

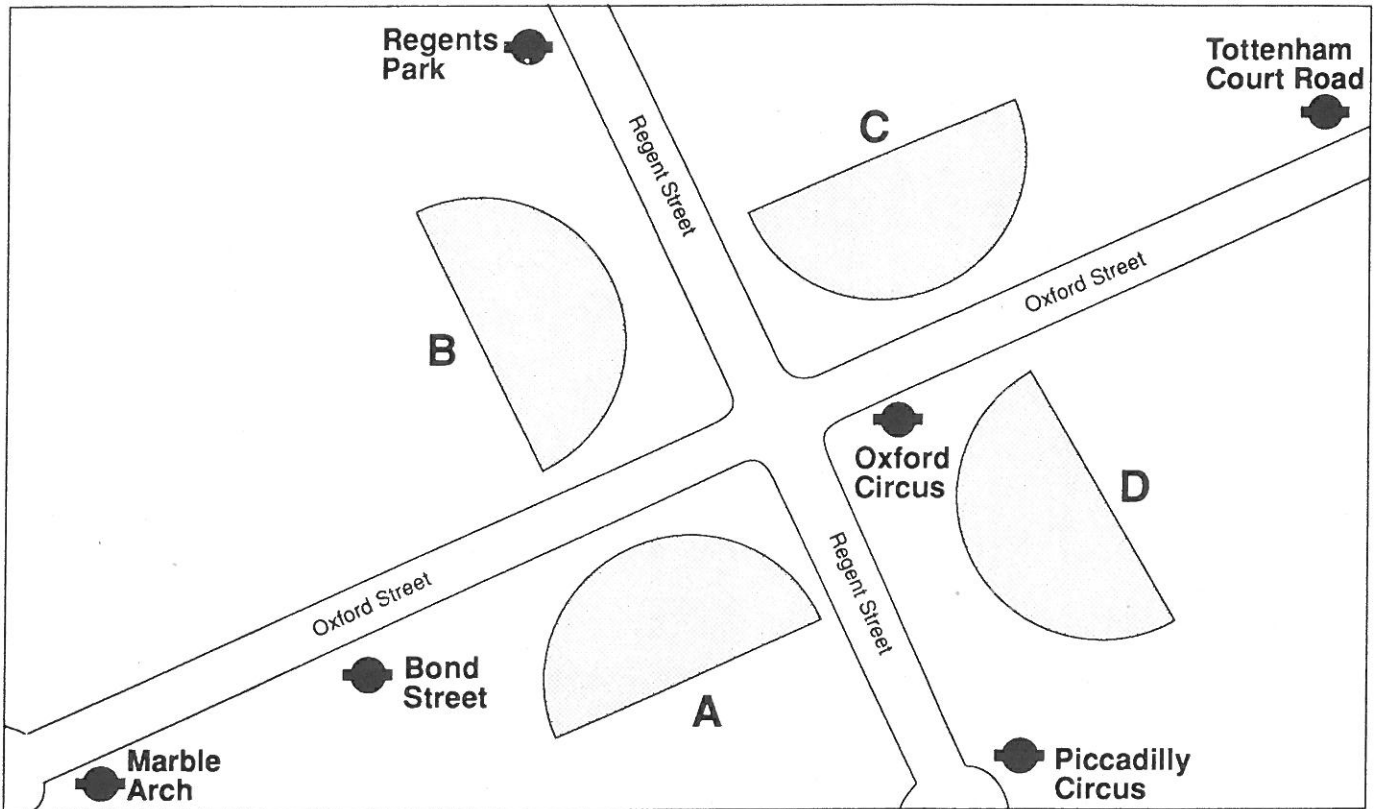
SMILE WORKCARDS

Topology

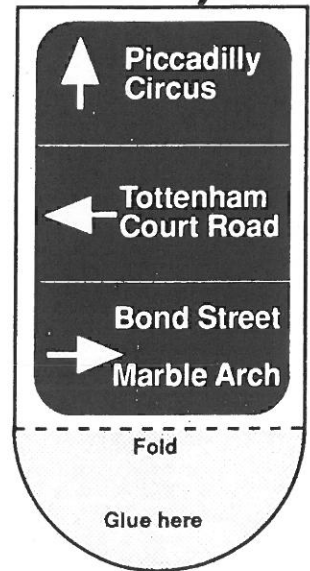
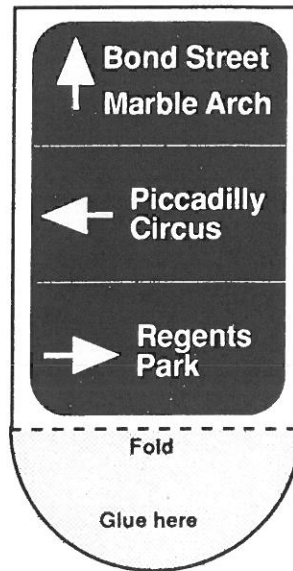
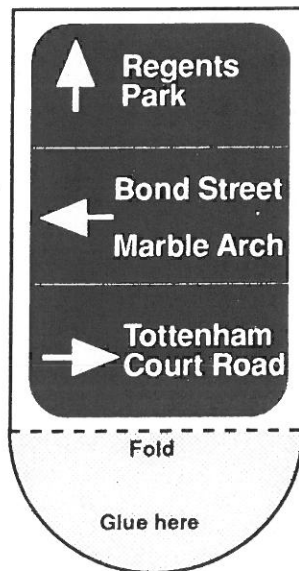
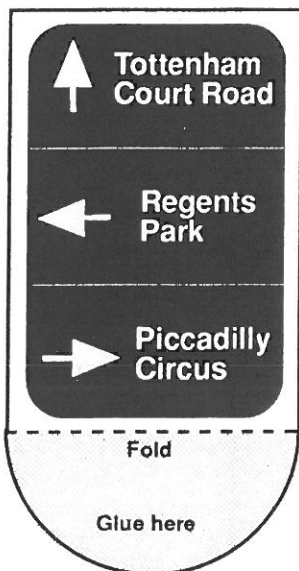
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1	Oxford Street w/8	2089
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You will need glue and scissors.

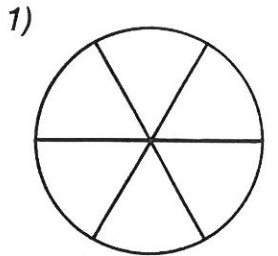


- Cut out the signs below.
- Place them in the correct position on the map and glue them on.
- You might like to make a map of a crossroads near your school and make road signs for it.

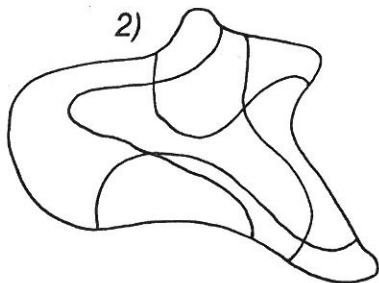


HOW MANY COLOURS?

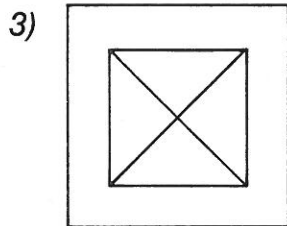
Colour in the shapes below after reading the rules.



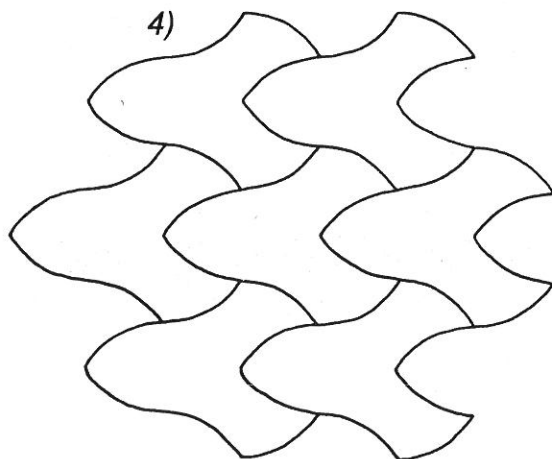
colours



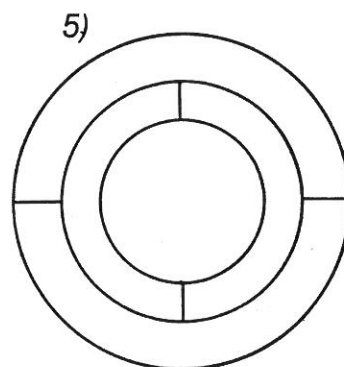
colours



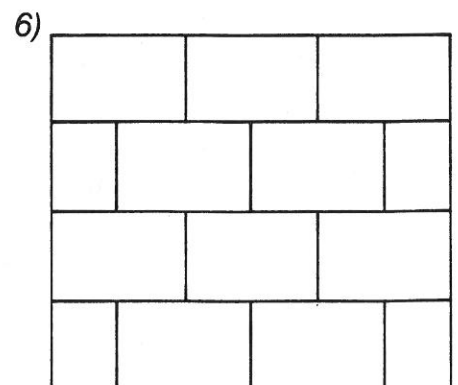
colours



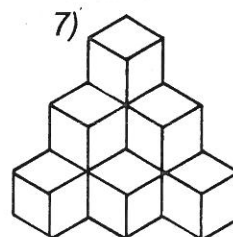
colours



colours



colours

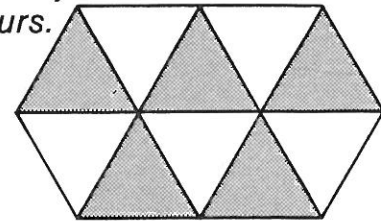


colours

RULES

- (a) You may not use the same colour for 2 areas which are next to each other.
- (b) Use as few colours as possible.

This pattern needs only 2 colours.



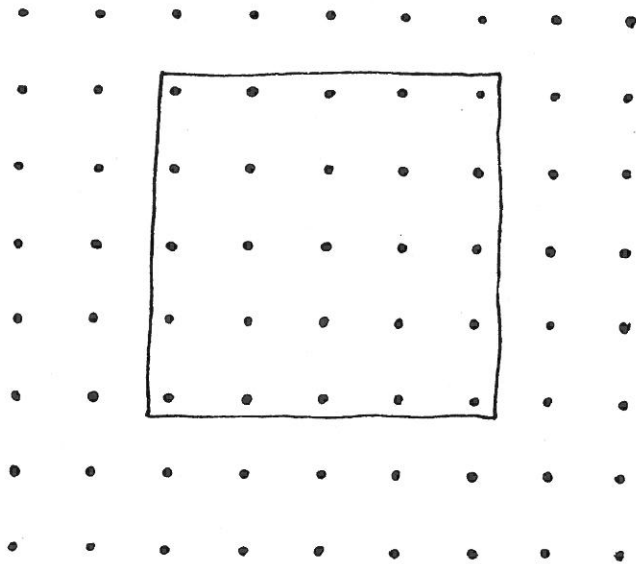
2 colours

How many colours do you need to shade each of the shapes?

You will need dotty paper.

Smile **1634**

COLOURING THE DOTS



Draw round a 5×5 square of dots.

Red and blue take turns to colour a dot.

Two adjacent blue dots are joined by a blue line.

Two adjacent red dots are joined by a red line.

Continue until all the dots are coloured.

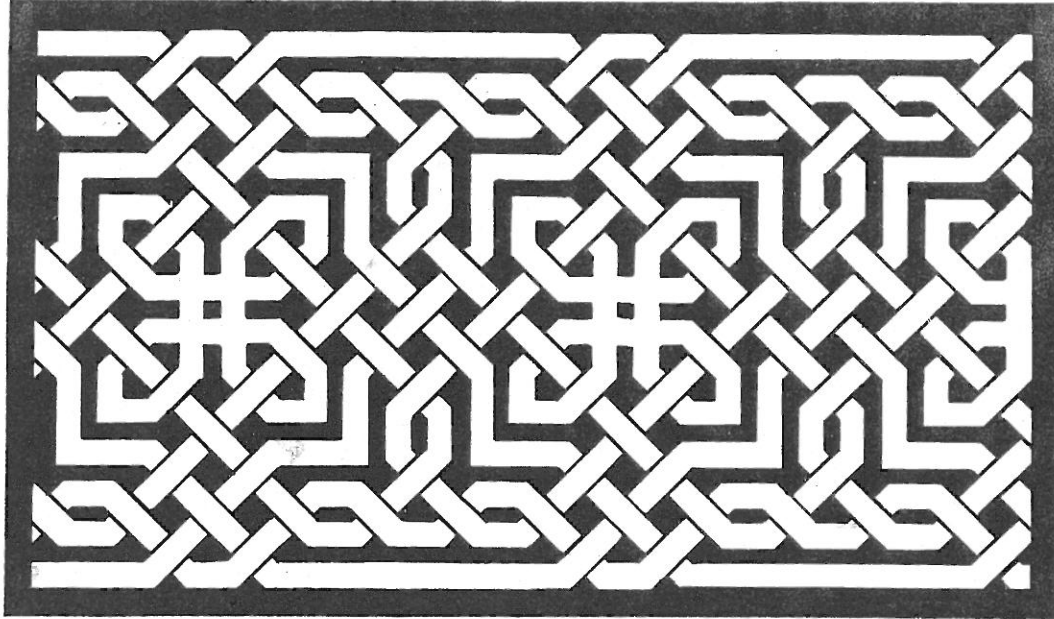
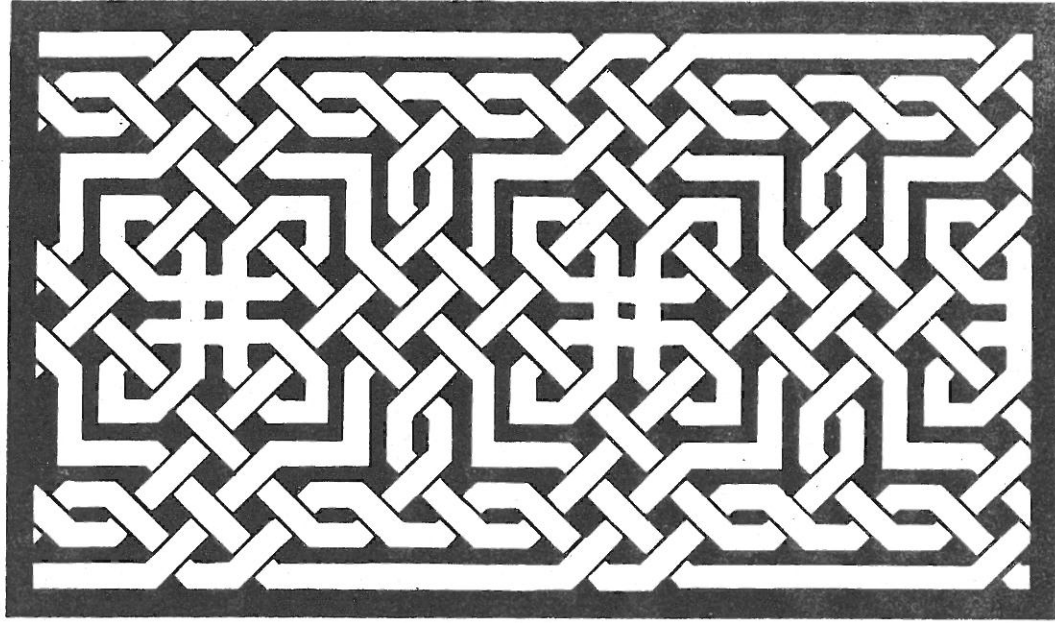
The player with the most lines is the winner.

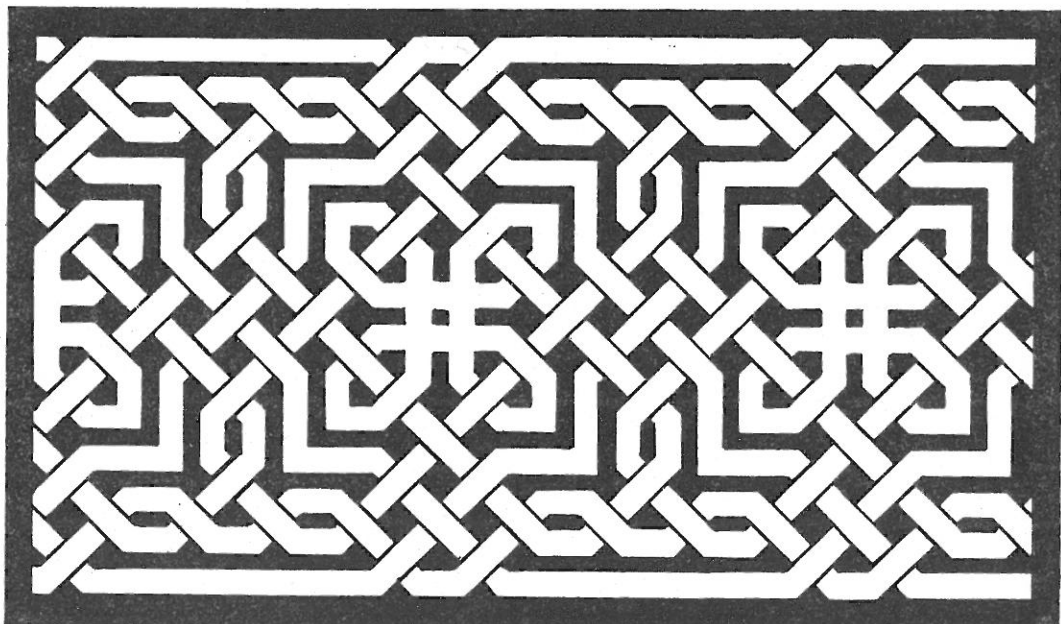
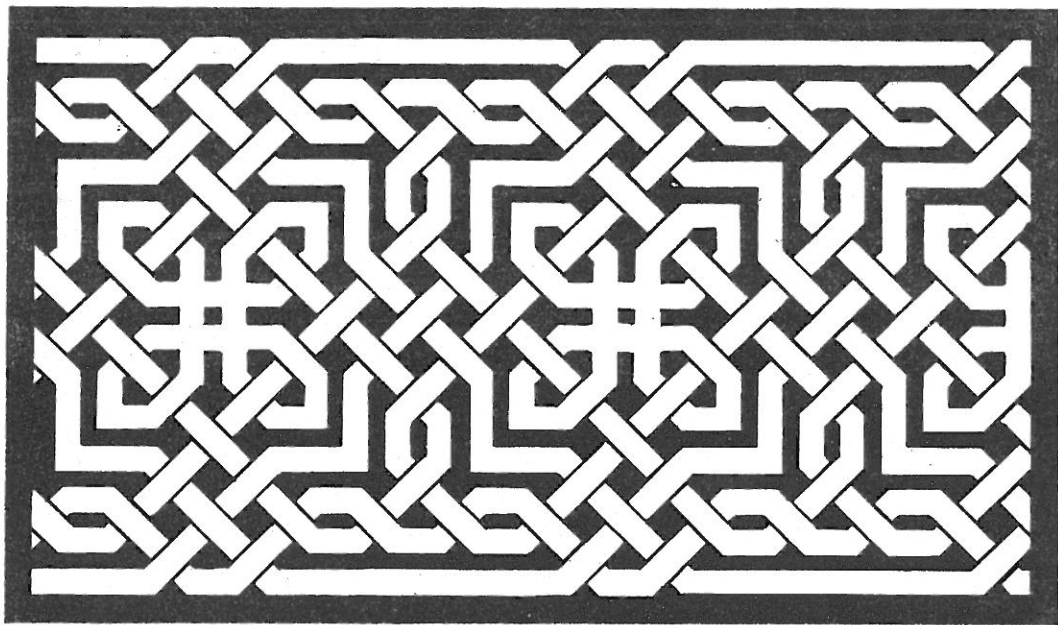
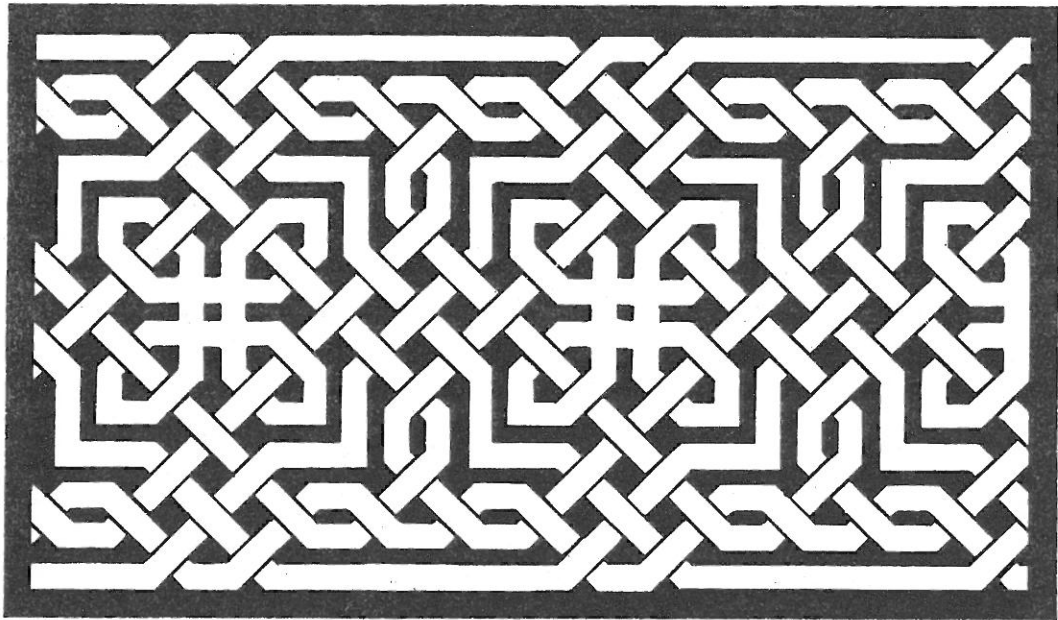
Economical Weaving

Colour this pattern so that the same colour never crosses itself.

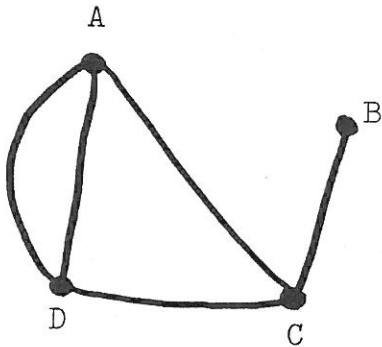
It is possible with 5 colours.

Try it!





How many Routes?



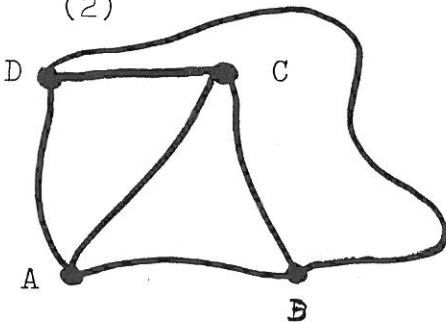
From A to A there are 0 routes.
 From B to C there is 1 route.
 From A to D there are 2 routes.

	A	B	C	D
A	0			2
B			1	
C				
D				

(1) Copy and complete this matrix table.

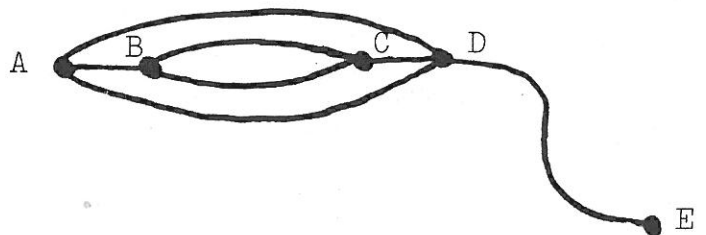
Draw these networks and complete the matrices.

(2)



	A	B	C	D
A				
B				
C				
D				

(3)



	A	B	C	D	E
A					
B					
C					
D					
E					

Turn over



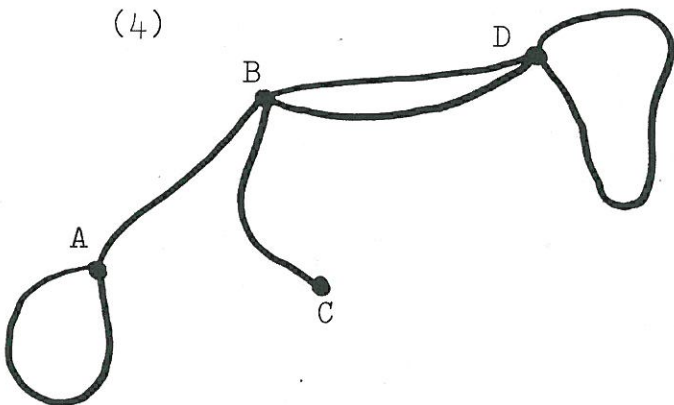
A to A?

There are 2 routes:



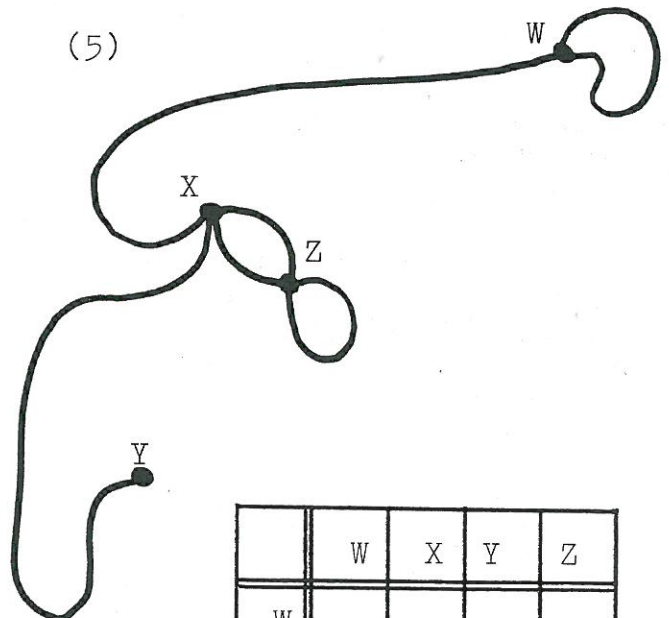
Draw these networks and work out their matrices.

(4)



	A	B	C	D
A				
B				
C				
D				

(5)



	W	X	Y	Z
W				
X				
Y				
Z				

(6) What do you notice about the 2 matrix tables?... Can you see why?

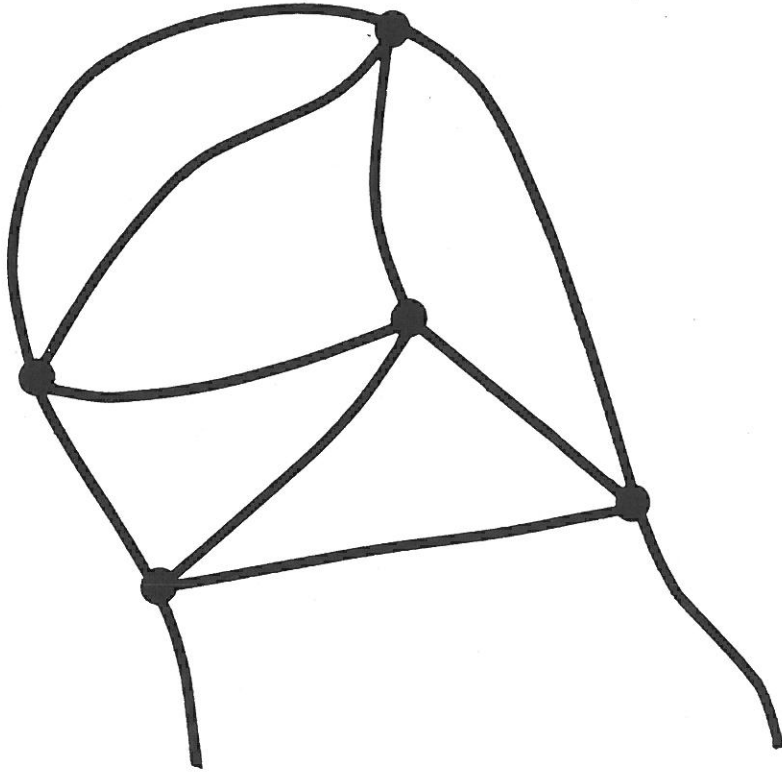
You will need tracing paper.

Smile 0075

Networks

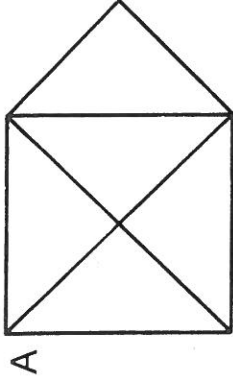
A network is **traversable** if you can draw it:

- ... in one stroke without taking your pencil off the paper
- ... without going over any line twice

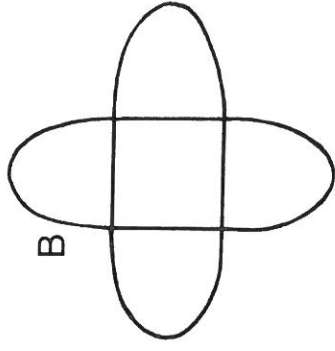


Use tracing paper to check that this network is traversable.

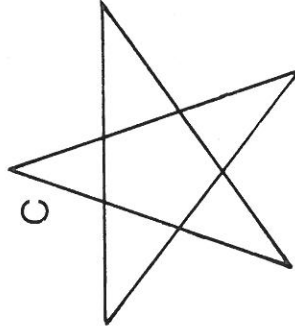
Are these networks traversable? Use tracing paper to find out.



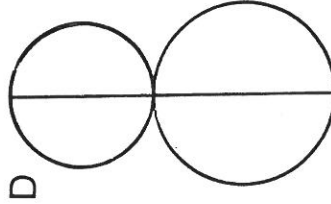
A



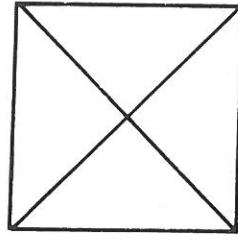
B



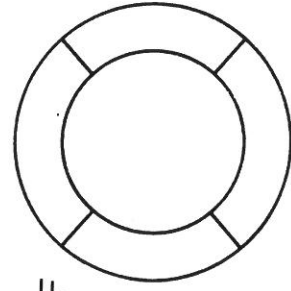
C



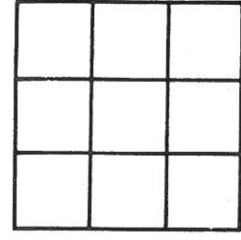
D



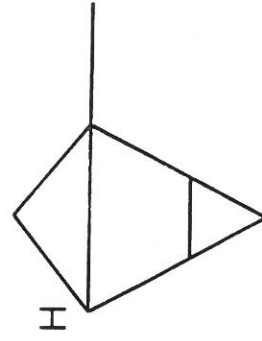
E



F



G

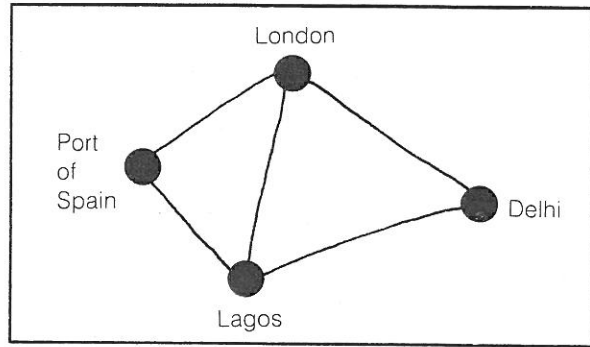


H

Turn over

Airline networks

The map on the right shows the air routes between four cities.



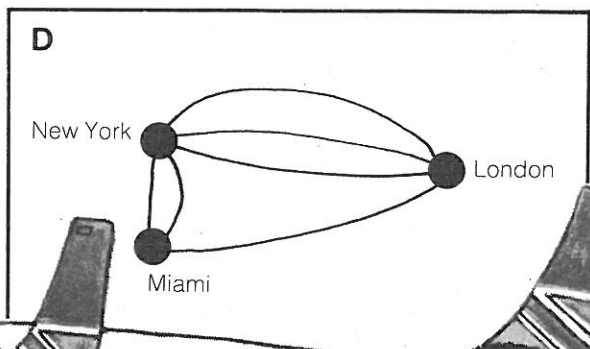
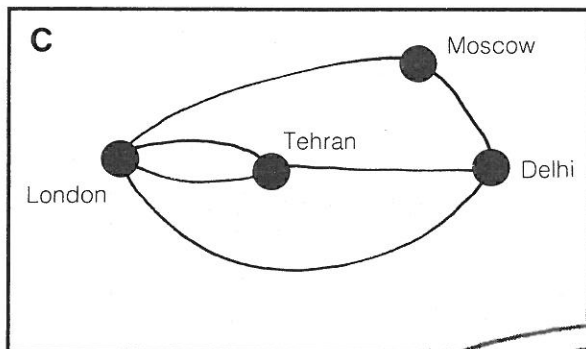
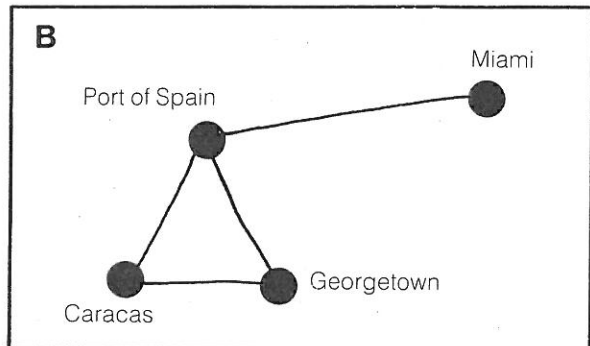
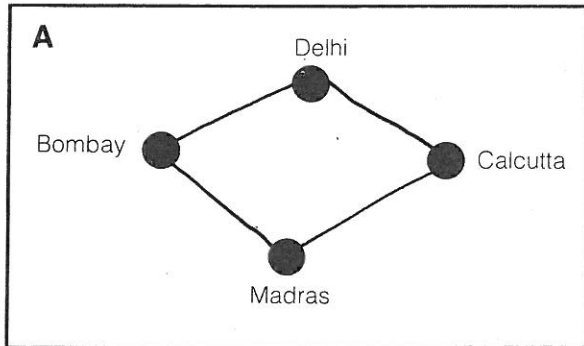
The table on the right will show the number of direct routes linking the cities.

From \ To	Delhi	Lagos	London	Port of Spain
Delhi				
Lagos			1	
London				
Port of Spain	0			

There is no direct route from Port of Spain to Delhi.

There is 1 direct route from Lagos to London.

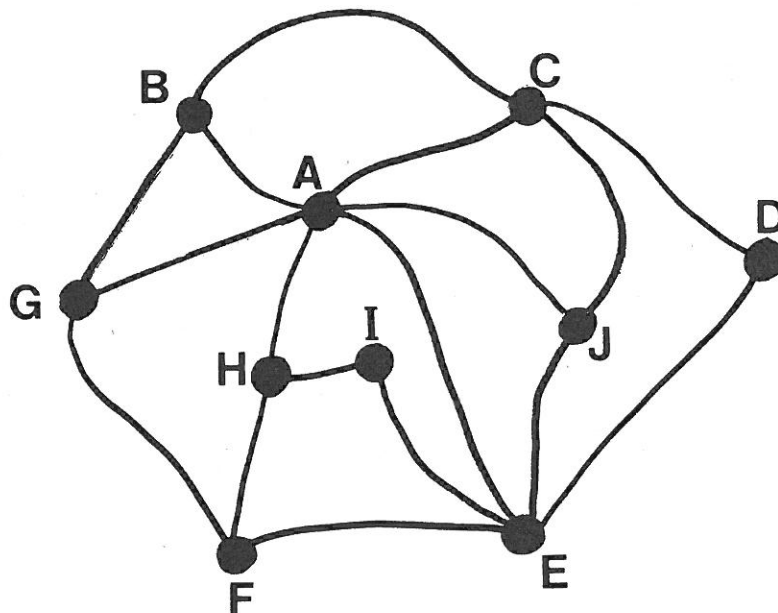
- Copy the map.
- Copy and complete the table.
- Draw each of the airline maps below. Make a table for each one.



You will need: tracing paper

ROUTEY

A firm has shops in 9 towns joined by roads as shown below:-

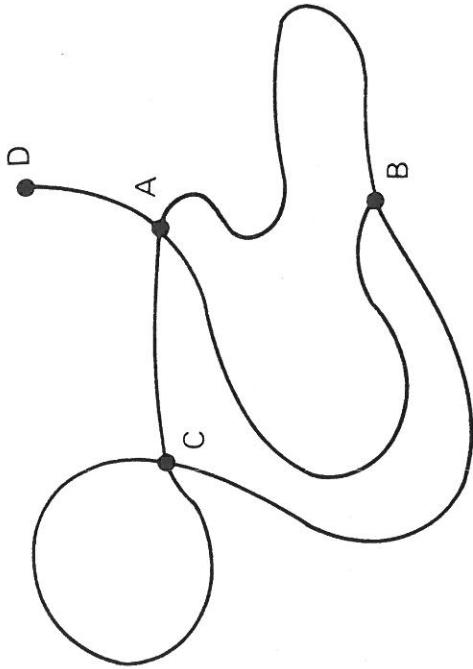


The manager, who has his office at town A, wants to visit each shop.

He does not want to travel down a road twice, or visit a town twice.

In what order could he visit the firms?

NODES



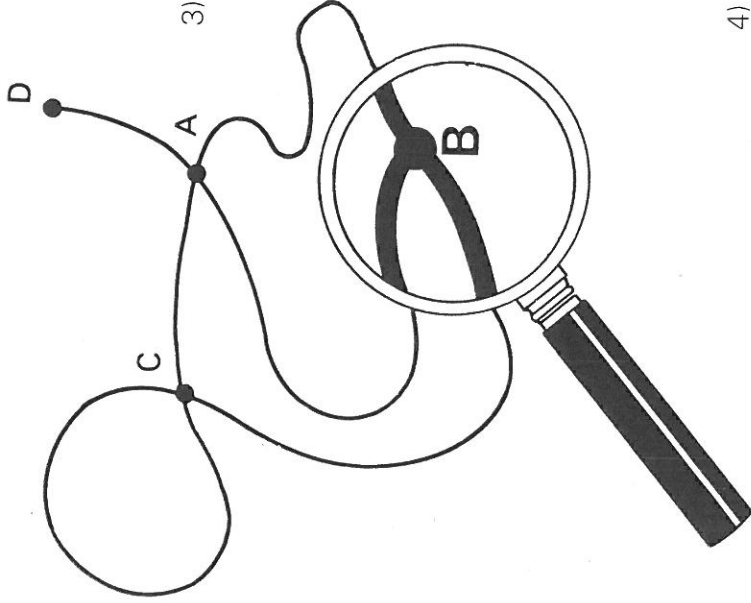
Four paths lead from node A.
One of these paths goes to D.

1) Where do the others go?

A is a 4-node.
A is a node of order 4.

2) How many paths lead from B?

3) Where do they go?



B is a 3-node.

B is a node of order

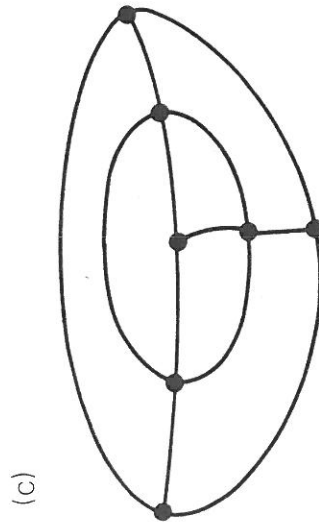
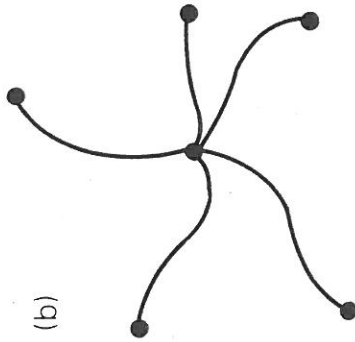
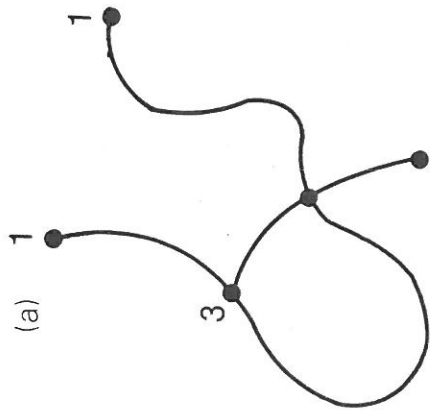
4) C is a -node.

D is a -node.

5) Complete the table:

Number of 1-Nodes	Number of 3-Nodes	Number of 4-Nodes	Number of 5-Nodes	Total Number of Nodes

Next to each node write the order of the node.
Some of (a) has been done for you.



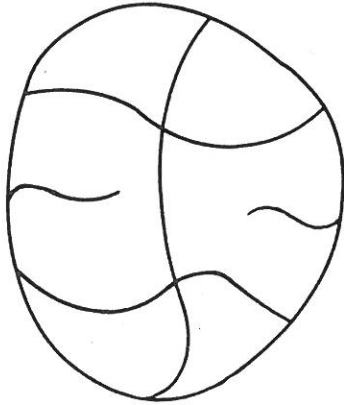
Complete the table:

	Number of 1 Nodes	Number of 3 Nodes	Number of 4 Nodes	Number of 5 Nodes	Total Number of Nodes
(a)		1		0	
(b)					
(c)					

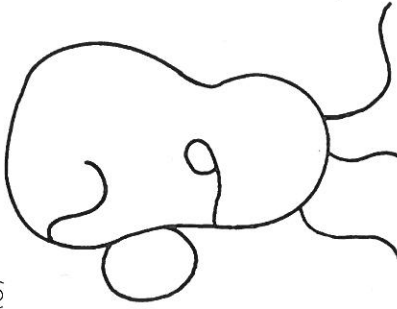
Turn over

Mark in the nodes on these networks.
By each node, write its order.

(d)



(e)



Complete the table:

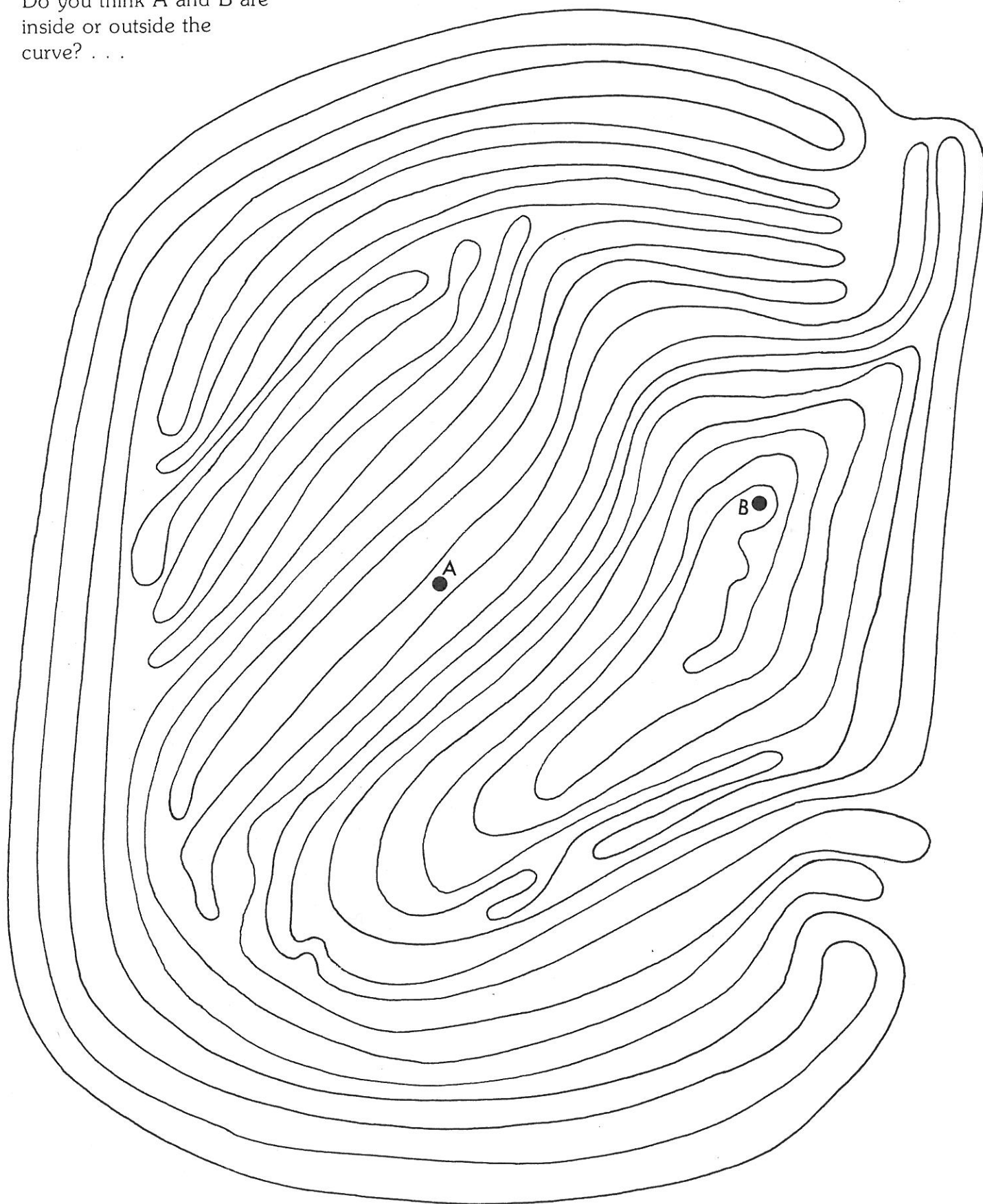
	Number of 1 Nodes	Number of 3 Nodes	Number of 4 Nodes	Number of 5 Nodes	Total Number of Nodes
(d)					
(e)					

You will need tracing paper.

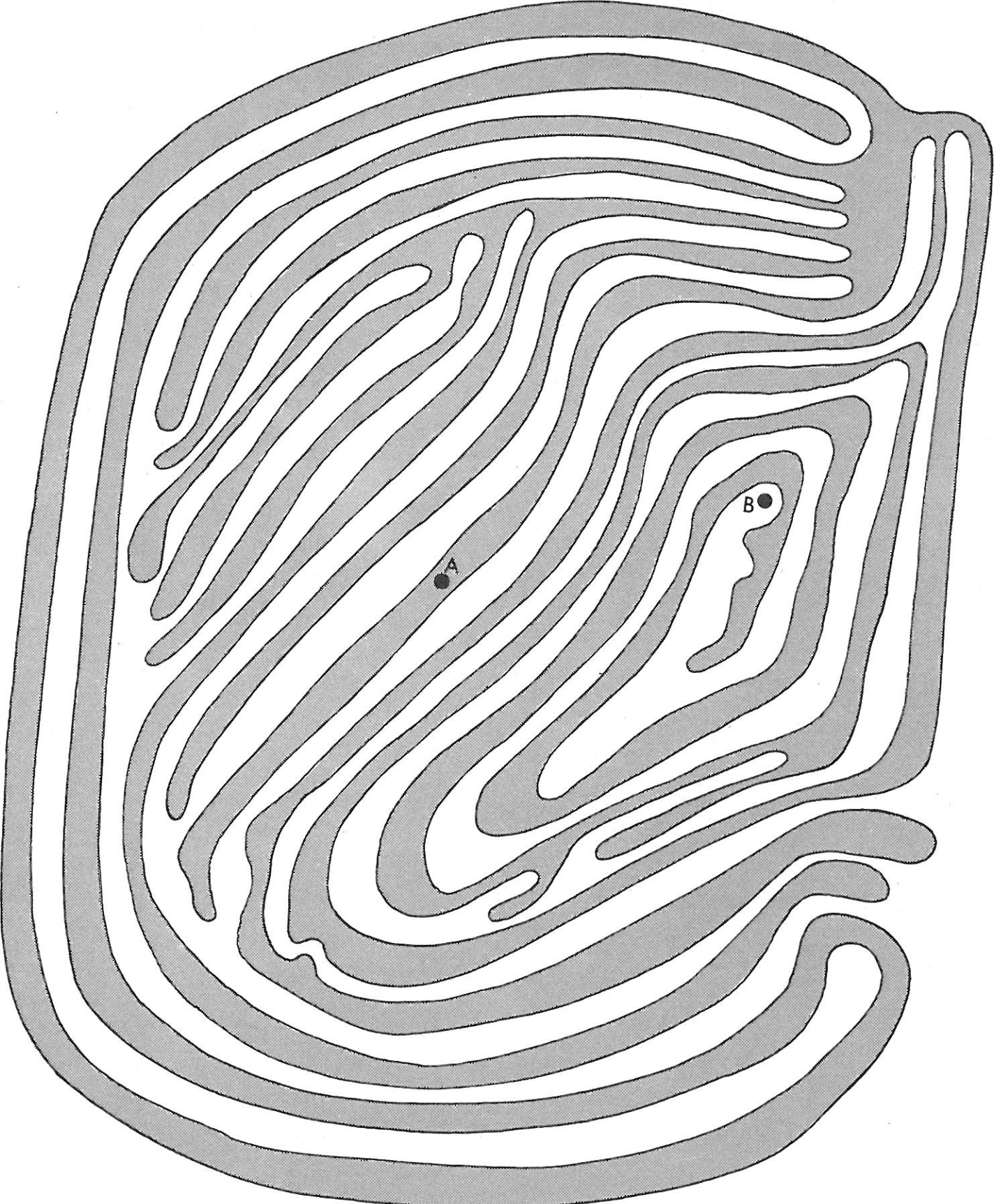
INSIDE OR OUTSIDE

This is a closed curve with no loose ends.
It has an inside and an outside.

Do you think A and B are
inside or outside the
curve? . . .



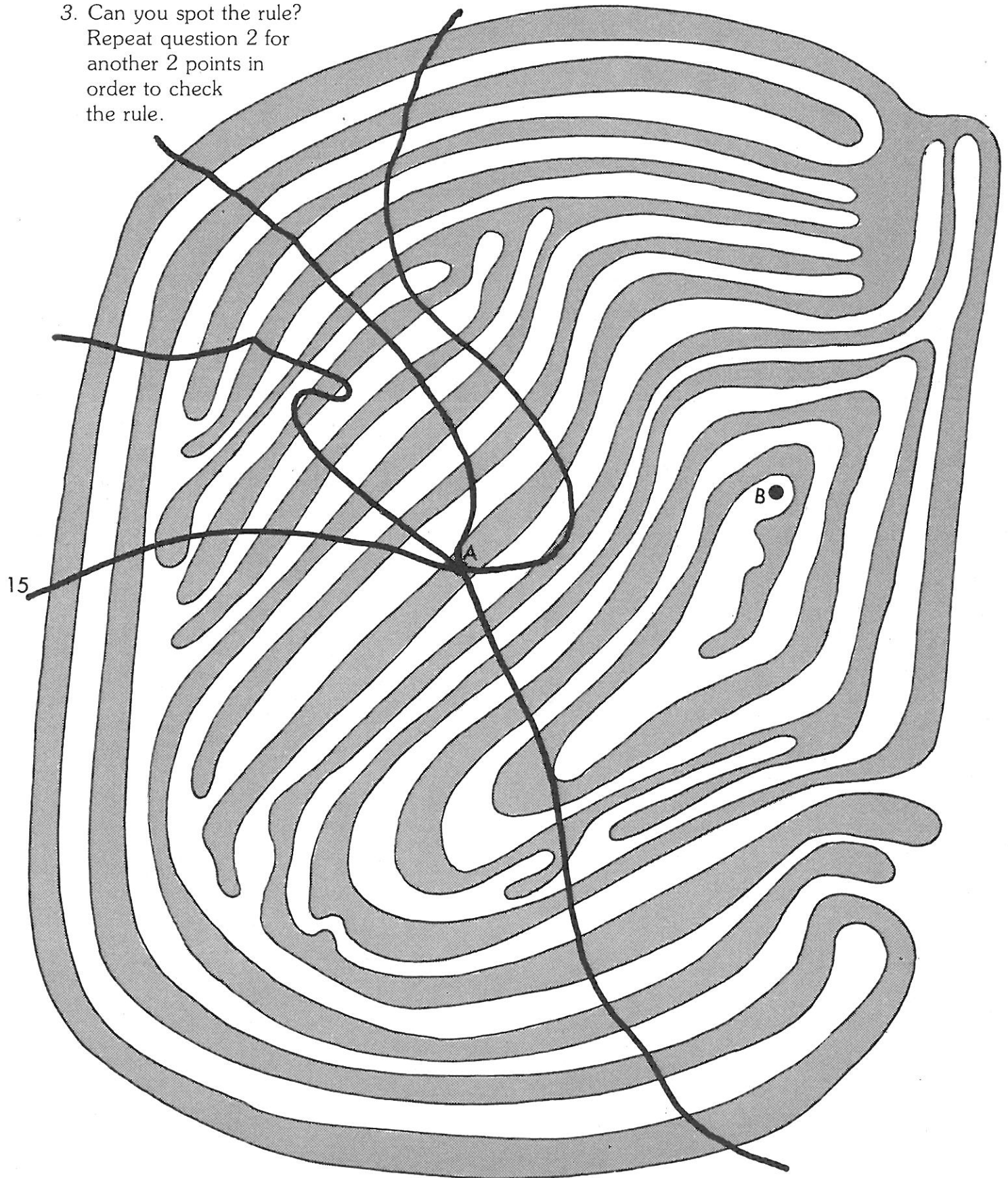
If the inside is shaded, you can see that A is inside but B is outside the curve . . .



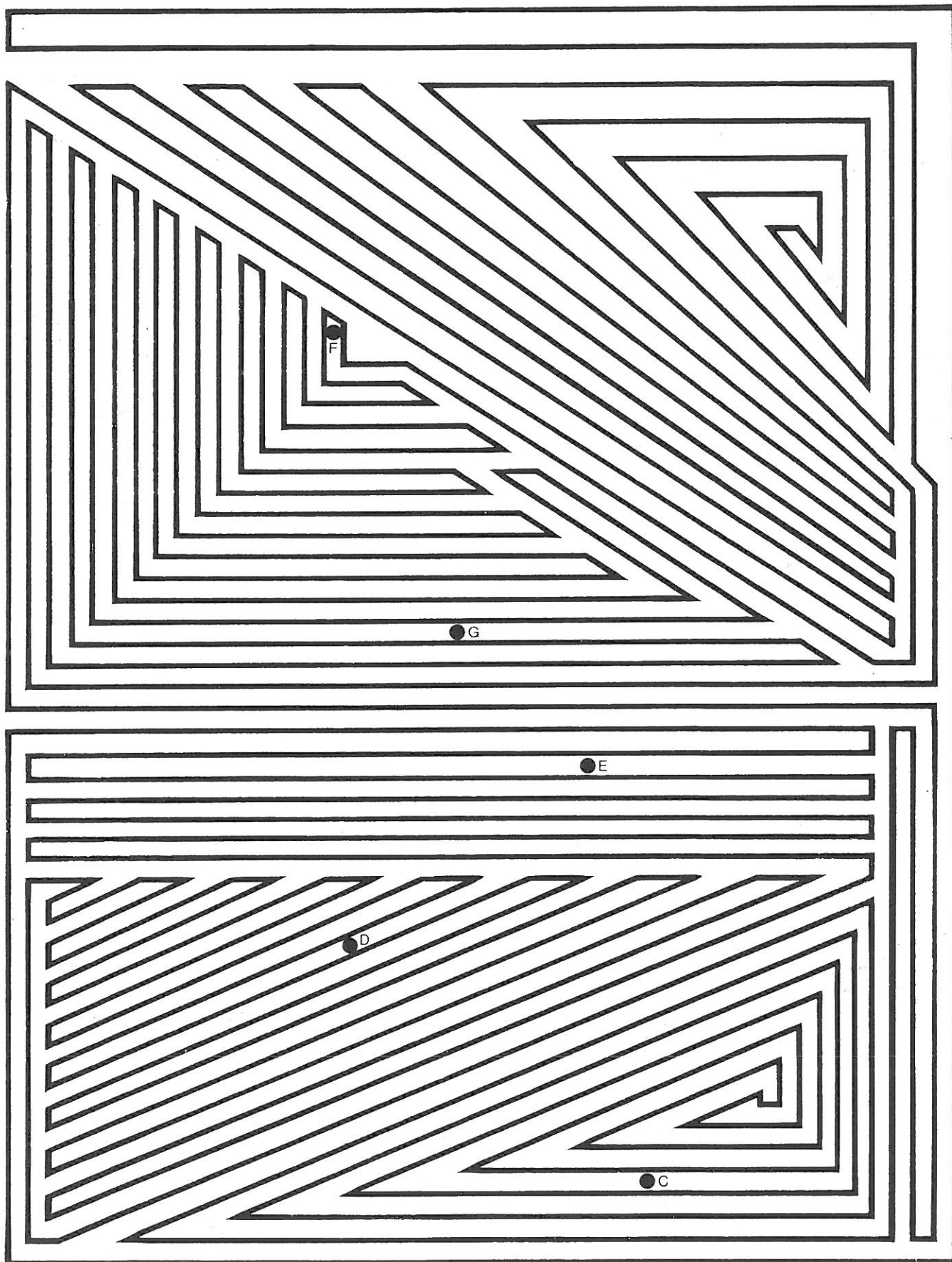
. . . but there is an easier way to decide.

5 lines have been drawn from A to well outside the curve. The one that is marked crosses the curve 15 times.

1. How many times does each line from A cross the curve?
2. Put a sheet of tracing paper over the page and draw some lines from B to well outside the curve. How many times do these lines cross the curve?
3. Can you spot the rule?
Repeat question 2 for another 2 points in order to check the rule.

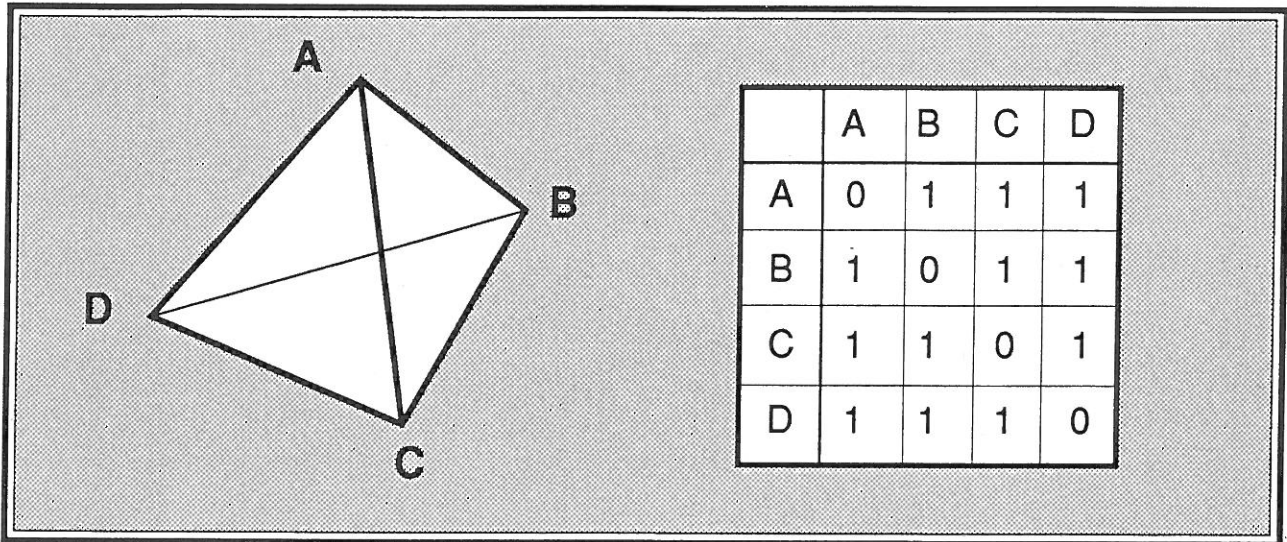


4. Use the rule to decide whether C, D, E, F and G are inside or outside this closed curve.

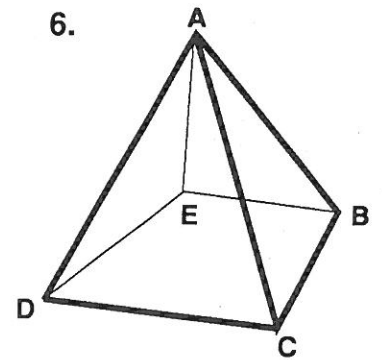
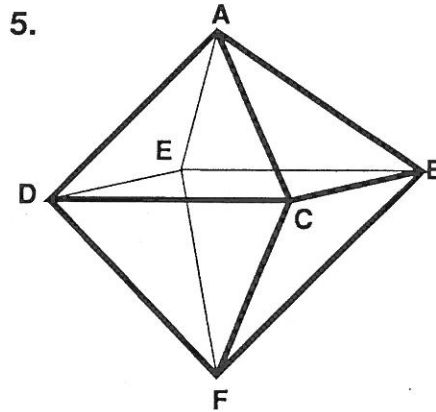
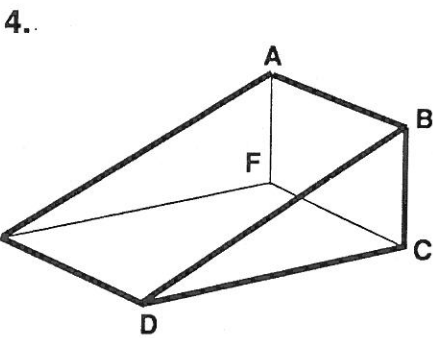
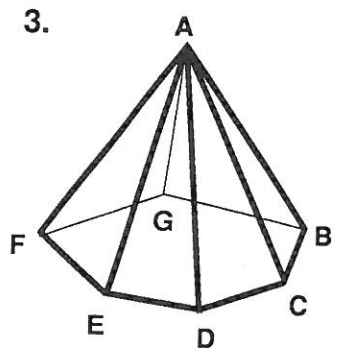
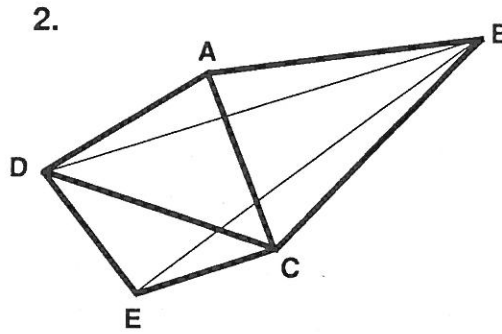
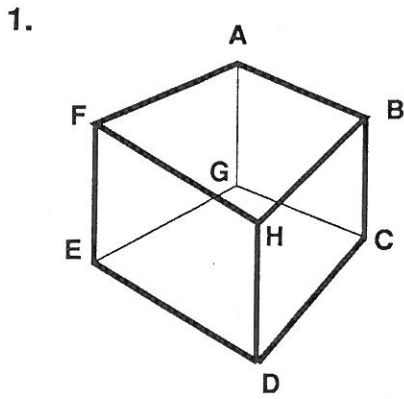


3D Frameworks

A matrix can describe a framework by listing the connecting lines.



Which matrices opposite describe the frameworks below?



a.

	A	B	C	D	E
A	0	1	1	1	0
B	1	0	1	1	1
C	1	1	0	1	1
D	1	1	1	0	1
E	0	1	1	1	0

b.

	A	B	C	D	E	F	G
A	0	1	1	1	1	1	1
B	1	0	1	0	0	0	1
C	1	1	0	1	0	0	0
D	1	0	1	0	1	0	0
E	1	0	0	1	0	1	0
F	1	0	0	0	1	0	1
G	1	1	0	0	0	1	0

c.

	A	B	C	D	E	F
A	0	1	0	0	1	1
B	1	0	1	1	0	0
C	0	1	0	1	0	1
D	0	1	1	0	1	0
E	1	0	0	1	0	1
F	1	0	1	0	1	0

d.

	A	B	C	D	E
A	0	1	1	1	1
B	1	0	1	0	1
C	1	1	0	1	0
D	1	0	1	0	1
E	1	1	0	1	0

e.

	A	B	C	D	E	F
A	0	1	1	1	1	0
B	1	0	1	0	1	1
C	1	1	0	1	0	1
D	1	0	1	0	1	1
E	1	1	0	1	0	1
F	0	1	1	1	1	0

f.

	A	B	C	D	E	F
A	0	1	1	0	1	0
B	1	0	1	0	0	1
C	1	1	0	1	0	0
D	0	0	1	0	1	1
E	1	0	0	1	0	1
F	0	1	0	1	1	0

g.

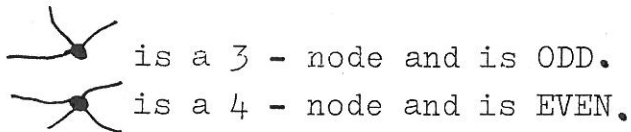
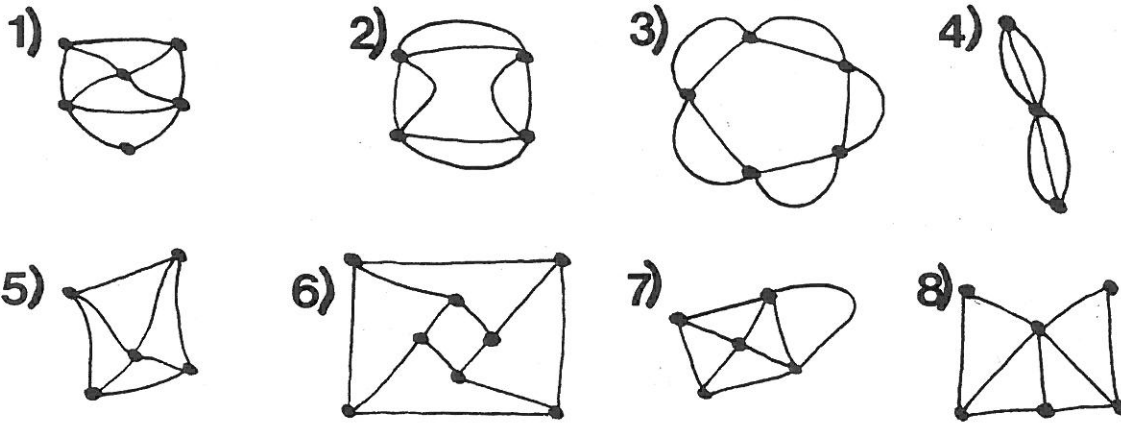
	A	B	C	D	E	F	G	H
A	0	1	0	0	0	1	1	0
B	1	0	1	0	0	0	0	1
C	0	1	0	1	0	0	1	0
D	0	0	1	0	1	0	0	1
E	0	0	0	1	0	1	1	0
F	1	0	0	0	1	0	0	1
G	1	0	1	0	1	0	0	0
H	0	1	0	1	0	1	0	0

Can you draw a network for the remaining matrix?

Traversable?

If you can copy a network
 (i) without lifting your pen off the paper
 (ii) without drawing any line twice,
 then it is TRAVERSABLE.

Are these traversable, yes or no?



..... so an EVEN node has order 2, 4, 6, 8,

an ODD node has order 1, 3, 5, 7,

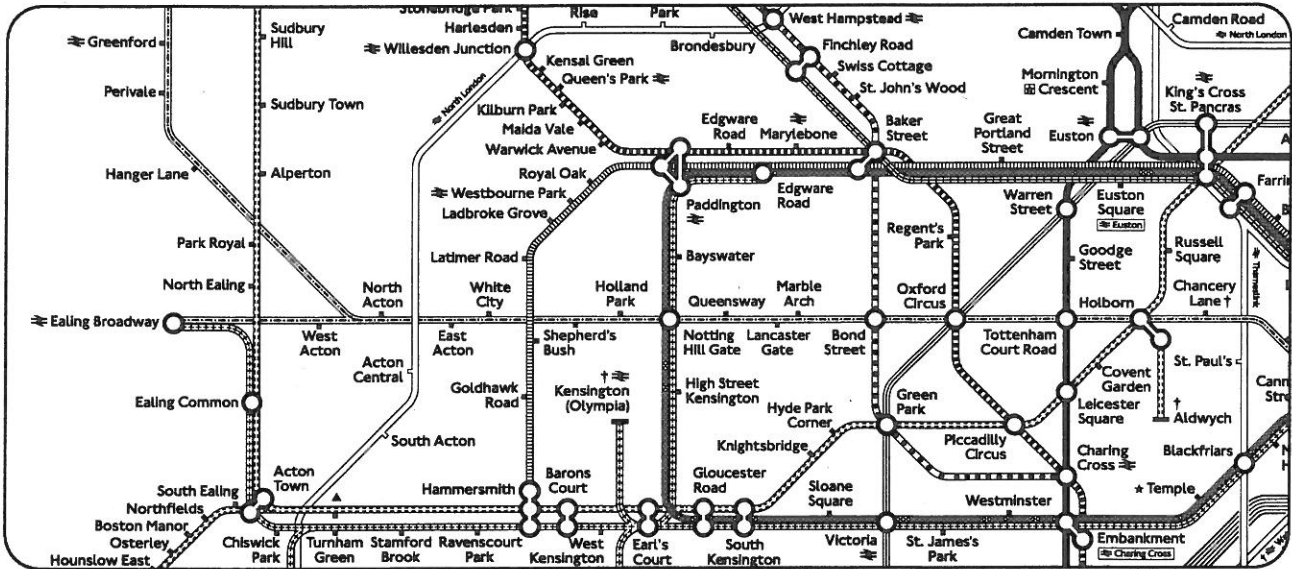
(9) Draw a table like this and complete a row for each network above.

	Number of odd nodes.	Number of even nodes	Is it traversable Yes or No?
1			
2			

- (10) Can you spot a rule for whether or not a network is traversable?
 (11) Check your rule in the answer book, then test it on some more networks.

Ealing Broadway

You will need a map of the London Underground.



"You can get from Ealing Broadway Underground Station to any other underground station with only one change".

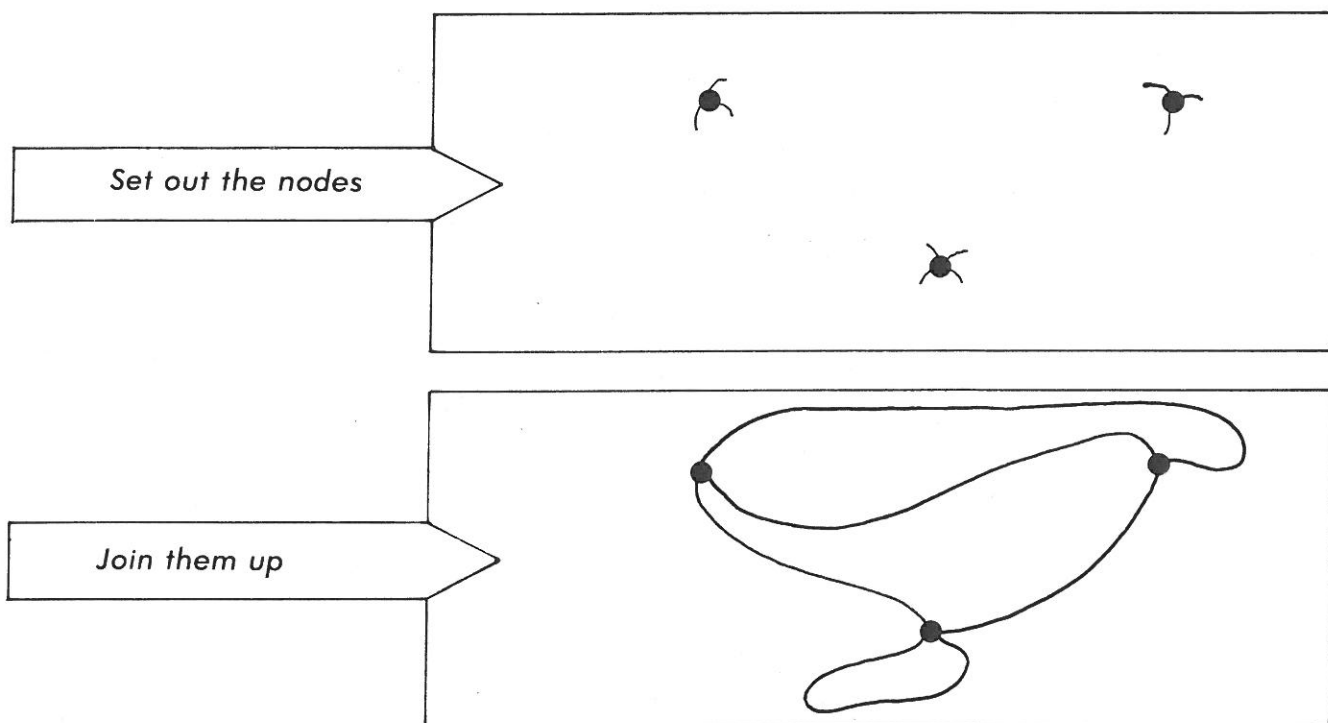
Is this true? Convince someone else that your answer is correct.

Is it true for any other stations?

About Nodes

To draw a network, it is a good idea to set out the nodes first and then join up the loose ends.

For a network with two 3-nodes and one 4-node:



There may be more than one possible answer.

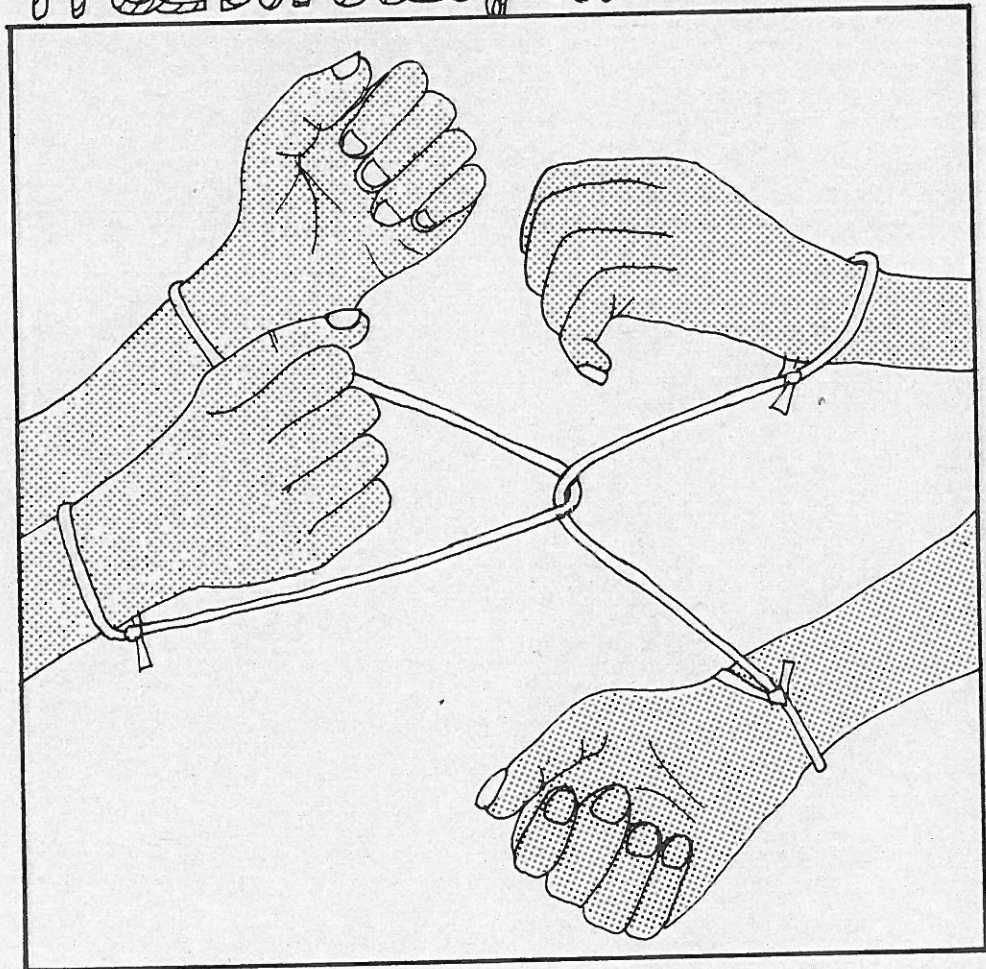
Try to draw networks for (a) to (h). You will find that two are impossible.

	Number of 1-nodes	Number of 3-nodes	Number of 4-nodes	Number of 5-nodes
(a)	2	0	0	0
(b)	3	1	0	0
(c)	0	0	1	0
(d)	0	1	0	0
(e)	0	1	0	1
(f)	0	1	1	1
(g)	1	1	0	1
(h)	2	1	1	1

Make up some examples of your own and try to find a rule to decide whether or not a network can be drawn.

smile
0492

The inseparables



How can they
escape ?

No cutting !
No untying !

ilea
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