UNIT 18 *3-D Geometry* Activities

Activities

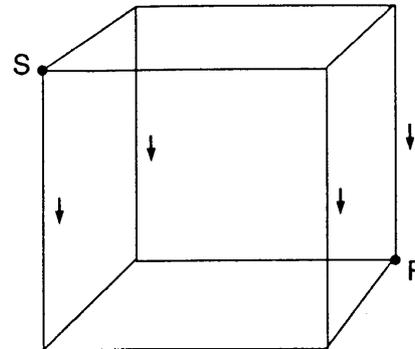UNIT 18 *3-D Geometry* Activities

ACTIVITY 18.1   *Routes on a Cube*

The drawing shows a wire
frame which is in the shape
of a cube.

The arrows show the 4
vertical edges.

Imagine that a small insect is at S (the start) and has to get to F (the finish) using these
rules –

- only walk along the wires
- only go *down* the verical edges (in the direction of the arrows) and *not up*
- never go over any wire twice
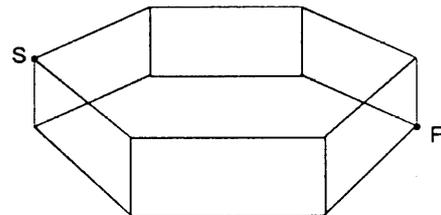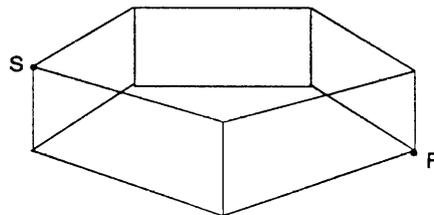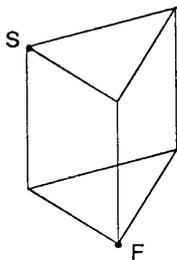- it may not go to any corner more than once *except* S.

Problem 1   If the length of each line is 10 cm,

     (a)   what is the length of the *shortest* path from S to F?

     (b)   what is the length of the *longest* path from S to F?

     (c)   how many different paths are there?

Problem 2   Which is the shortest distance from S to F if the insect can fly?

Extension

Investigate similar paths on these shapes from S to F.

Can you generalise your results to regular *n*-sided polygons in the horizontal planes?

ACTIVITY 18.2.1   *Klein Cube*

A *Klein Cube* is a three-dimensional version of a Mobius Strip (*August Mobius* was a pupil of the great mathematician *Carl Friedrich Gauss* (1777-1855)), and is named after its inventor, the German mathematician *Felix Klein* (1849-1928). He designed the *Klein Bottle* which is a three dimensional shape with only one surface; the model given here is based on the design of the Klein Bottle.

When you have constructed it, imagine that you start to paint the outside blue and continue painting along any joining surface. You will eventually find the whole shape (inside and outside) has been painted blue; hence it has only *one* surface.


Instructions for making the Klein Cube

Activity pages 18.2.2 and 18.2.3

1. First cut out around the solid line of the edge of the net on page 18.2.2. Score and crease all the dotted lines to make tabs A, B and C.

2. Cut along solid lines in X, Y and Z and score along the dotted lines.

2. Fold up to make a box. Glue tabs A and B but NOT C.

3. Push tabs X and Y to outside of box and tab Z inside.

4. Next make the Tube for Klein Cube using the nets and instructions on page 18.2.3.

5. Now push the longer piece of the tube through the Y-opening of the box and into the Z-opening.

6. Glue the X, Y and Z tabs to the tube. The X and Y tabs go on the outside of the tube; the Z-tab goes inside the tube.

7. Glue tabs C to complete your Klein Cube.

B

A

B

A

Z
Z Z
Z

Y
Y Y
Y

X
X X
X

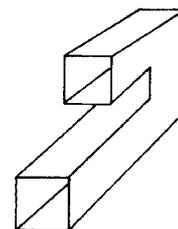C

C

C
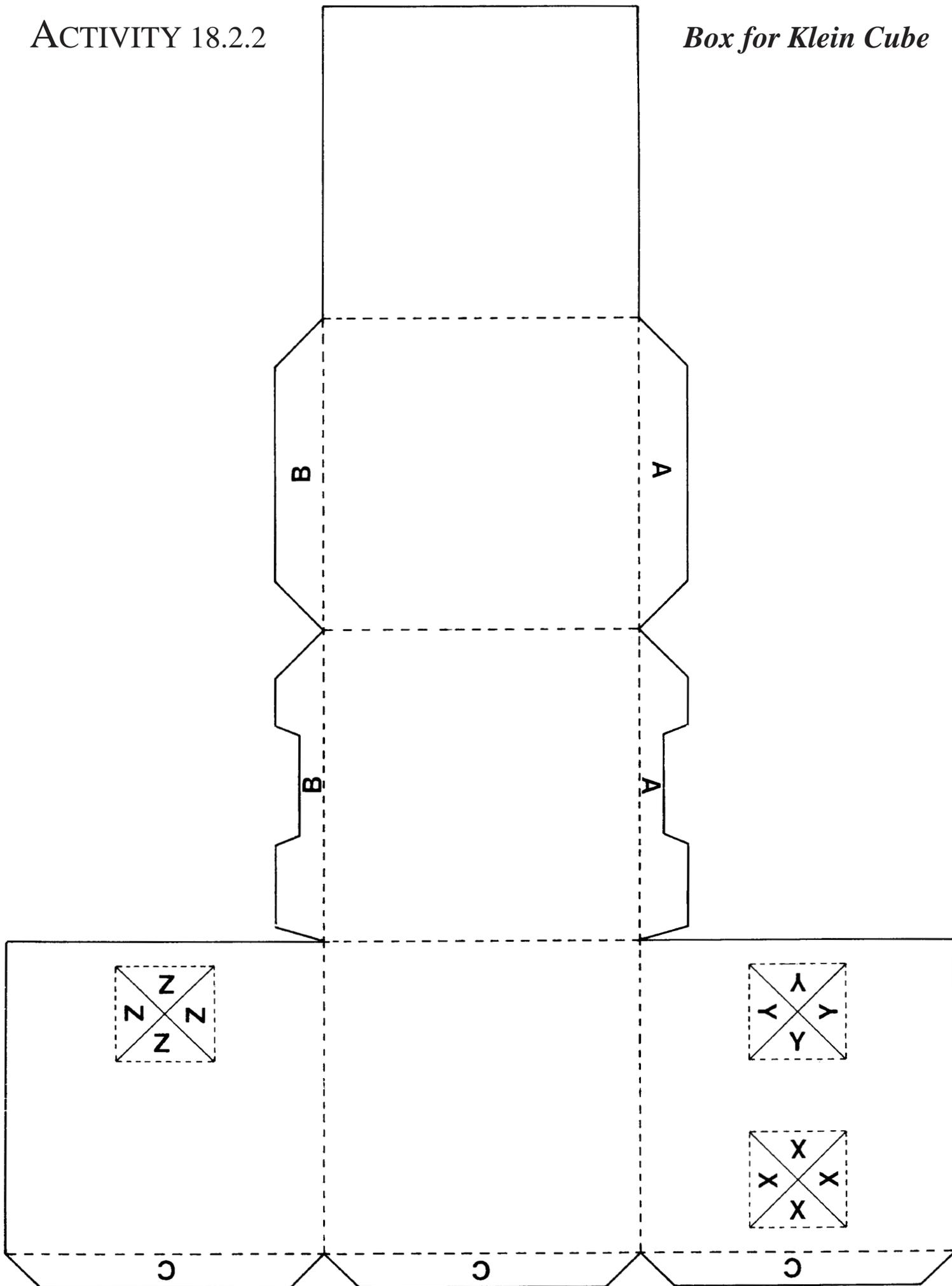
ACTIVITY 18.2.3   *Tube for Klein Cube*
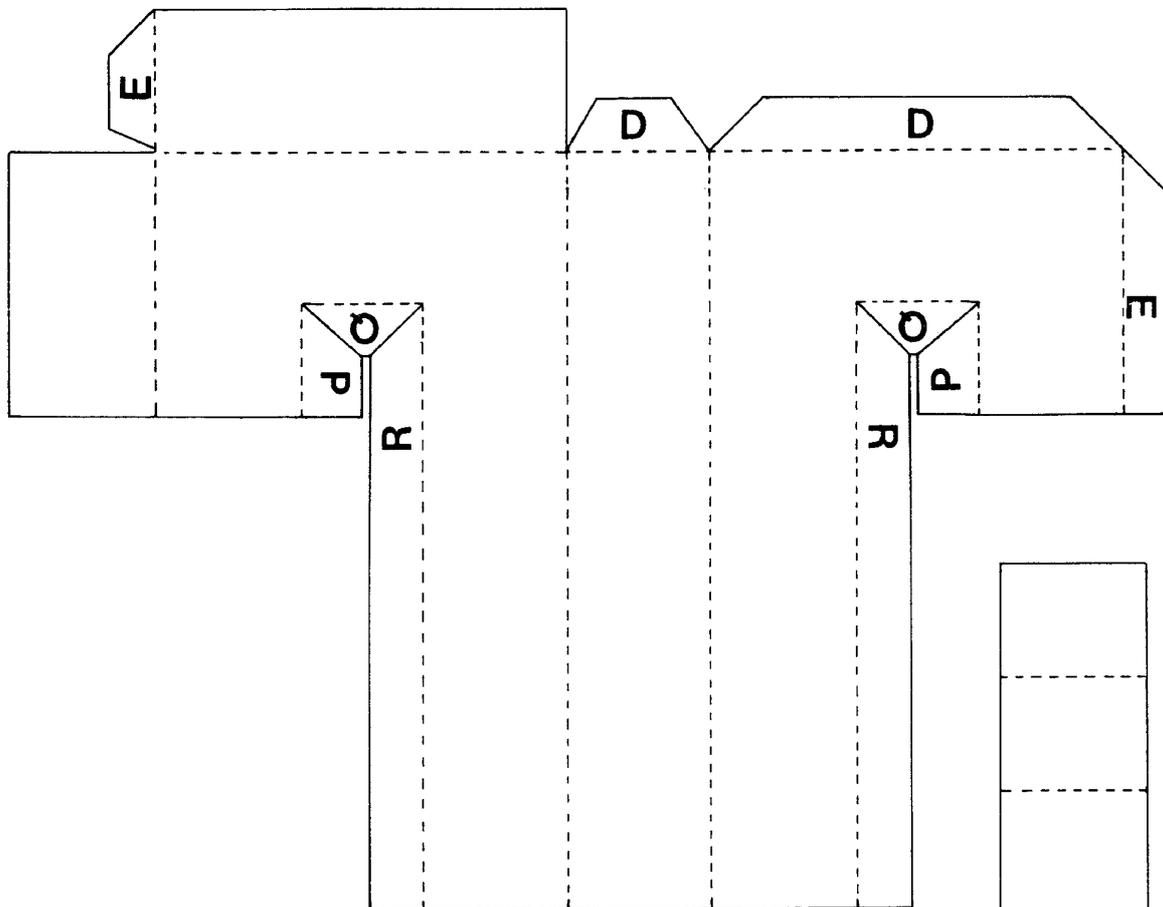
Tube for Klein Cube

Using the nets on this page,

1.   Cut out around the solid line of the edge of the larger net.

2.   Cut along solid lines PQ and QR.

3.   Score and crease all dotted lines to make tabs D, E, P, Q and R.

4.   Fold up and glue tabs D and then tabs E.

5.   Cut out, score and crease the smaller net.

6.   Fold it and glue tabs P, Q and R to complete
      the tube.
      (It is easiest to do P and Q first, then R.)

Finished Tube