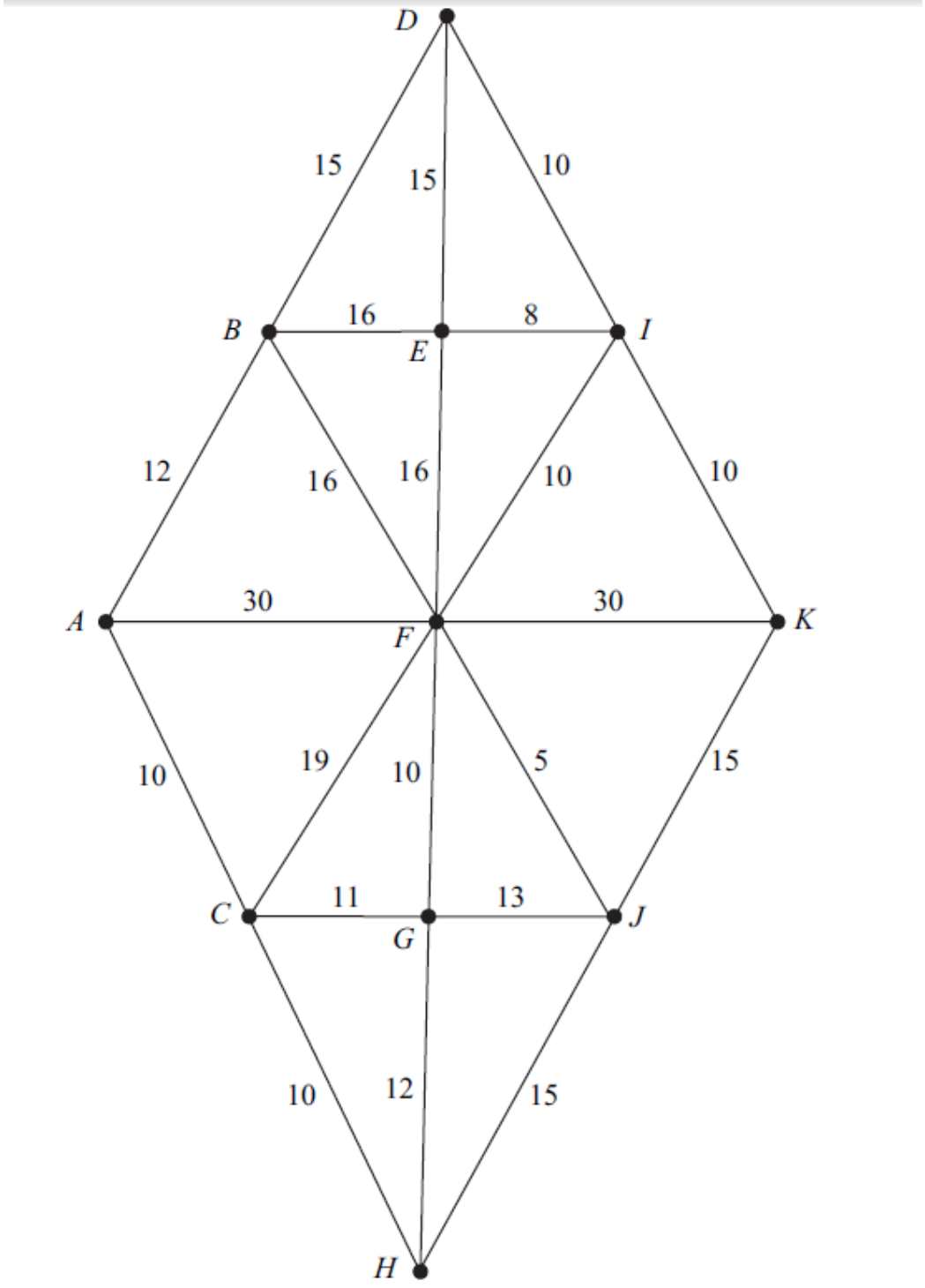
from A to D, with a walking time of 30 minutes; or

from A to I, with a walking time of 20 minutes.

Determine which of the two alternative new footpaths would reduce the walking time from A to L by the greater amount. *(3 marks)*

4 [**Figure 2**, printed on the insert, is provided for use in this question.]

The network shows 11 towns. The times, in minutes, to travel between pairs of towns are indicated on the edges.



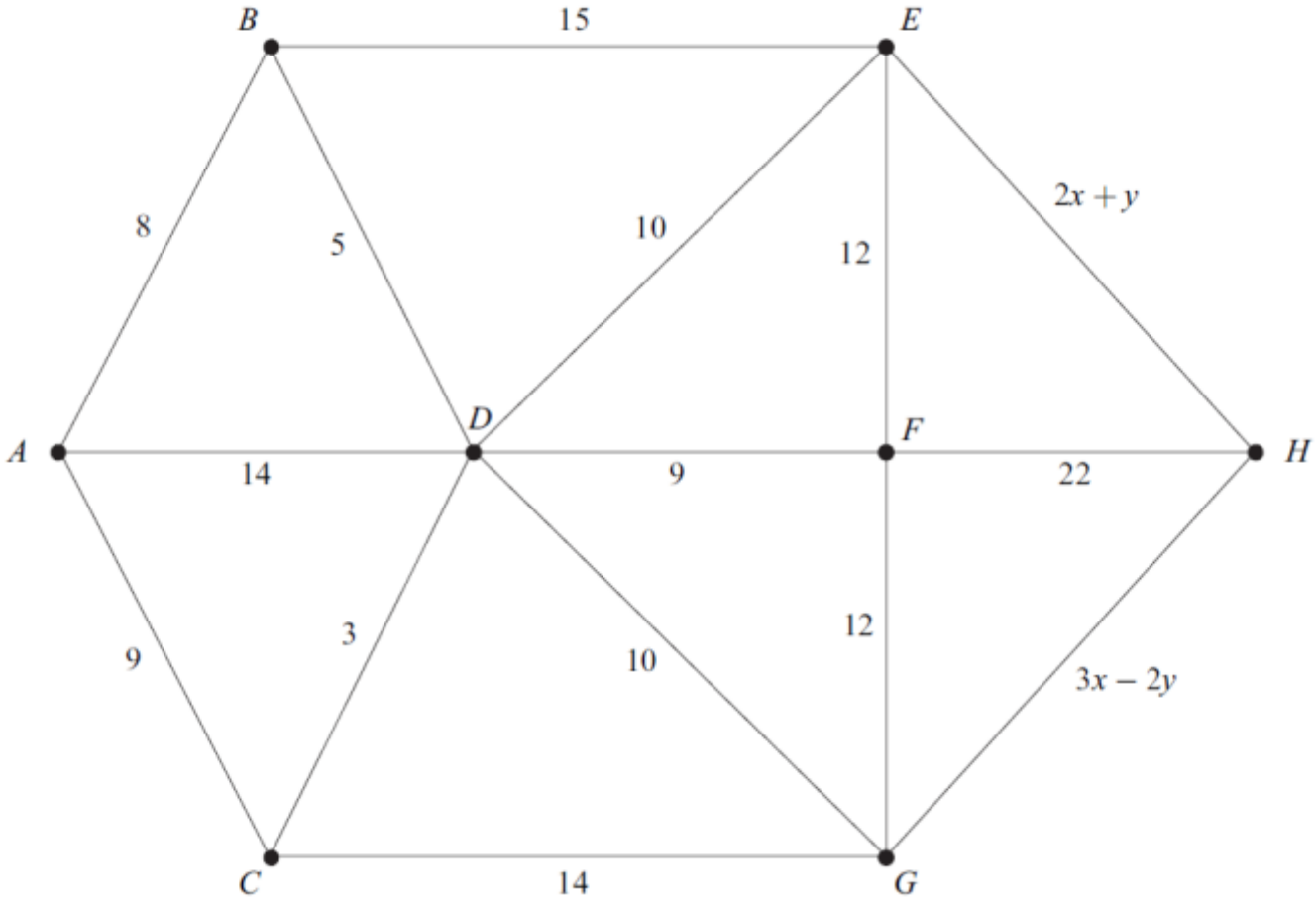
The total of all of the times is 308 minutes.

(a) (i) Use Dijkstra's algorithm on **Figure 2** to find the minimum time to travel from A to K. *(6 marks)*

(ii) State the corresponding route. *(1 mark)*

7 [**Figure 2**, printed on the insert, is provided for use in this question.]

The following network has eight vertices, A, B, ..., H, and edges connecting some pairs of vertices. The number on each edge is its weight. The weights on the edges EH and GH are functions of x and y.



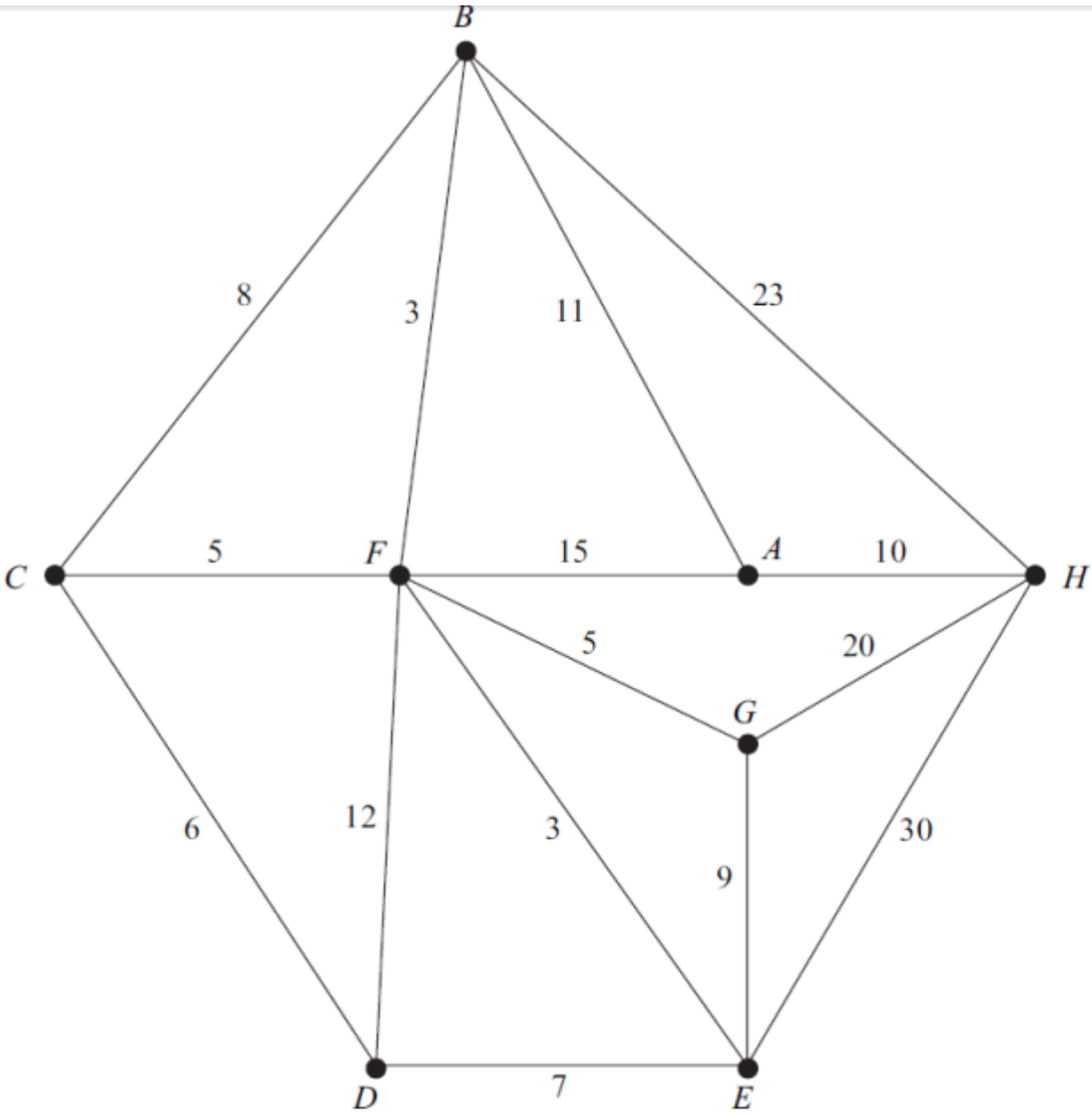
Given that there are three routes from A to H with the same minimum weight, use Dijkstra's algorithm on **Figure 2** to find:

(a) this minimum weight; *(6 marks)*

(b) the values of x and y. *(3 marks)*

3 [**Figure 1**, printed on the insert, is provided for use in this question.]

The diagram shows roads connecting some places of interest in Berlin. The numbers represent the times taken, in minutes, to walk along the roads.



The total of all walking times is 167 minutes.

(a) Mia is staying at D and is to visit H.

(i) Use Dijkstra's algorithm on **Figure 1** to find the minimum time to walk from D to H. *(6 marks)*

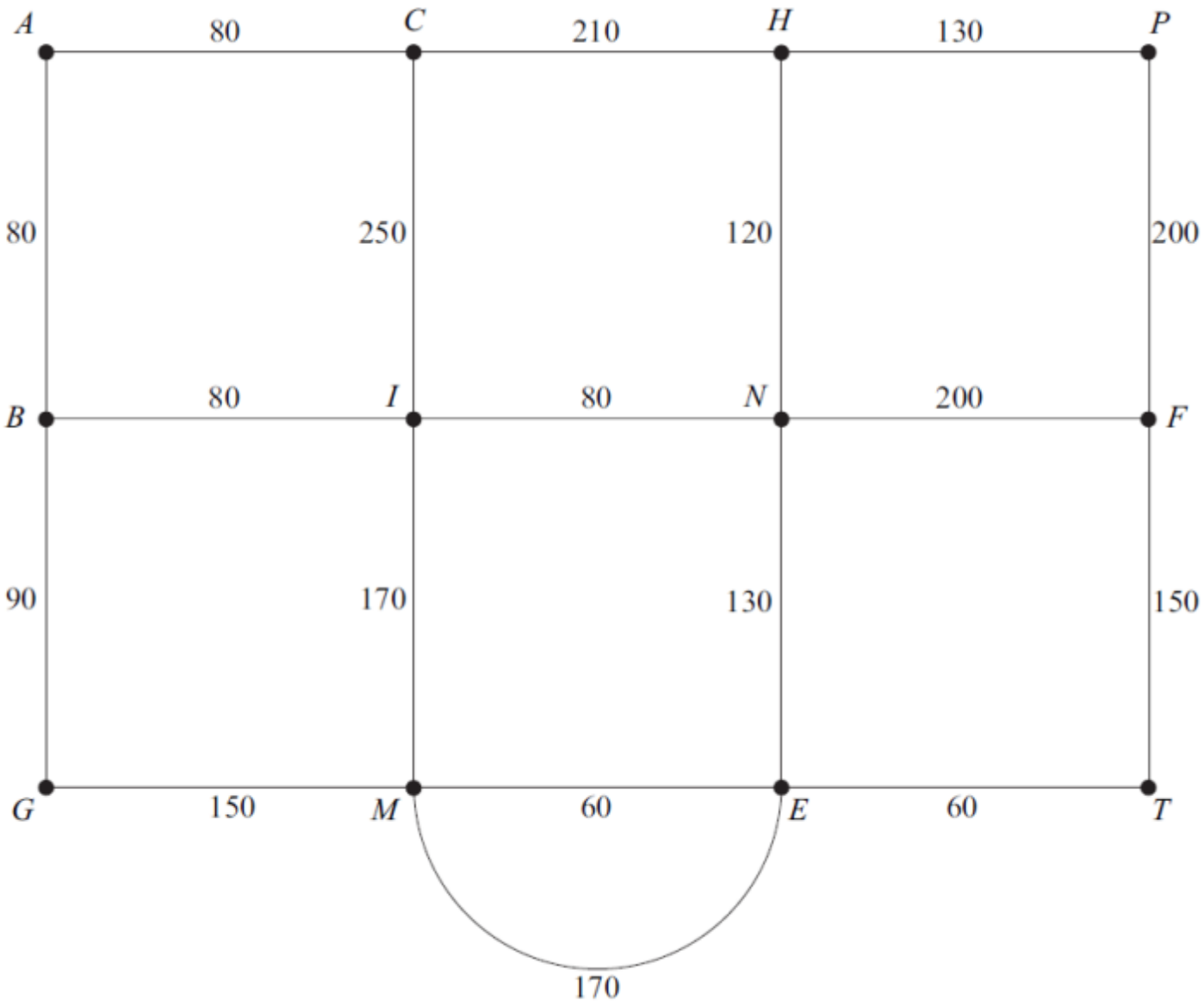
(ii) Write down the corresponding route. *(1 mark)*

June 2009

4 The diagram opposite shows a network of roads on a housing estate. The number on each edge is the length, in metres, of the road.

Joe is starting a kitchen-fitting business.

(b) Joe gets a job fitting a kitchen in a house at T. Joe starts from C and wishes to drive to T. Use Dijkstra's algorithm on the diagram opposite to find the minimum distance to drive from C to T. State the corresponding route. *(7 marks)*

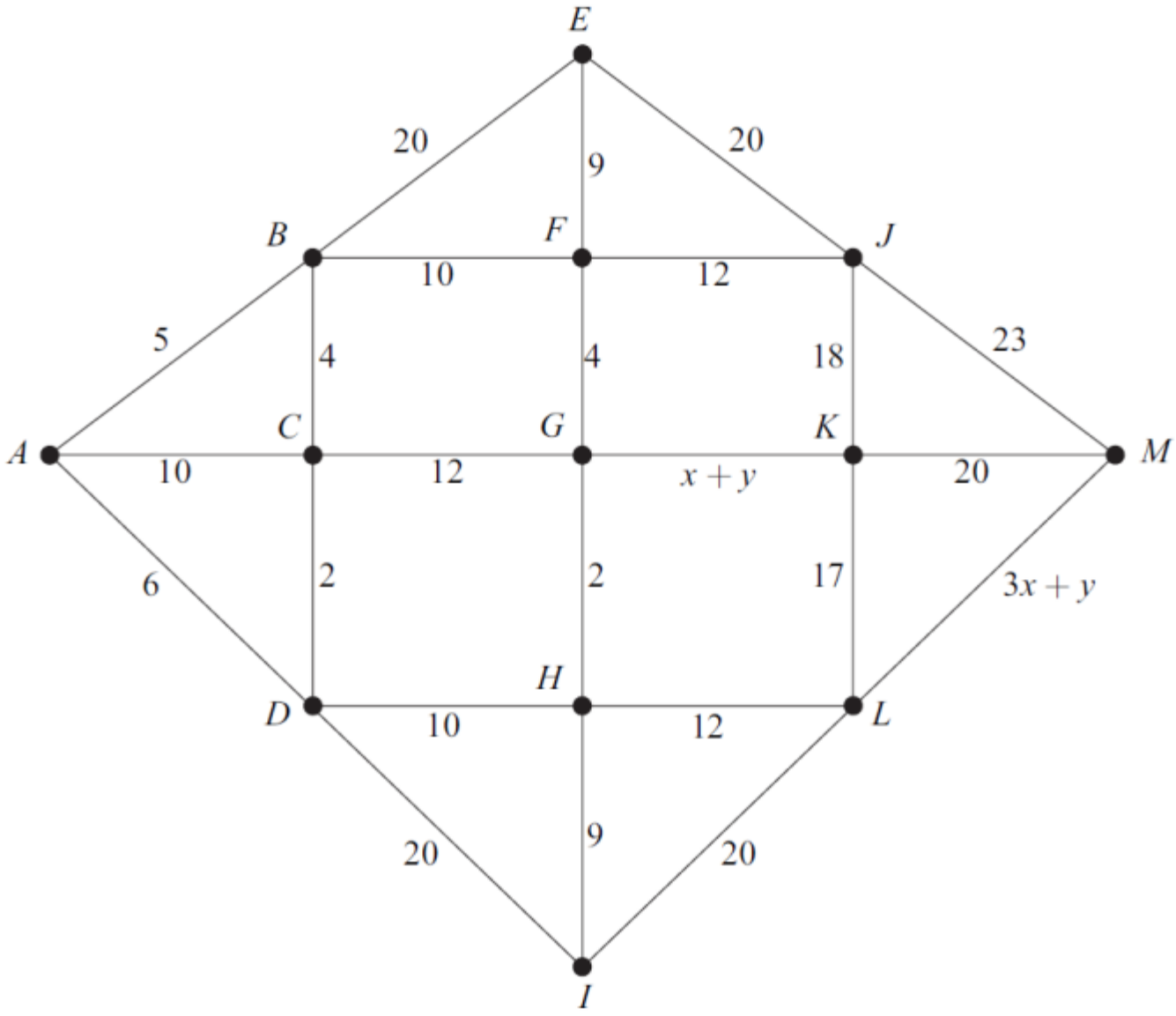


Total length of roads = 2410 metres

7 [**Figure 2**, printed on the insert, is provided for use in this question.]

The following network has 13 vertices and 24 edges connecting some pairs of vertices. The number on each edge is its weight.

The weights on the edges GK and LM are functions of x and y, where $x > 0$, $y > 0$ and $10 < x + y < 27$.



There are three routes from A to M of the same minimum total weight.

(a) Use Dijkstra's algorithm on **Figure 2** to find this minimum total weight. *(7 marks)*

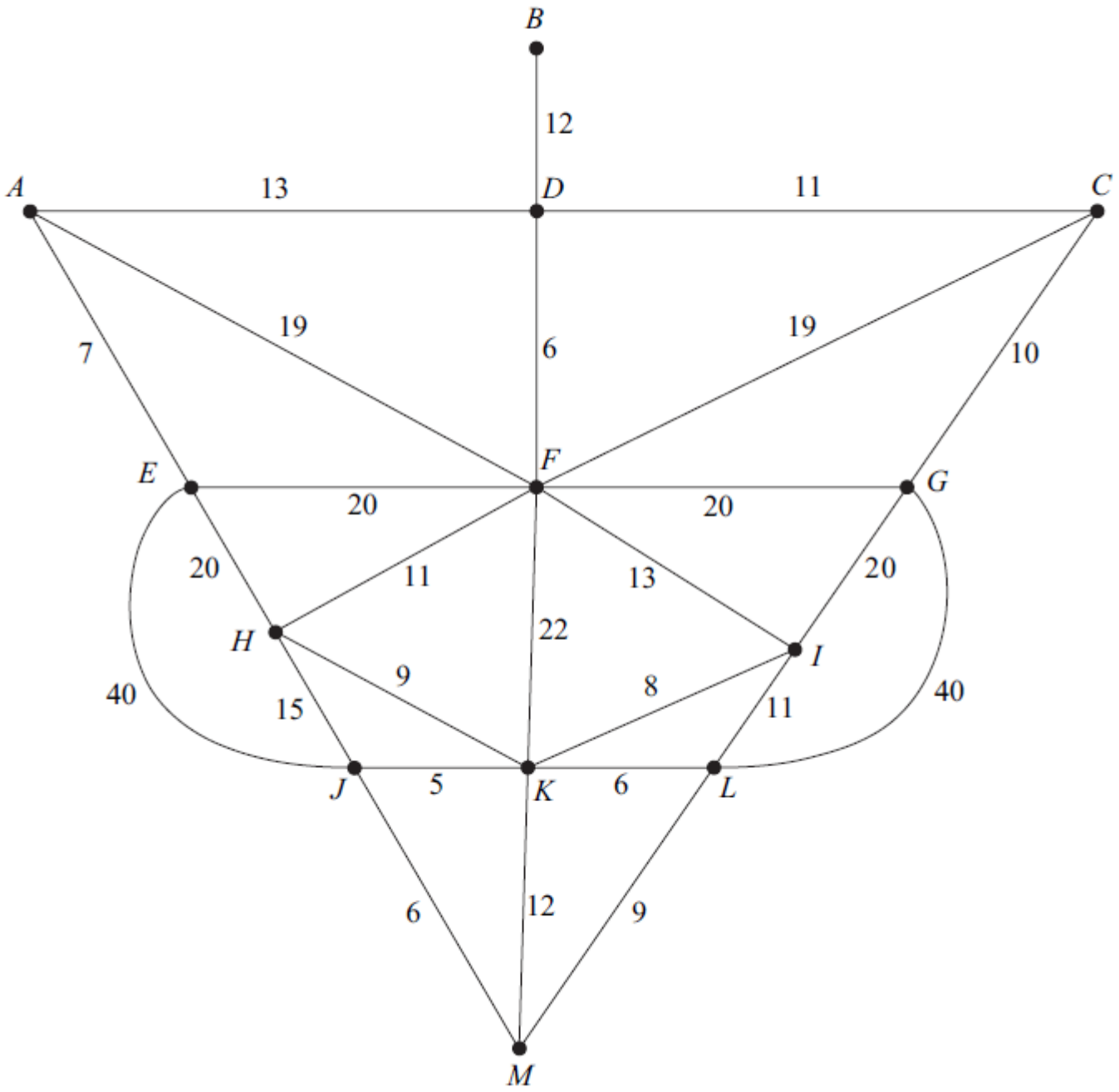
(b) Find the values of x and y. *(3 marks)*

June 2010

4 The network below shows 13 towns. The times, in minutes, to travel between pairs of towns are indicated on the edges.

The total of all the times is 384 minutes.

(a) Use Dijkstra's algorithm on the network below, starting from M, to find the minimum time to travel from M to each of the other towns. *(7 marks)*



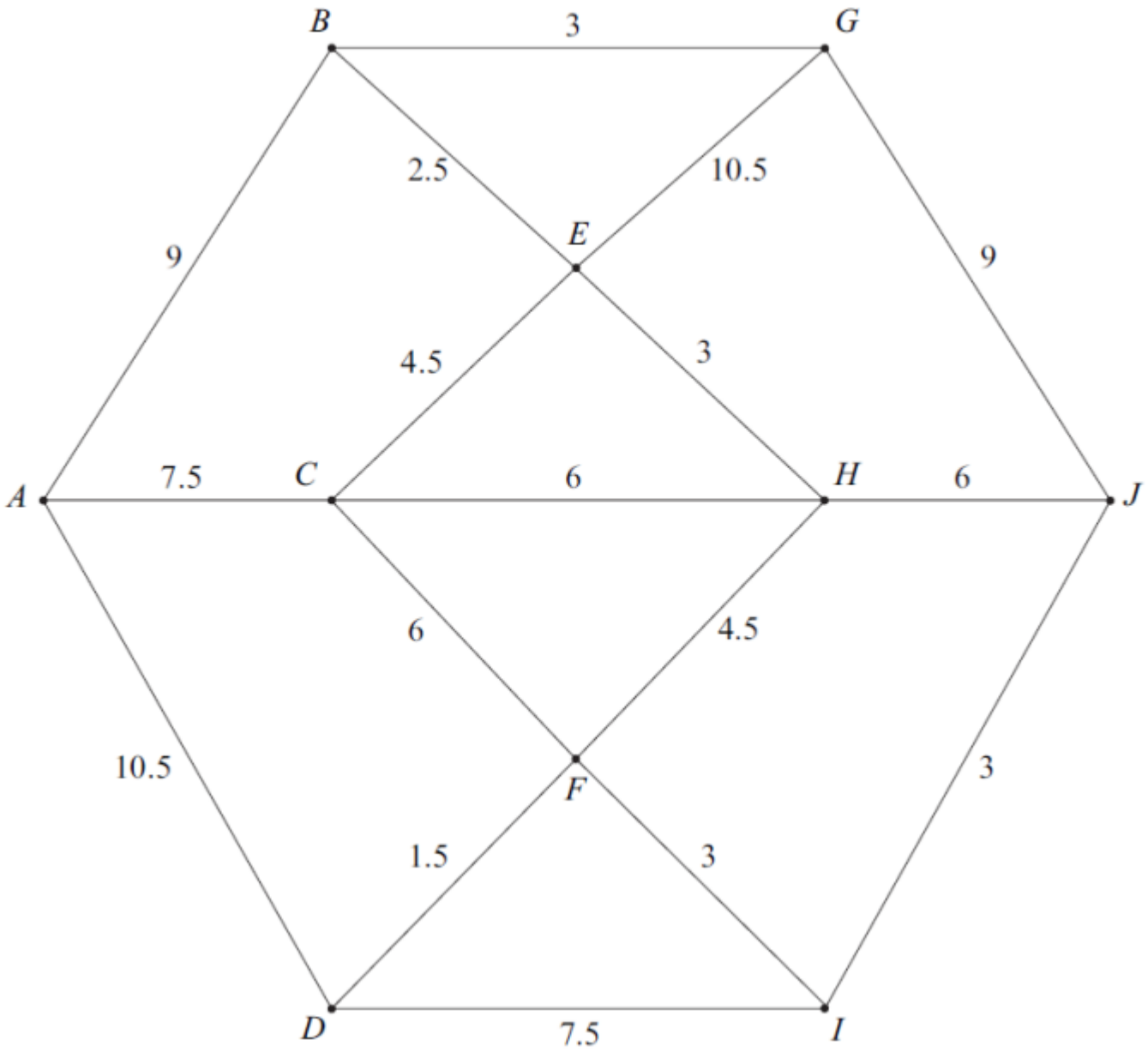
4 The network below shows some paths on an estate. The number on each edge represents the time taken, in minutes, to walk along a path.

(a) (i) Use Dijkstra's algorithm on the network to find the minimum walking time from A to J. *(6 marks)*

(ii) Write down the corresponding route. *(1 mark)*

(b) A new subway is constructed connecting C to G directly. The time taken to walk along this subway is x minutes. The minimum time taken to walk from A to G is now reduced, but the minimum time taken to walk from A to J is not reduced.

Find the range of possible values for x. *(3 marks)*



4 The network below shows some pathways at a school connecting different departments. The number on each edge represents the time taken, in minutes, to walk along that pathway.

Carol, the headteacher, wishes to walk from her office (O) to the Drama department (D).

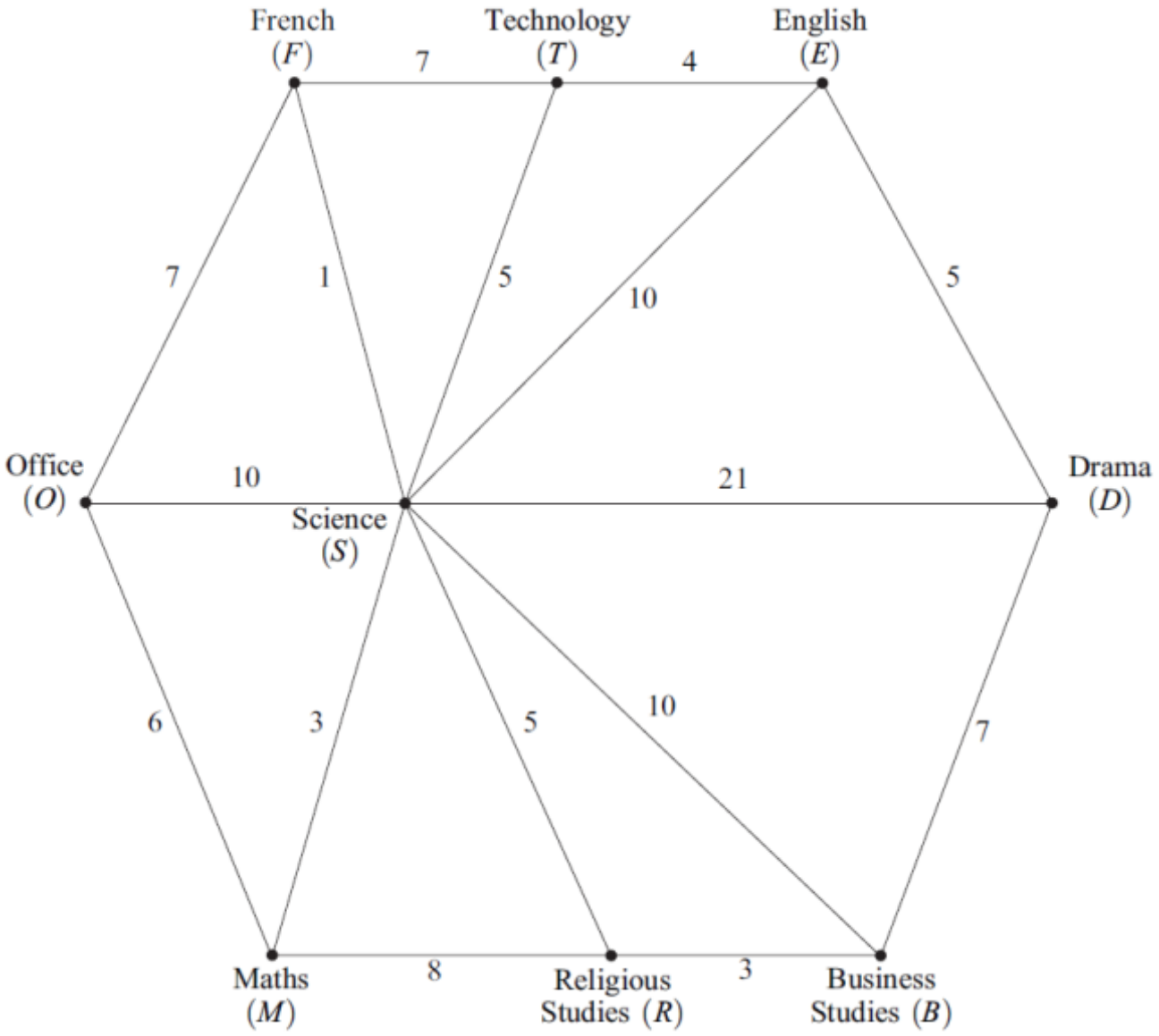
(a) (i) Use Dijkstra's algorithm on the network to find the minimum walking time from O to D. *(6 marks)*

(ii) Write down the corresponding route. *(1 mark)*

(b) On another occasion, Carol needs to go from her office to the Business Studies department (B).

(i) Write down her minimum walking time. *(1 mark)*

(ii) Write down the route corresponding to this minimum time. *(1 mark)*



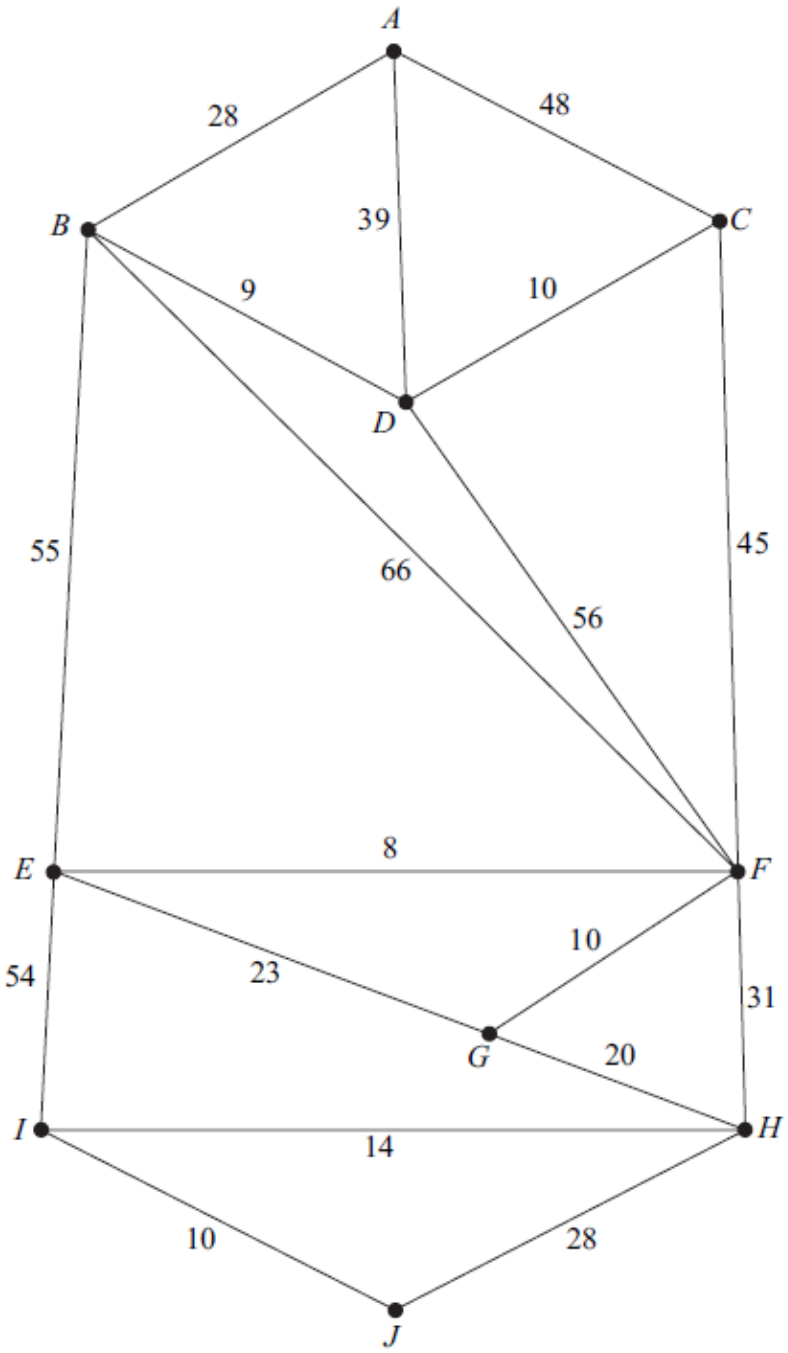
January 2012

6 The network below shows the lengths of roads, in miles, connecting 10 towns, A, B, ..., J.

(a) Use Dijkstra's algorithm on the network to find the shortest distance from A to J. Show all your working at each vertex. *(7 marks)*

(b) Write down the corresponding route. *(1 mark)*

(c) A new road is to be constructed connecting B to G. Find the length of this new road if the shortest distance from A to J is reduced by 10 miles. State the new route. *(3 marks)*



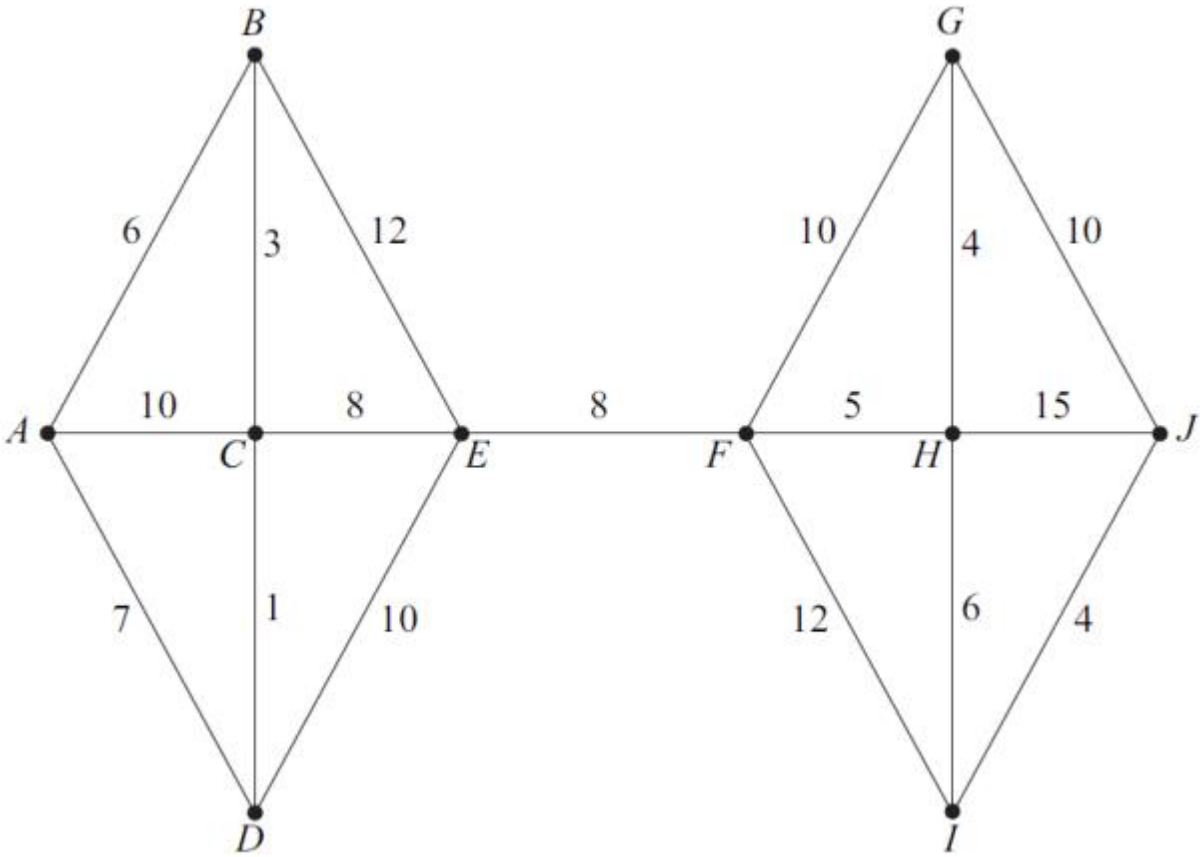
4 The edges on the network below represent some major roads in a city. The number on each edge is the minimum time taken, in minutes, to drive along that road.

(a) (i) Use Dijkstra's algorithm on the network to find the shortest possible driving time from A to J. *(5 marks)*

(ii) Write down the corresponding route. *(1 mark)*

(b) A new ring road is to be constructed connecting A to J directly.

Find the maximum length of this new road from A to J if the time taken to drive along it, travelling at an average speed of 90 km/h, is to be no more than the time found in part **(a)(i)**. *(2 marks)*



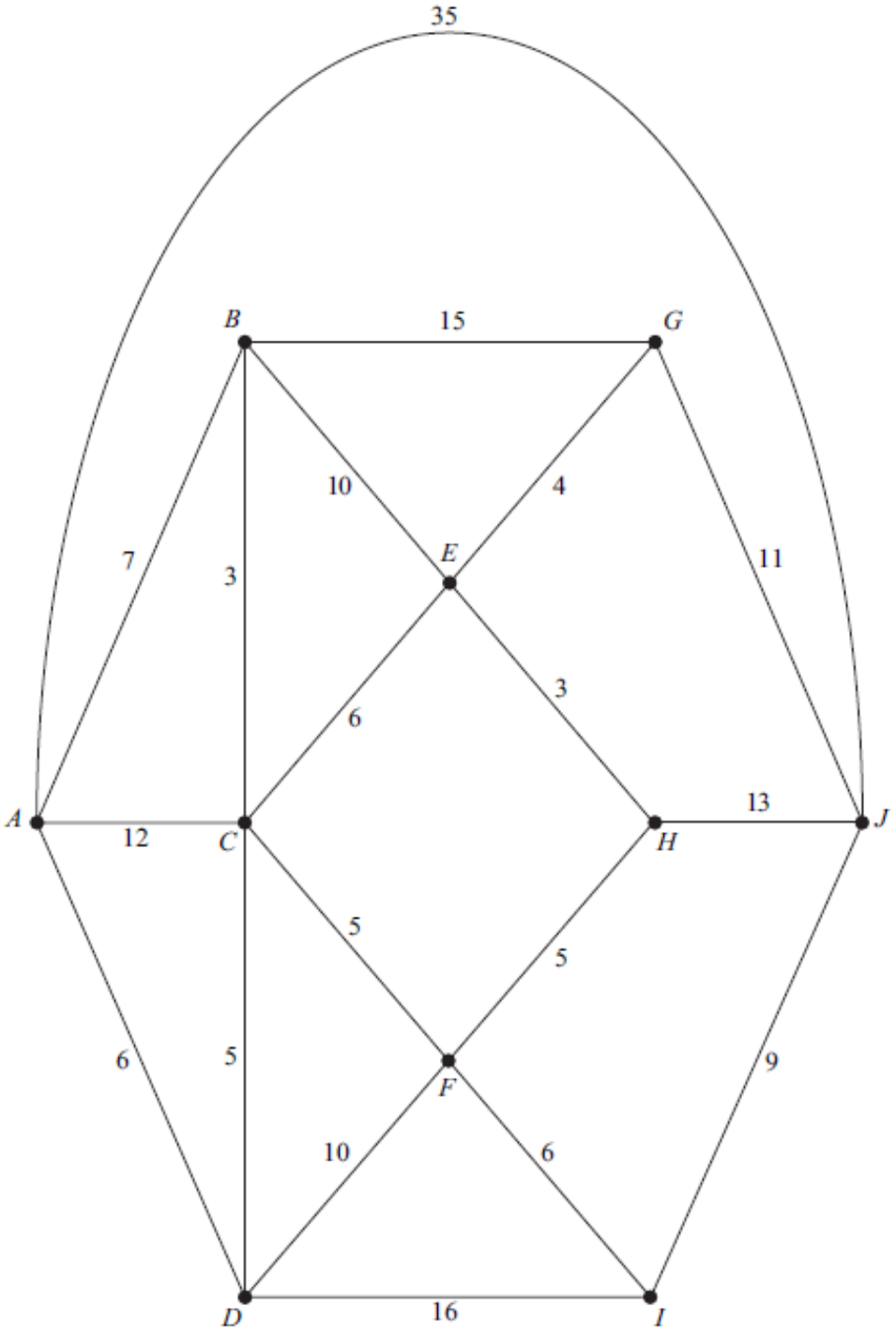
6 The network opposite shows some roads connecting towns. The number on each edge represents the length, in miles, of the road connecting a pair of towns.

(a) (i) Use Dijkstra's algorithm on the network to find the minimum distance from A to J.

(ii) Write down the corresponding route. *(7 marks)*

(b) The road AJ is a dual carriageway. Ken drives at 60 miles per hour on this road and drives at 50 miles per hour on all other roads.

Find the minimum time to travel from A to J. *(3 marks)*



June 2013

5 The network on the page opposite shows the times, in minutes, taken by police cars to drive along roads connecting 12 places, A, B, …, L.

On a particular day, there are three police cars in the area at A, E and J. There is an emergency at G and all three police cars drive to G.

(a) (i) Use Dijkstra's algorithm on the network, **starting from *G***, to find the minimum driving time for each of the police cars to arrive at G. *(7 marks)*

(ii) For each of the police cars, write down the route corresponding to the minimum driving time in your answer to part **(a)(i)**. *(3 marks)*