## *D1 – Minimum Spanning Trees Exam Questions (Edexcel)*

**Q1.**

| | Art | Biology | Chemistry | Drama | English | French | Graphics |
|---|---|---|---|---|---|---|---|
| Art (A) | – | 61 | 93 | 73 | 50 | 48 | 42 |
| Biology (B) | 61 | – | 114 | 82 | 83 | 63 | 58 |
| Chemistry (C) | 93 | 114 | – | 59 | 94 | 77 | 88 |
| Drama (D) | 73 | 82 | 59 | – | 89 | 104 | 41 |
| English (E) | 50 | 83 | 94 | 89 | – | 91 | 75 |
| French (F) | 48 | 63 | 77 | 104 | 91 | – | 68 |
| Graphics (G) | 42 | 58 | 88 | 41 | 75 | 68 | – |

The table shows the travelling times, in seconds, to walk between seven departments in a college.

(a) Use Prim's algorithm, starting at Art, to find the minimum spanning tree for the network represented by the table. You must clearly state the order in which you select the **edges** of your tree.

**(3)**

(b) Draw the minimum spanning tree using the vertices given in Diagram 1 in the answer book.

**(1)**

(c) State the weight of the tree.

**(1)**

**(Total 5 marks)**

**(Q01 6689/01, June 2014)**


| | Art | Biology | Chemistry | Drama | English | French | Graphics |
|---|---|---|---|---|---|---|---|
| Art (A) | – | 61 | 93 | 73 | 50 | 48 | 42 |
| Biology (B) | 61 | – | 114 | 82 | 83 | 63 | 58 |
| Chemistry (C) | 93 | 114 | – | 59 | 94 | 77 | 88 |
| Drama (D) | 73 | 82 | 59 | – | 89 | 104 | 41 |
| English (E) | 50 | 83 | 94 | 89 | – | 91 | 75 |
| French (F) | 48 | 63 | 77 | 104 | 91 | – | 68 |
| Graphics (G) | 42 | 58 | 88 | 41 | 75 | 68 | – |


**Q2.**

(a)

18 20 11 7 17 15 14 21 23 16 9

The list of numbers shown above is to be sorted into **ascending** order. Apply quick sort to obtain the sorted list. You must make your pivots clear.

**(5)**

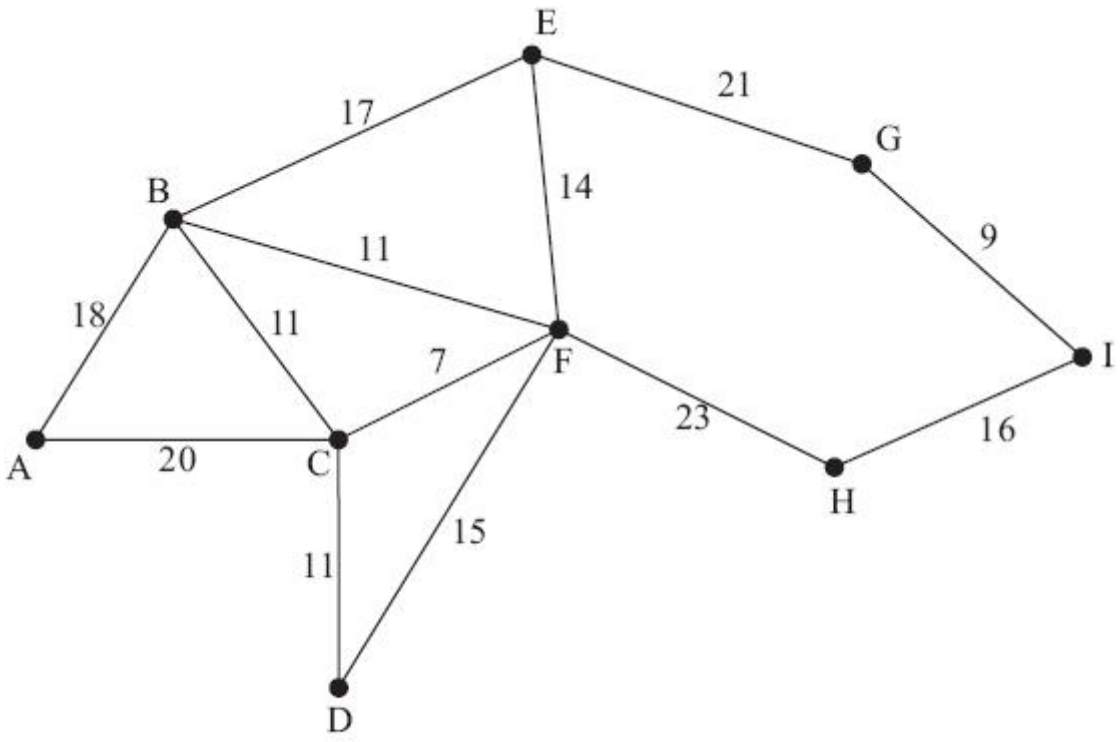



**Figure 3**

Figure 3 represents a network of paths in a park. The number on each arc represents the length of the path in metres.

(b) Using your answer to part (a) and Kruskal's algorithm, find a minimum spanning tree for the network in Figure 3. You should list the arcs in the order in which you consider them and state whether you are adding it to your minimum spanning tree.

**(4)**

(c) Find the total weight of the minimum spanning tree.

**(1)**

**(Total 10 marks)**

**(Q01 6689/01, Jan 2008)**

**Q3.**

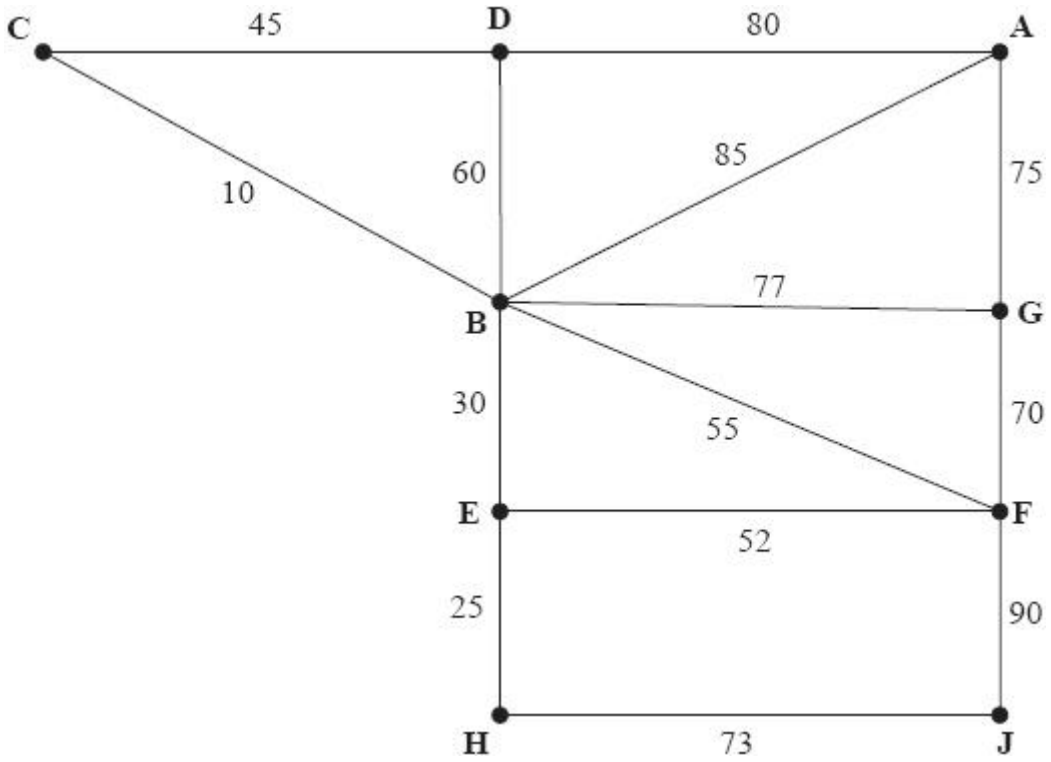



**Figure 3**

Figure 3 represents nine computer terminals, A, B, C, D, E, F, G, H and J, at Pearsonby School. The school wishes to connect them to form a single computer network. The number on each arc represents the cost, in pounds, of connecting the corresponding computer terminals.

(a) Use Prim's algorithm, starting at B, to find the minimum spanning tree for the computer network. You must clearly state the order in which you select the arcs of your tree.

**(3)**

(b) State the minimum cost of connecting the nine computer terminals.

**(1)**

It is discovered that some computer terminals are already connected. There are already direct connections along BD and FJ, as shown in bold in Diagram 1 in the answer book. It is decided to use these connections.

(c) Use Kruskal's algorithm to find the minimum spanning tree that includes arcs BD and FJ. You must list the arcs in the order that you consider them. In each case, state whether or not you are adding the arcs to your spanning tree.

**(3)**

**(Total for question = 7 marks)**

**(Q01 6689/01, June 2017)**

**Q4.**

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| A | – | 85 | 110 | 160 | 225 | 195 |
| B | 85 | – | 100 | 135 | 180 | 150 |
| C | 110 | 100 | – | 215 | 200 | 165 |
| D | 160 | 135 | 215 | – | 235 | 215 |
| E | 225 | 180 | 200 | 235 | – | 140 |
| F | 195 | 150 | 165 | 215 | 140 | – |

The table shows the average journey time, in minutes, between six towns, A, B, C, D, E and F.

(a) Use Prim's algorithm, starting at A, to find a minimum spanning tree for this network. You must list the arcs that form your tree in the order in which you selected them.

**(3)**

(b) Draw your tree using the vertices given in Diagram 1 in the answer book.

**(1)**

(c) Find the weight of your minimum spanning tree.

**(1)**

Kruskal's algorithm may also be used to find a minimum spanning tree.

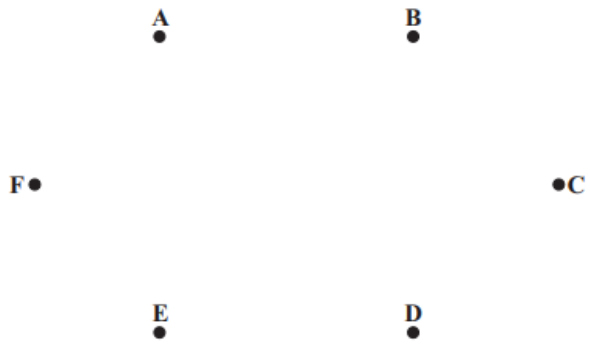
(d) State three differences between Prim's algorithm and Kruskal's algorithm.

**(3)**

**(Total 8 marks)**

**(Q01 6689/01/R, June 2013)**


| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| A | – | 85 | 110 | 160 | 225 | 195 |
| B | 85 | – | 100 | 135 | 180 | 150 |
| C | 110 | 100 | – | 215 | 200 | 165 |
| D | 160 | 135 | 215 | – | 235 | 215 |
| E | 225 | 180 | 200 | 235 | – | 140 |
| F | 195 | 150 | 165 | 215 | 140 | – |

**Q5.**

The table below shows the lengths, in km, of the roads in a network connecting seven towns, A, B, C, D, E, F and G.

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| A | – | 24 | – | 22 | 35 | – | – |
| B | 24 | – | 25 | 27 | – | – | – |
| C | – | 25 | – | 33 | 31 | 36 | 26 |
| D | 22 | 27 | 33 | – | – | 42 | – |
| E | 35 | – | 31 | – | – | 37 | 29 |
| F | – | – | 36 | 42 | 37 | – | 40 |
| G | – | – | 26 | – | 29 | 40 | – |

(a) By adding the arcs from vertex D along with their weights, complete the drawing of the network on Diagram 1 in the answer book.

**(2)**

(b) Use Kruskal's algorithm to find a minimum spanning tree for the network. You should list the arcs in the order that you consider them. In each case, state whether you are adding the arc to your minimum spanning tree.

**(3)**

(c) State the weight of the minimum spanning tree.

**(1)**

**(Total for question = 6 marks)**

**(Q01 9FM0/03D, Oct 2020)**


| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| A | – | 24 | – | 22 | 35 | – | – |
| B | 24 | – | 25 | 27 | – | – | – |
| C | – | 25 | – | 33 | 31 | 36 | 26 |
| D | 22 | 27 | 33 | – | – | 42 | – |
| E | 35 | – | 31 | – | – | 37 | 29 |
| F | – | – | 36 | 42 | 37 | – | 40 |
| G | – | – | 26 | – | 29 | 40 | – |

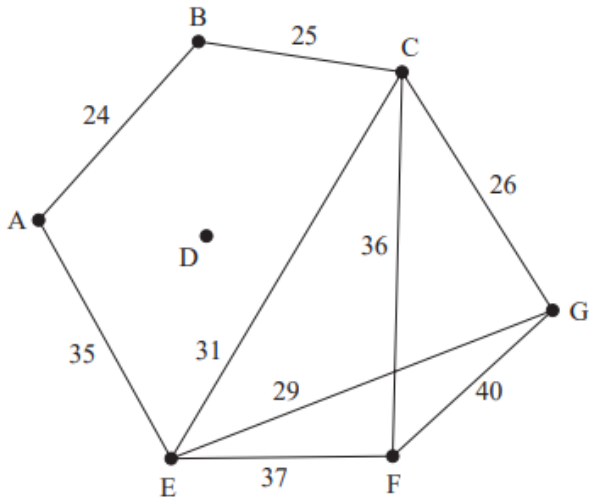




**Diagram 1**

**Q6.**

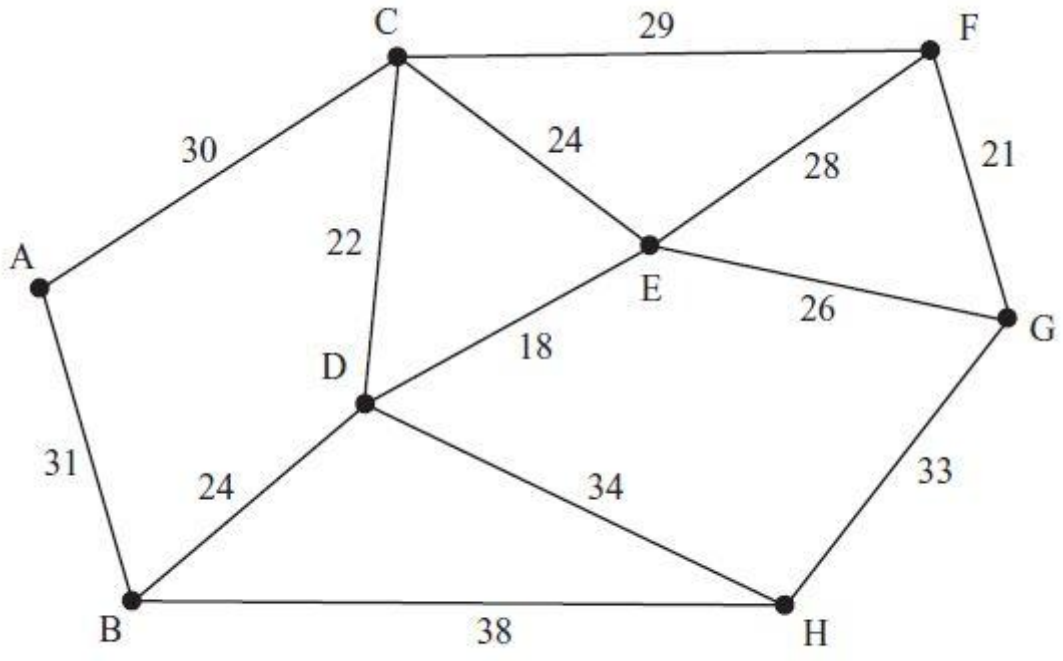



**Figure 1**

Figure 1 represents the distances, in metres, between eight vertices, A, B, C, D, E, F, G and H, in a network.

(a) Use Kruskal's algorithm to find a minimum spanning tree for the network.
You should list the arcs in the order in which you consider them. In each case, state whether you are adding the arc to your minimum spanning tree.

**(3)**

(b) Complete Matrix 1 in your answer book, to represent the network.

**(2)**

(c) **Starting at A, use Prim's algorithm** to determine a minimum spanning tree. You must clearly state the order in which you considered the vertices and the order in which you included the arcs.

**(3)**

(d) State the weight of the minimum spanning tree.

**(1)**

**(Total 9 marks)**
**(Q01 6689/01, June 2010)**