1. The bike path on Moss island has eight trails. Two of them connect the north shore of the island (N) to the rest area (R). Another trail connects the north shore of the island to the eastern shore (E), and another connects the north shore to a flower garden (F). A trail connects the rest area to the western shore (W) of the island. The last three trails connect the south shore (S) to the rest area and to the eastern and western shores of the island.
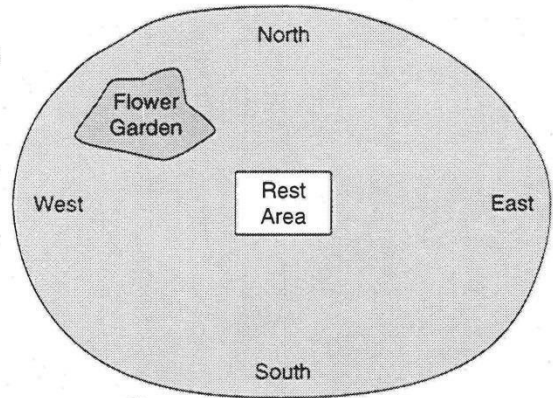
   a) Construct the graph illustrating the connections between these places.

   b) Is this a connected graph? Justify your answer.

   c) Is this graph a tree? Justify your answer.

   d) Does this graph contain an Euler path? If so, name it.

   e) Does this graph contain a Hamiltonian path? If so, name it.

2. Represent the indicators of inflation (below) by a directed graph.

   – A drop in interest rates leads to greater indebtedness and a decrease in savings.

   – Greater indebtedness and a decrease in savings lead to an increase in the money supply.

   – An increase in the money supply leads to rising prices.
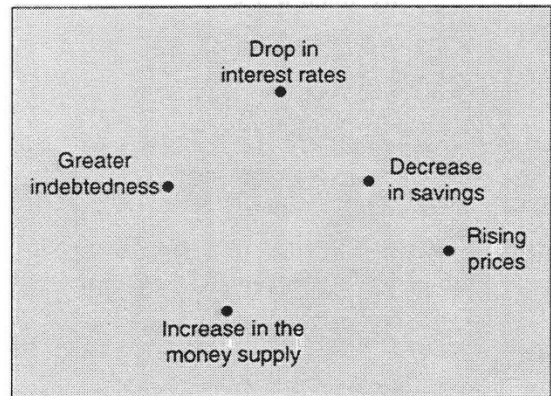
3. On the right is a plan of a "mouse maze" created by a researcher studying animal behaviour. The researcher wants to study the effects of overpopulation on the behaviour of mice. The different sections of the maze are connected by a series of openings in the panels. Construct the graph of the relationships defined by the expression "communicates with" between the vertices, which are the different areas of the plan.
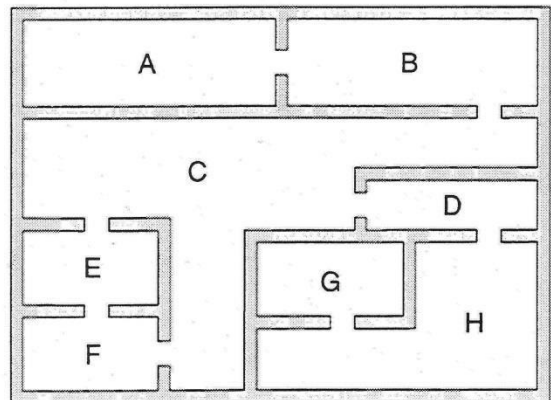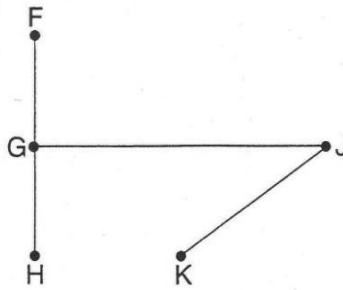
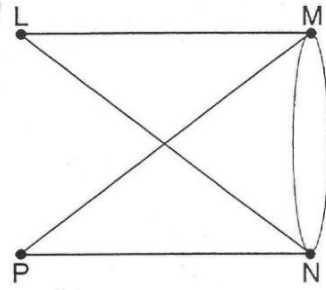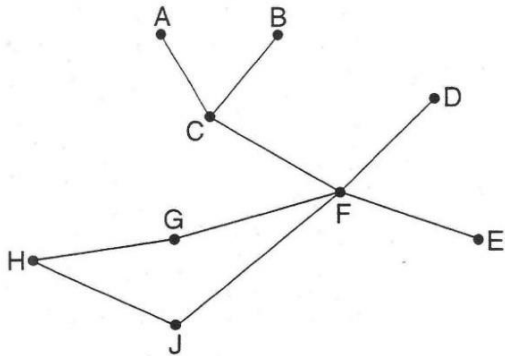**4.** Determine if the following graphs contain an Euler path or circuit.

a)
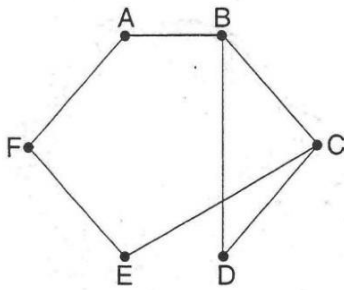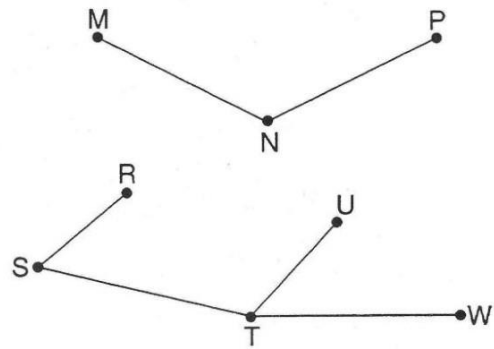

b)

c)

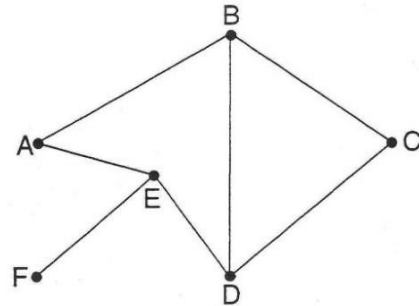**5.** Why are the graphs shown below not trees?

*a)*

b)

6. Find d(C, F) in this graph.

7. On the right is a graph of the floor of a school's atrium. Parallel edges indicate that the sections of the atrium floor are separated by benches, while a simple edge indicates that the section is free of obstacles.

a) Can a caretaker clean the floors by going over each section of floor once and only once?

*b)* If so, where must he begin and end his work?
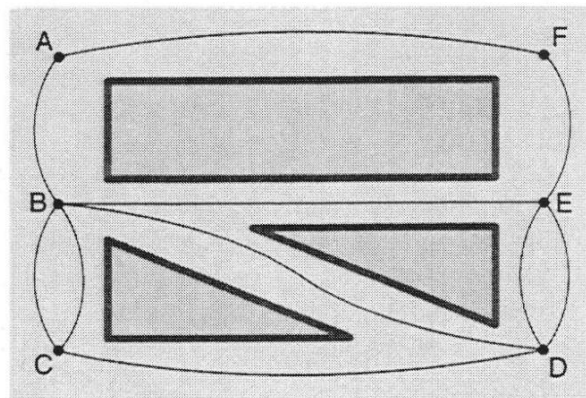
8. The floor plan of a shopping centre indicates the number of possible directions that can be taken at each intersection.
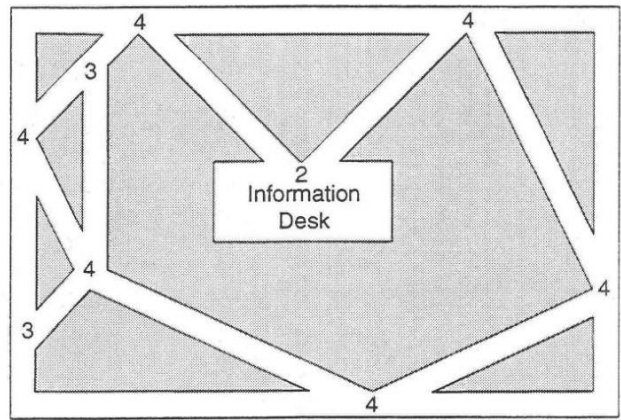
   a) Does this plan contain an Euler path?

   b) Explain why a security guard cannot start and end at the information desk and patrol each corridor only once.

9. Find the following (refer to the graph and show your work):
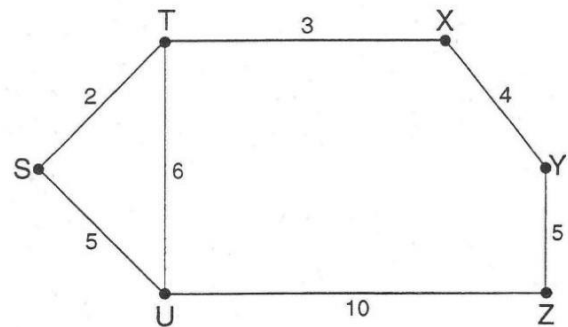
   a) the distance between S and Z;

   b) the path of least value joining S to Z.

10. If comic books are anything to go by, fraud artists in the Wild West were tarred and feathered before being run out of town. To avoid this humiliation, Jack, a notorious fraud artist, must avoid passing through the same town twice. The vertices of the graph on the right represent the towns, and the edges, the roads connecting them.
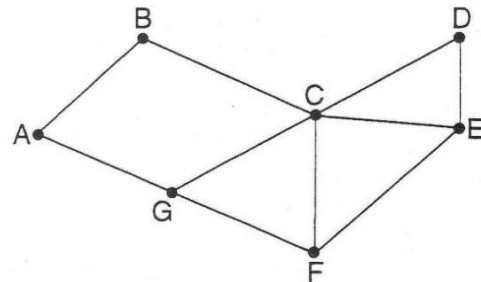
    a) Can Jack carry out his scams by passing through each town only once? If so, give the appropriate path or circuit.

    b) Can he travel all the roads once and only once? Justify your answer.

11. A doctor living in village K in a developing country wants to visit the surrounding villages. Before leaving his village, he estimates the time it will take him to travel the distance between each village. Here is the graph he constructed.
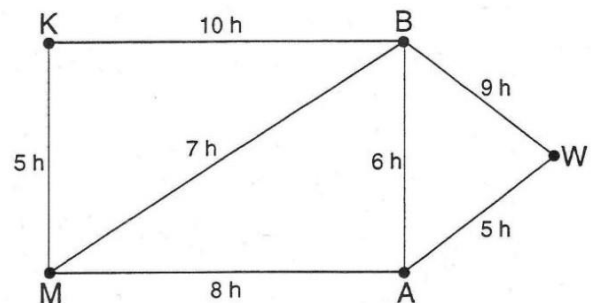
    a) What route must the doctor take if he wants to return home as quickly as possible?

    b) What is the minimum amount of time it will take him to visit all the villages and return home?