AQA Computer Science A-Level

4.2.5 Trees

Past Paper Questions

10   A graph can be drawn to represent a maze. In such a graph, each graph vertex represents one of the following:

- the entrance to or exit from the maze
- a place where more than one path can be taken
- a dead end.

Edges connect the vertices according to the paths in the maze.

Figure 6 shows a maze and **Figure 7** shows one possible representation of this maze. Position 1 in **Figure 6** corresponds to vertex 1 in **Figure 7** and is the entrance to the maze. Position 7 in **Figure 6** is the exit to the maze and corresponds to vertex 7. Dead ends have been represented by the symbol ——⊣ in **Figure 7**.

Figure 8 shows a simplified undirected graph of this maze with dead ends omitted.
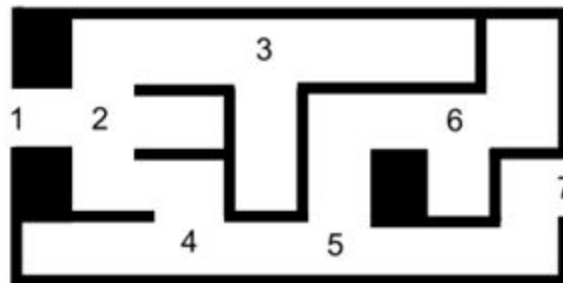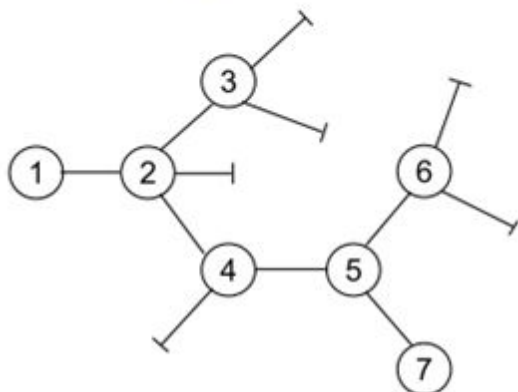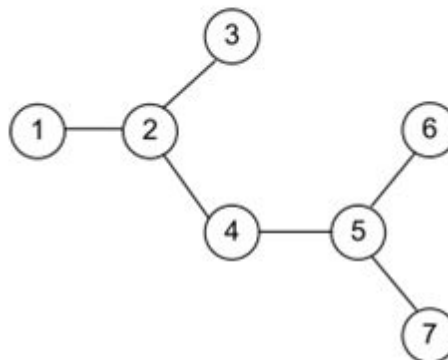
Figure 6

Figure 7

Representation of maze
including dead ends

Figure 8

Graph representing maze
with dead ends omitted

10 (a) The graph in **Figure 8** is a tree.

State **one** property of the graph in **Figure 8** that makes it a tree.

....

....

(1 mark)

10 (b) The graphs of some mazes are not trees.

Describe a feature of a maze that would result in its graph **not** being a tree.

....

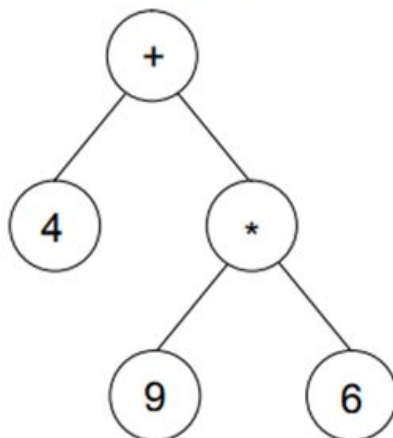..

(1 mark)

4   A tree can be used to represent a mathematical expression. This is known as an expression tree. **Figure 5** is an expression tree for the infix expression 4 + 9 * 6.

Figure 5

4 (a)   An expression tree is an example of a rooted tree.

State the contents of the root node: ....

List the contents of **all** of the leaf nodes: ....

(2 marks)

4 (b) The expression tree in **Figure 5** could be represented using three one-dimensional arrays named **A**, **B** and **C**. **Figure 6** shows a representation of **Figure 5** together with the array indices.

Figure 6

Arrays

Index	A	B	C
[1]	+	2	3
[2]	4	0	0
[3]	*	4	5
[4]	9	0	0
[5]	6	0	0

Describe the role of each of the arrays **A**, **B** and **C**.

A: ....

B: ....

C: ....

(3 marks)

4 (c) What does an entry of 0 in array **B** indicate?

....

....

(1 mark)

4 (d)   The procedure in **Figure 7** describes a type of tree traversal that can be carried out on the representation of the tree shown in **Figure 6**.

Figure 7

```
Procedure Traverse(Pos:Integer)
   If B[Pos] > 0 Then Traverse(B[Pos])
   If C[Pos] > 0 Then Traverse(C[Pos])
   Output A[Pos]
End Procedure
```

Using the table below, trace the execution of the procedure when it is called using `Traverse(1)`. You may not need to use all of the lines provided in the table.

Pos	Output

(4 marks)

4 (e)   Which type of tree traversal does the procedure `Traverse` carry out?

....

(1 mark)

4 (f)   What does the output of the procedure represent?

....
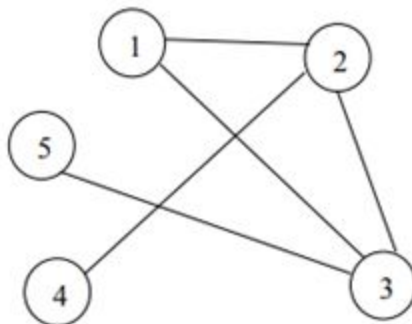
(1 mark)

0 3   The Cat transportation company (CTC) is a business that specialises in preparing cats for cat shows.

They need to take five cats to the AQA cat show. They will transport the cats in their van. CTC owns only one van.

They cannot put all the cats in their van at the same time because some of the cats get stressed when in the company of some of the other cats. The cats would not therefore arrive in top condition for the cat show if they were all in the van at the same time.

The graph in **Figure 3** shows the relationships between the five cats (labelled 1 to 5). If there is an edge between two cats in the graph then they **cannot** travel in the van together at the same time.

Figure 3

0 3 . **1**   Explain why the graph in **Figure 3** is **not** a tree.

[1 mark]