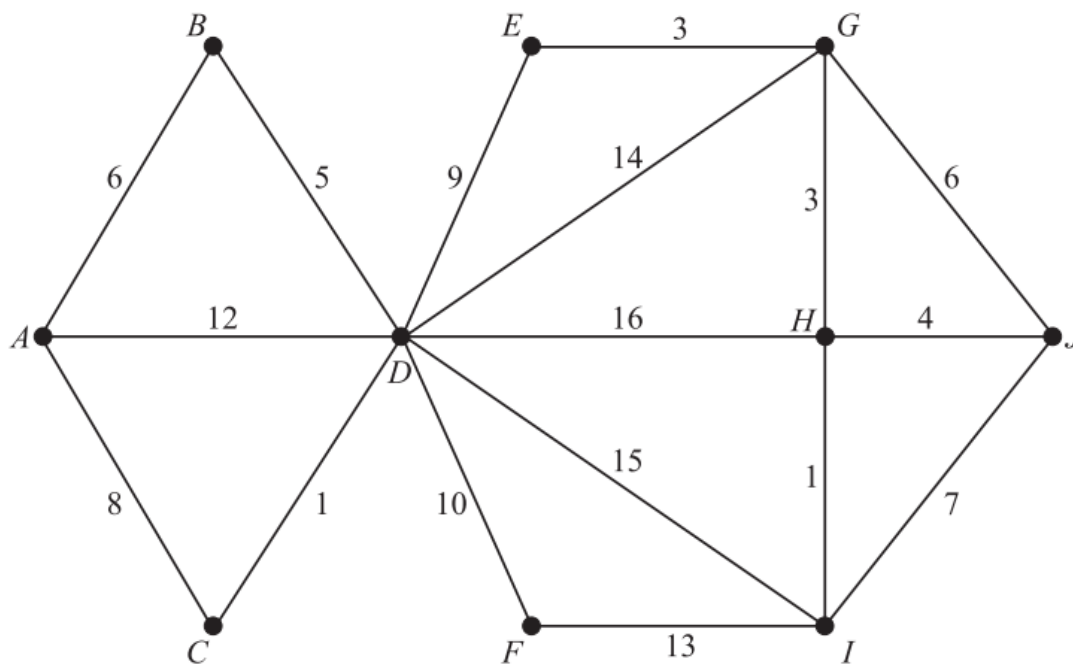# D1 Shortest Path Algorithms

Challenge 1

[**Figure 1**, printed on a separate sheet, is provided for use in answering this question.]

The following network shows the distances, in kilometres, of roads connecting ten towns.

(a) An ambulance is based at *A* and has to respond to an emergency at *J*. Use Dijkstra's algorithm on **Figure 1** to find the minimum distance to travel from *A* to *J*, and state the route.   *(6 marks)*

Challenge 2

3 [Figure 1, printed on a separate sheet, is provided for use in answering this question.]

The following network shows the time, in minutes, to travel between ten towns.
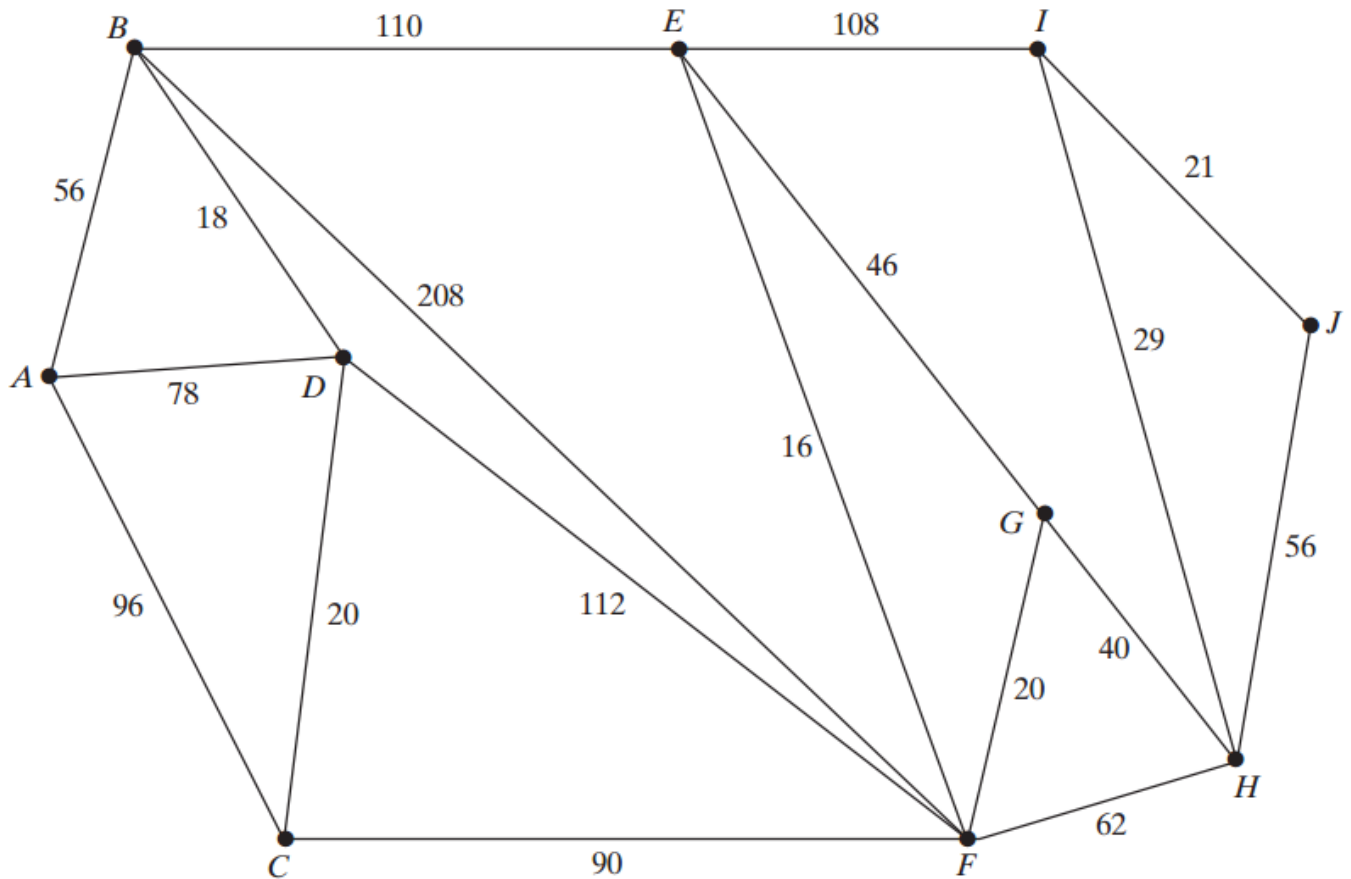
(a) Use Dijkstra's algorithm on Figure 1 to find the minimum time to travel from A to J, and state the route. *(7 marks)*

(b) A new road is to be constructed connecting D to E. Find the time needed for travelling this section of road if the overall minimum journey time to travel from A to J is reduced by 10 minutes. State the new route. *(3 marks)*

Final Challenge

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

Three boys, John, Lee and Safraz, are to take part in a running race. They are each starting from a different point but they all must finish at the same point N.

John starts from the point A, Lee from the point B and Safraz from the point C.

The following diagram shows the network of streets that they may run along. The numbers on the arcs represent the time, in seconds, taken to run along each street.
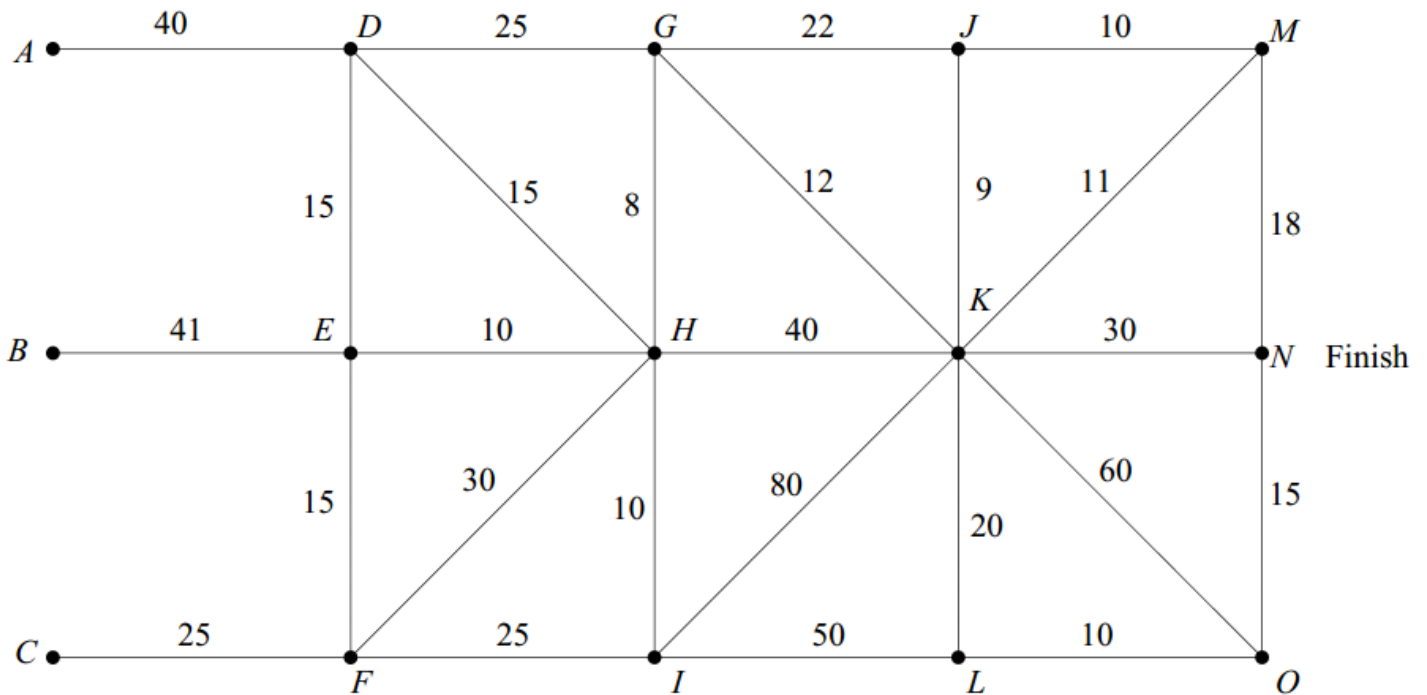
(a) Working backwards from N, or otherwise, use Dijkstra's algorithm on **Figure 2** to find the time taken for each of the three boys to complete the course. Show all your working at each vertex.

(8 marks)

(b) Write down the route that each boy should take.

(3 marks)

Insets

Graph 1

- B to E: 110
- E to I: 108
- B to A: 56
- B to D: 18
- B to C: 208 (edge labeled 208 from B toward F area)
- A to D: 78
- A to C: 96
- D to C: 20
- D to F: 112
- I to J: 21
- I to H: 29
- E to G: 46
- E to F: 16
- G to H: 40
- G to F: 20
- J to H: 56
- C to F: 90
- F to H: 62

Graph 2

From–To	Weight
A–D	40
D–G	25
G–J	22
J–M	10
D–E	15
D–H	15
G–H	8
G–K	12
J–K	9
K–M	11
M–N	18
B–E	41
E–H	10
H–K	40
K–N	30
E–F	15
F–H	30
H–I	10
I–K	80
K–O	60
K–L	20
C–F	25
F–I	25
I–L	50
L–O	10
N–O	15