

1985

Space 1

Kevin Jones

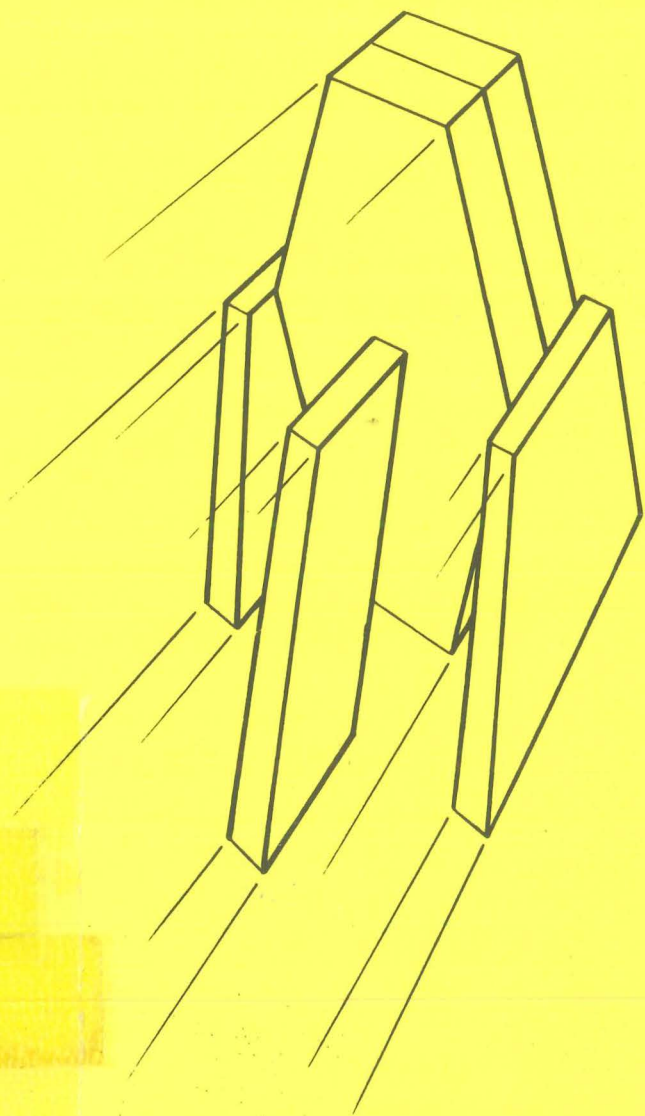
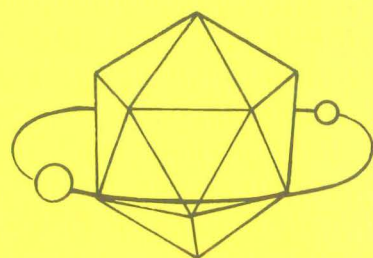
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SPACE 1



S P A C E O N E

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INTRODUCTION

This activity workbook is based on the Space strand of the mathematics syllabus for Western Australian middle primary school students (i.e. Years 4 & 5). It is absolutely essential however for children working at upper primary levels (i.e. Years 6 & 7) to do most, if not all, of the activities it contains. The only exception to this should be children who have received a thorough grounding in the mathematical ideas contained in the Space strand of the syllabus for middle primary stages, by way of the activities described therein. Pencil and paper work cannot substitute for these experiences.

Some of the activities pose problems requiring considerable investigation (and discussion if possible). Some "answers" might remain elusive but that doesn't matter. The notion of "right" and "wrong" is very much less significant here than the host of valuable ideas which will be constructed in searching for the solution to a problem. The process of searching for a solution will bear fruit long after any "answer" has been forgotten.

Note that Exercises 25 and 26 are better suited to Years 5, 6 and 7, although some Year 4 children may like to attempt them.

Exercises or pages marked with an asterisk * are to be despatched for evaluation. Any models made, or shapes cut out to be utilized in the exercises should be retained for possible on site evaluation at a later date i.e. the only materials to be forwarded for evaluation should be sheets of paper, either directly from the workbook, or on a separate sheet as occasionally requested.

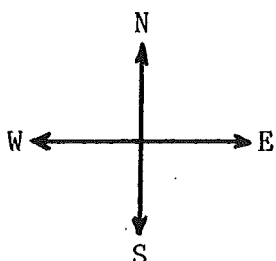
PLEASE NOTE: It is essential to realise that it is the MATERIALS which are being "trialled" and NOT the children involved. It is of paramount importance that the activities be viewed as FUN, and that if any counter-productive stress or anxiety arises then that exercise or problem should be simply left out. A note or comment describing the nature of the difficulty would be very helpful.

EXERCISE 1

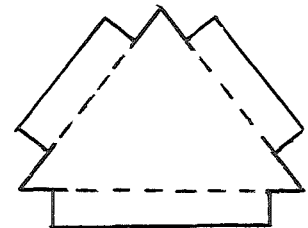
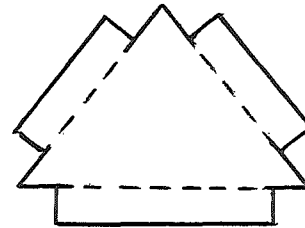
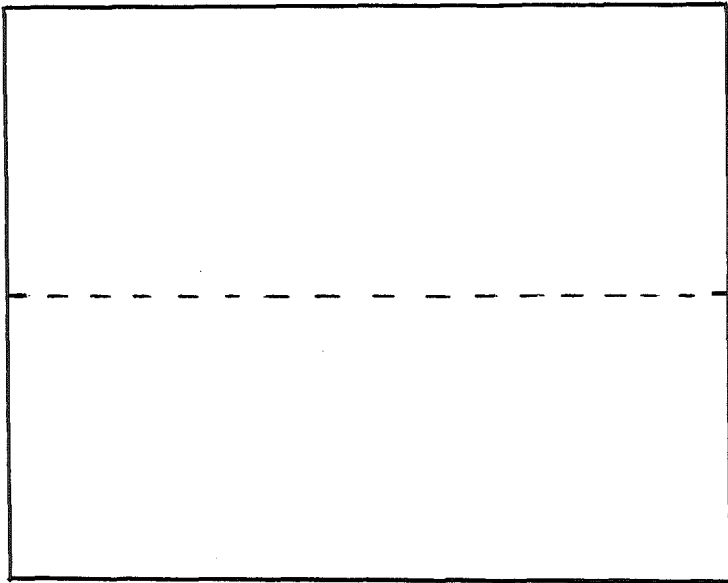
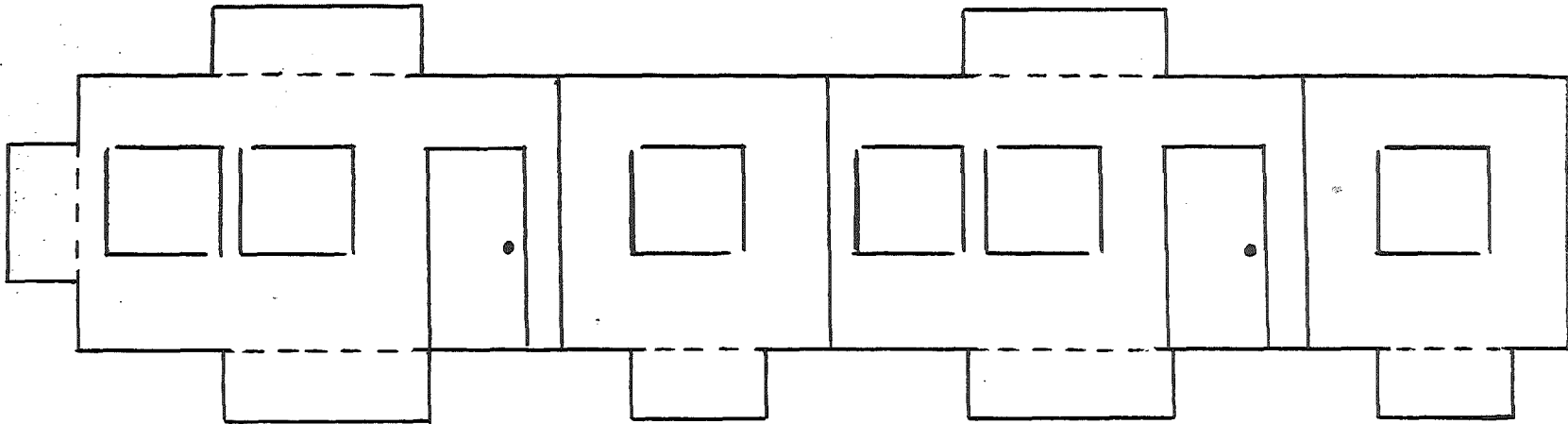
On pp2. to 4. are "cut outs" for buildings, cars, service stations, etc.. Cut the shapes out and, folding carefully where shown, construct a small town.

Some things you will need to make for yourself are a school, hospital, police station, park, an airport (with some aeroplanes), fences, streets, bushes, trees and whatever else you can think of. Matchboxes and other containers will be useful. Glue everything onto a large sheet of cardboard, and then paint your town.

All of your streets will need street names, and each building will need a street number. If it is a house, print the name of the family living there on or near the house.

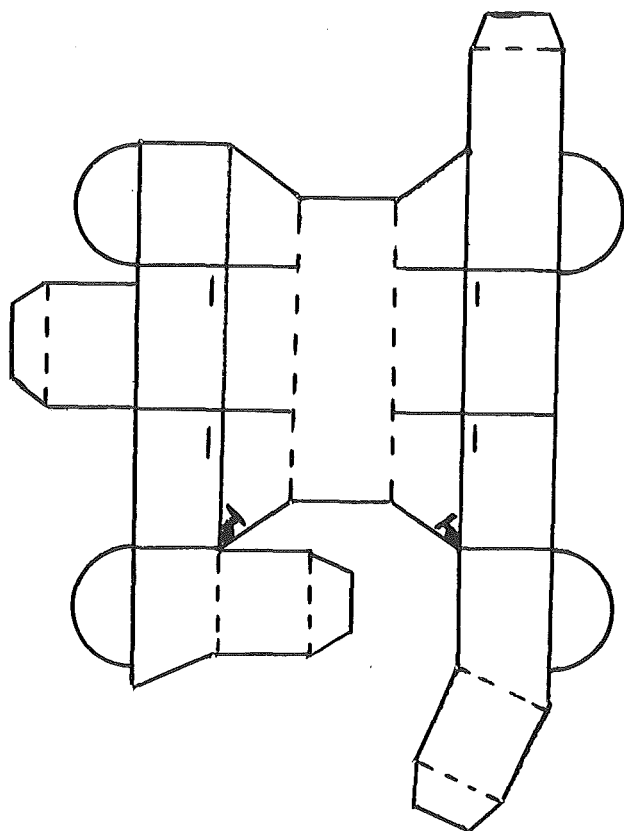
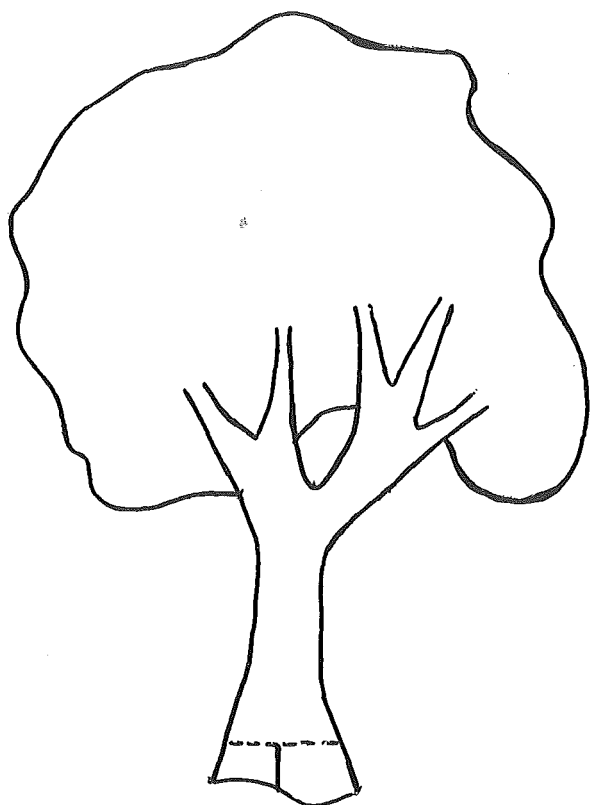
Make sure you have a  somewhere on your model.

NOTE: This is a long term project (i.e. several lessons). It will be used to aid the development of Entries 6 and 7 when it is completed. In fact, on completion, Entries 6 and 7 could be worked immediately if desired.



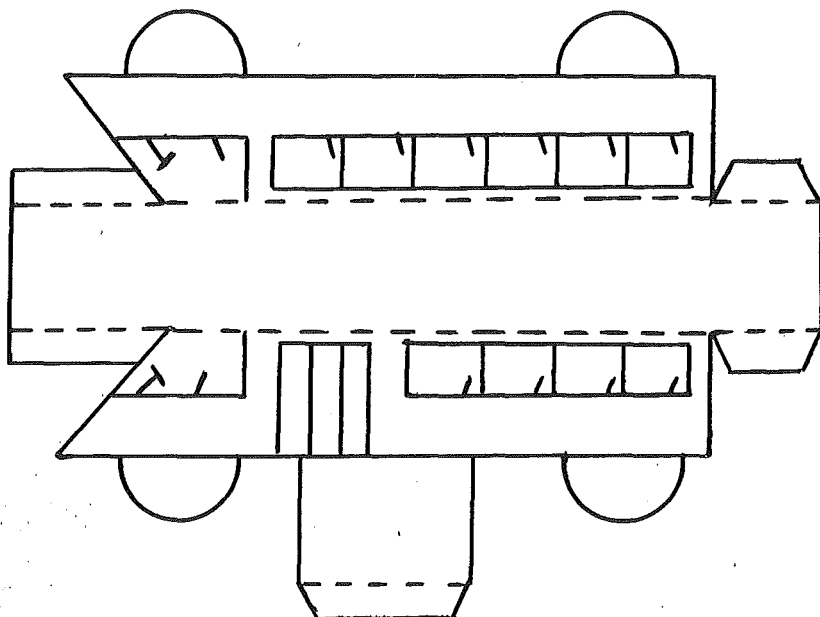
Before assembly, draw around the pieces on card, and cut out two or three other houses.

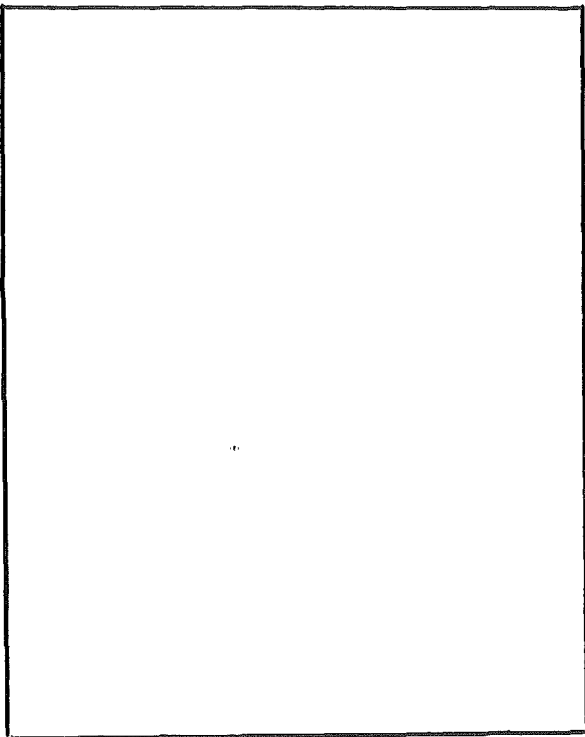
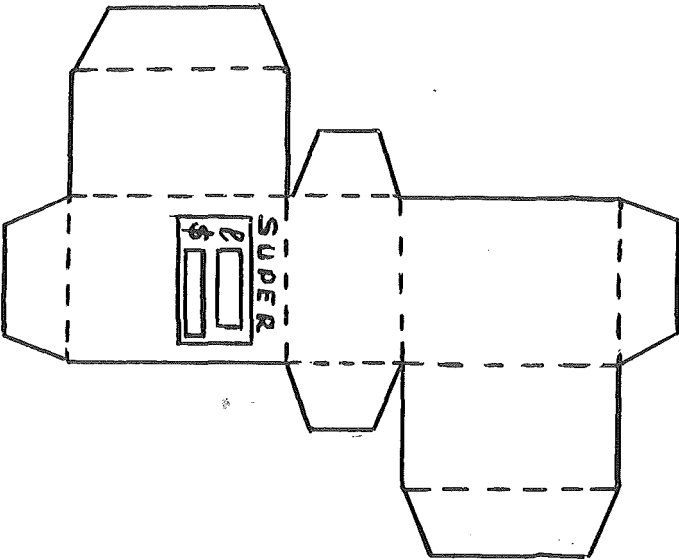
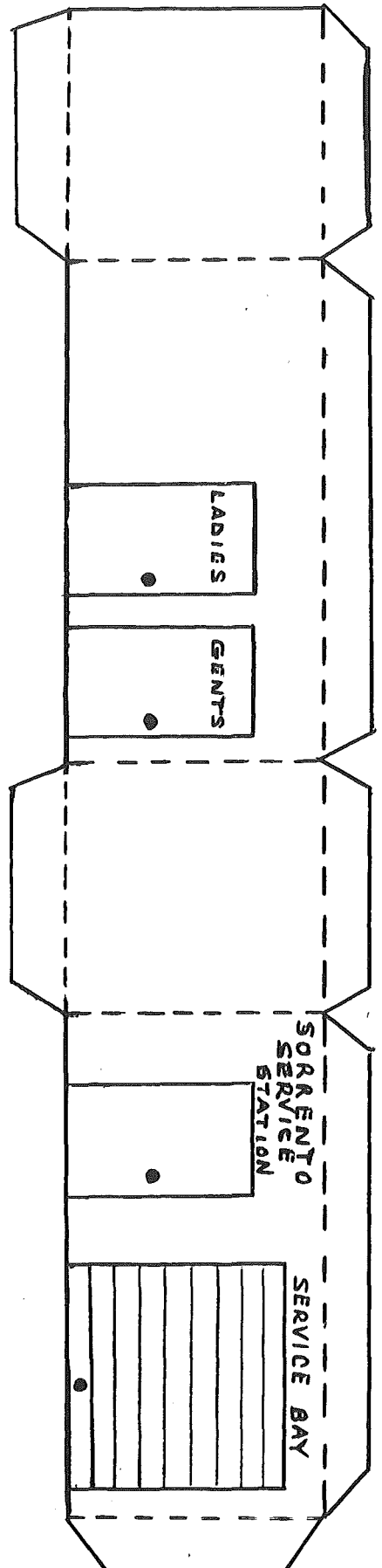
The roof can be left flat if desired.



C A R

B U S

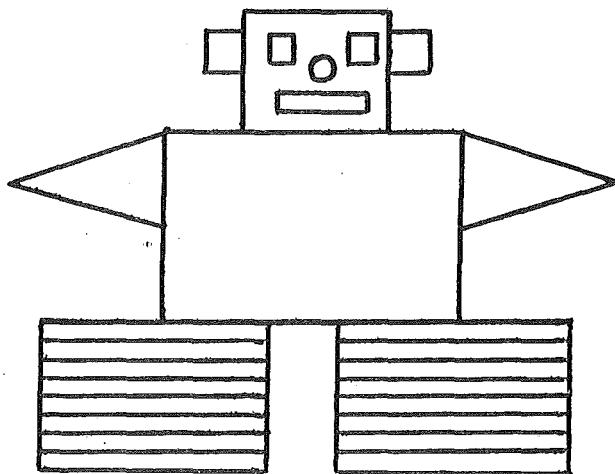




EXERCISE 2

Using whatever materials you can find (e.g. empty toothpaste packets, different size cardboard boxes, etc.) and glue, build whatever you like.

Use as many different shapes/objects as possible. Large constructions will probably be easier to build. Your model might look like a robot :



* EXERCISE 5

Make a list below of things in your classroom or home which are shaped like cubes, cylinders, cuboids, pyramids or cones.

THINGS SHAPED LIKE A CUBE	THINGS SHAPED LIKE A CYLINDER	THINGS SHAPED LIKE A CUBOID	THINGS SHAPED LIKE A PYRAMID	THINGS SHAPED LIKE A CONE

EXERCISE 6

You need to use the shapes on pp 11-16 for this exercise. The dotted lines show where to fold the shape. Place a spot of glue on the "G" on each tab.

- * 1. Cut out and assemble the p 11 shapes. (There are six of them!)

This shape is called a _____ when assembled.

Shapes I can see on the outside are _____

When I tried to stack these shapes I noticed _____

- * 2. Cut out and assemble the p 12 shapes. (There are six of them!)

This shape is called a _____ when assembled.

Shapes I can see on the outside are _____

When I tried to stack these shapes I noticed _____

- * 3. Cut out and assemble the p 13 shapes. (There are six of them.)

This shape is called a _____ when assembled.

Shapes I can see on the outside are _____

When I tried to stack these shapes I noticed _____

- * 4. Cut out and assemble the p 14 shapes. (There are six of them.)

This shape is called a _____ when assembled.

Shapes I can see on the outside are _____

When I tried to stack these shapes I noticed _____

- * 5. Cut out and assemble the p 15 shapes. (There are six of them.)

This shape is called a _____ when assembled.

Shapes I can see on the outside are _____

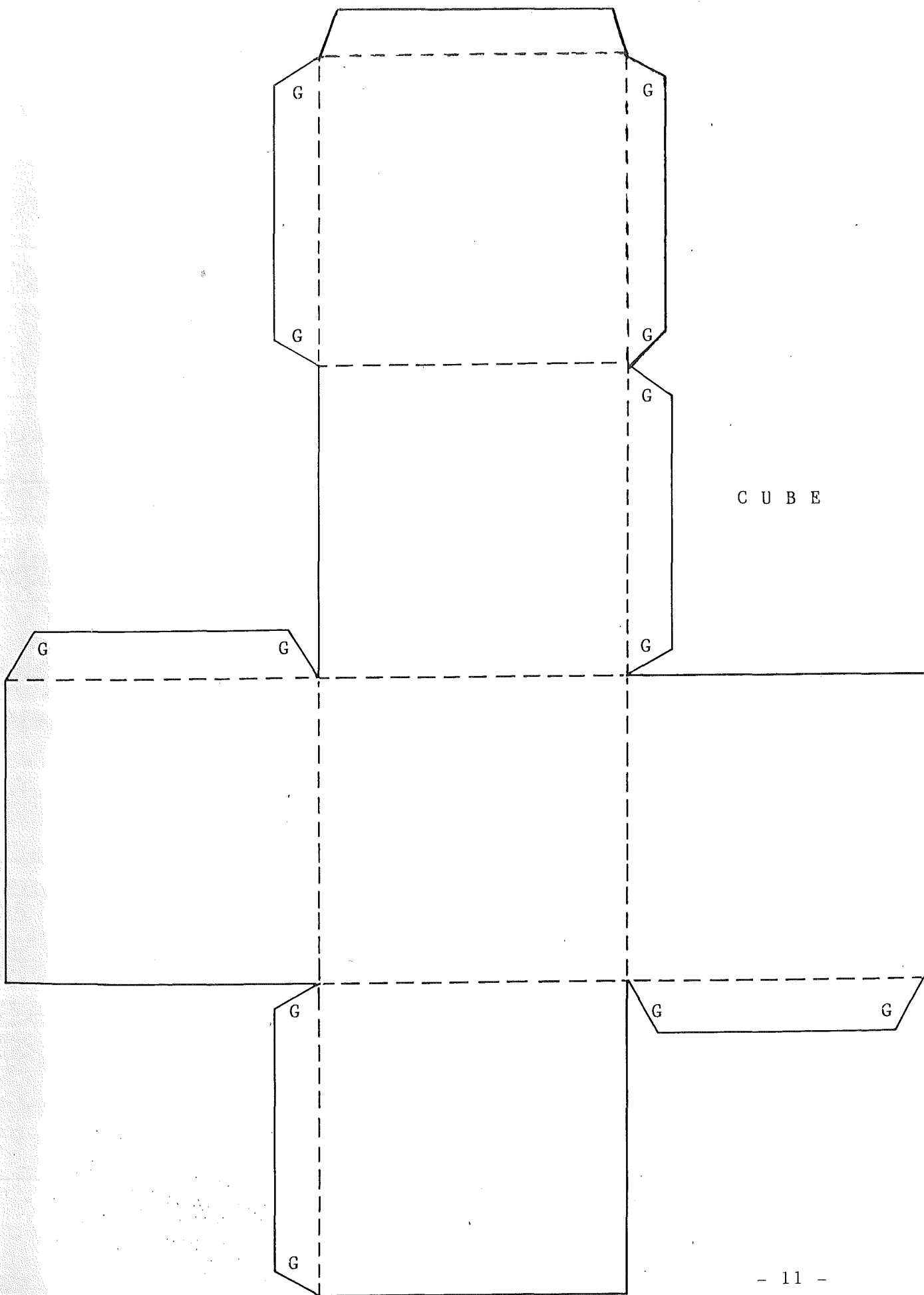
When I tried to stack these shapes I noticed _____

- * 6. Cut out and assemble the p 16 shapes. (There are six of them.)

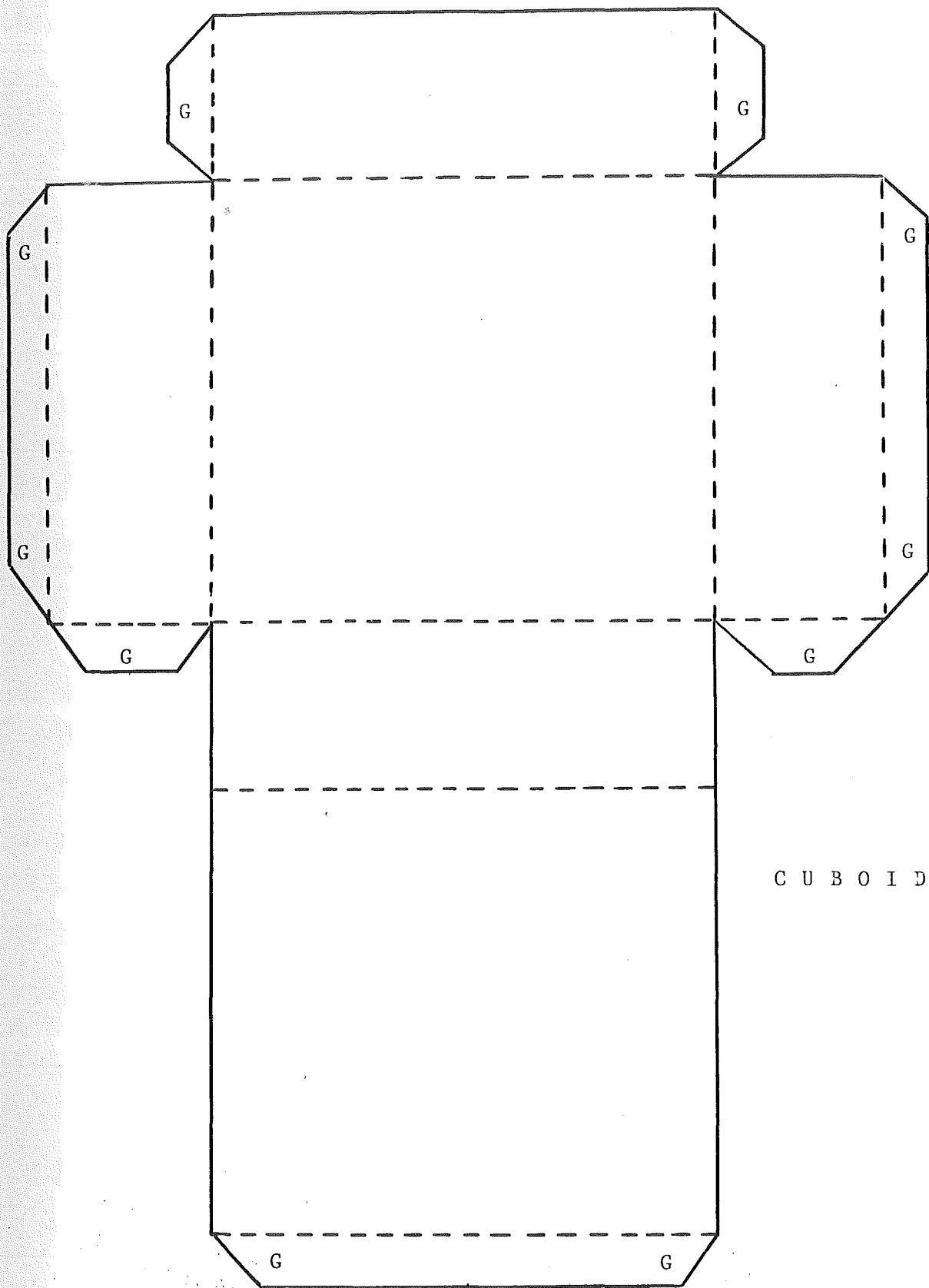
This shape is called a _____ when assembled.

Shapes I can see on the outside are _____

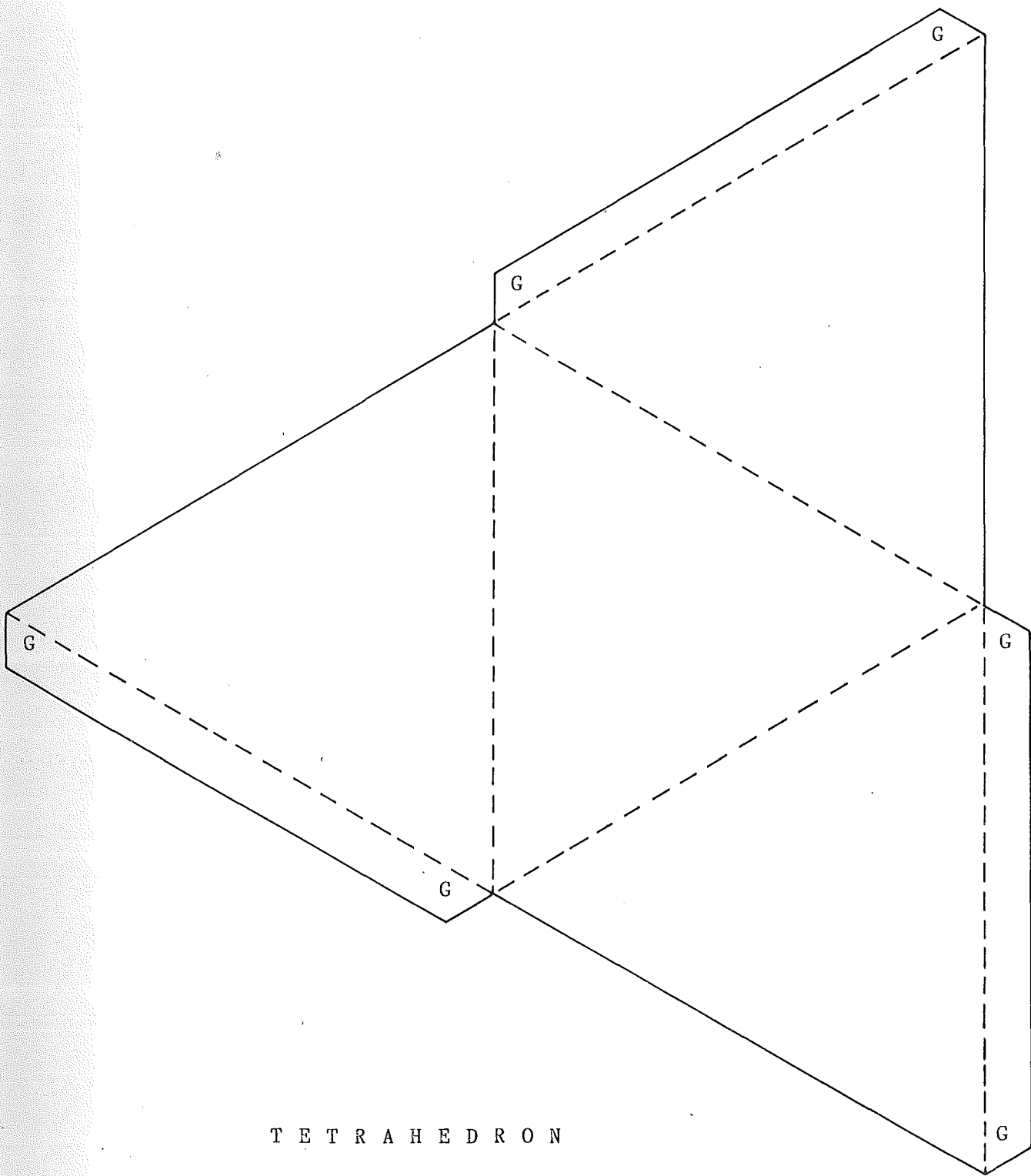
When I tried to stack these shapes I noticed _____



C U B E

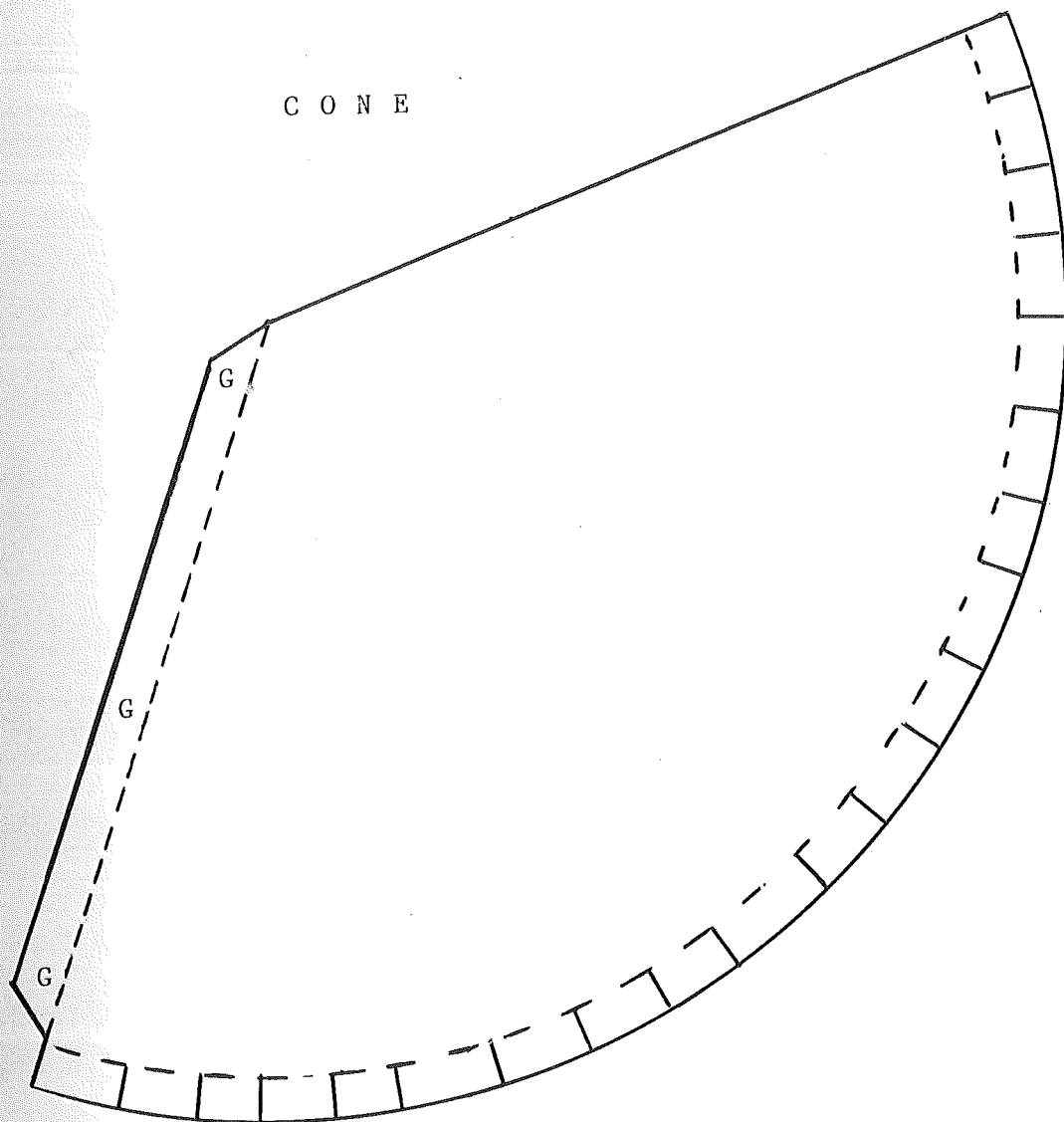


C U B O I D

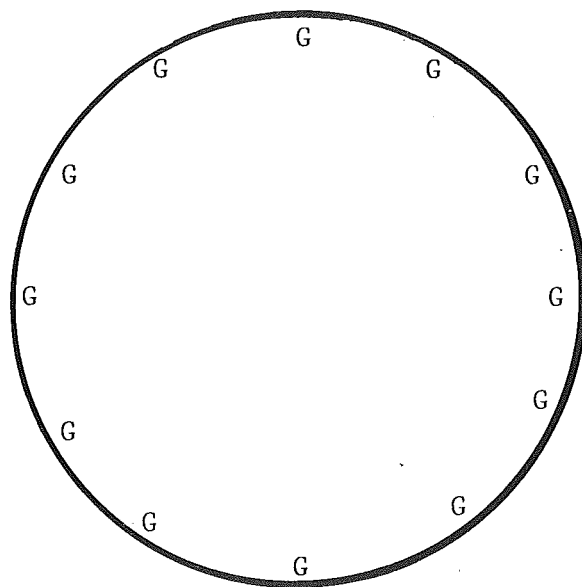


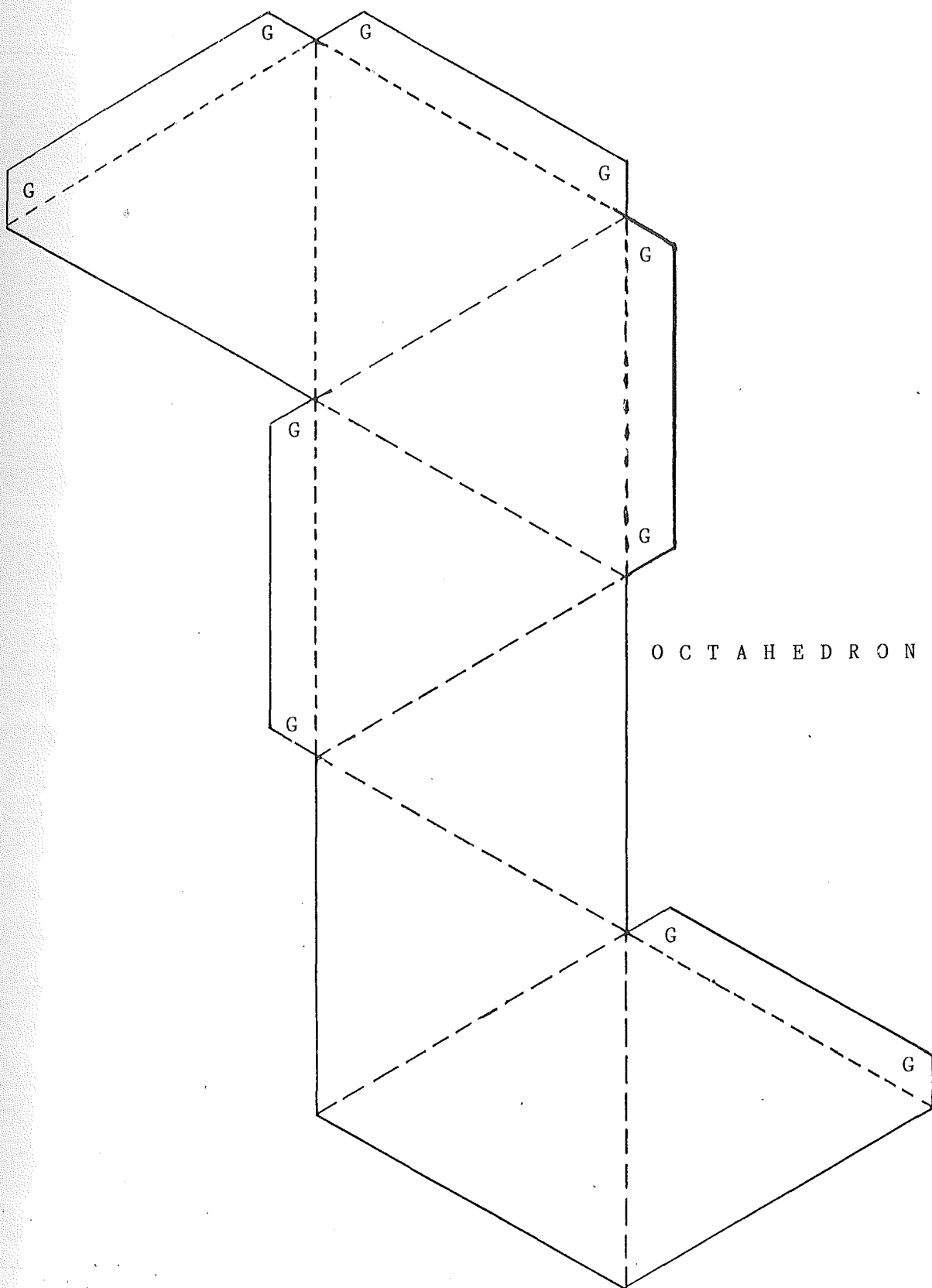
T E T R A H E D R O N

C O N E



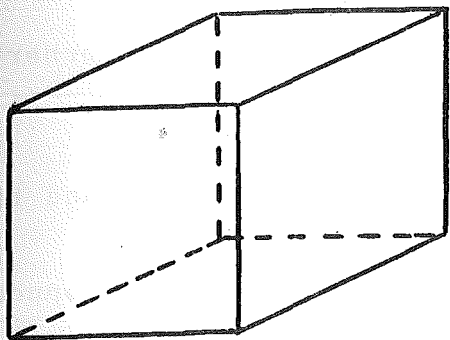
TRIM BASE AS
NECESSARY



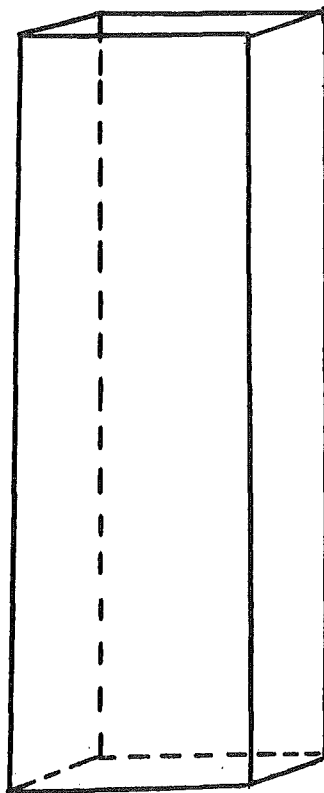
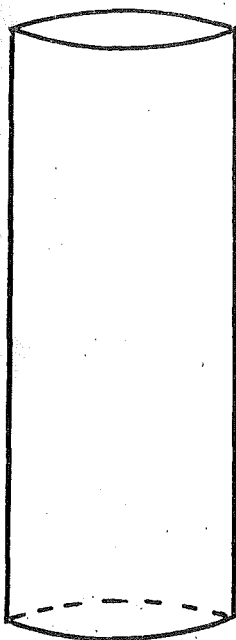
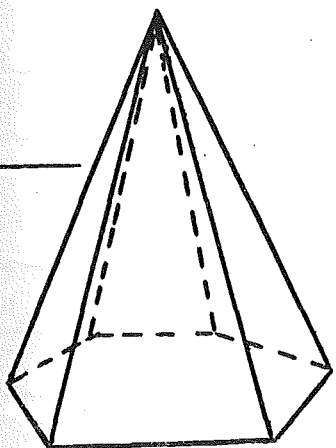
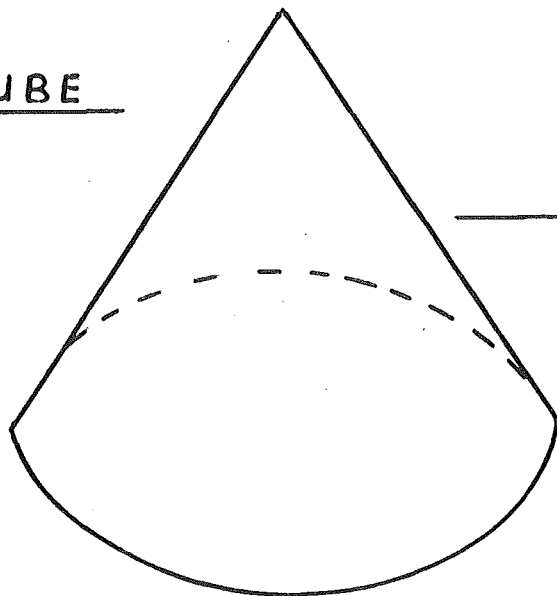


* EXERCISE 7

Label each of these shapes. The first is done for you.



CUBE



Here is some information to help you to answer the following :

EQUILATERAL means the sides of the shape are all the same length.

RECTANGLE means a four sided shape with square corners.

GON means "angle".

PENTA means "five".

HEPTA means "seven".

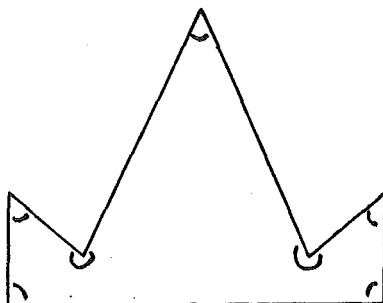
HEXA means "six".

REGULAR means the sides are all equal in length and the angles are all the same size.

A PARALLELOGRAM is a shape with four sides whose opposite sides are parallel.

Using your ruler join the stars on p 19 like this :

- (i) $A \rightarrow B \rightarrow C \rightarrow D \rightarrow A$. This shape has _____ sides. It is called a r_____.
- (ii) $E \rightarrow F \rightarrow G \rightarrow E$. This shape has _____ sides. It is called an equ_____ t_____.
- (iii) $H \rightarrow I \rightarrow J \rightarrow K \rightarrow L \rightarrow H$. This shape has _____ angles. It is called a p_____ gon.
- (iv) $M \rightarrow N \rightarrow O \rightarrow P \rightarrow Q \rightarrow R \rightarrow M$. This shape has _____ angles. It is called a reg_____ h_____ gon.
- (v) $S \rightarrow T \rightarrow U \rightarrow V \rightarrow S$. This shape has _____ sides. It is called a p_____. (HINT : The opposite sides are parallel.)



HINT : These are angles

THIS SHAPE IS
CALLED A

_____ GON

A *

* B

E *

* C

D *

S *

* V

F *

* G

H *

* K

L
*

T*

* U

M *

* R

H1 *

I *

J *

* J1

* A1

N*

* Q

K1
*

O *

* P R1
*

* Y1

G1
*

S1*

* X1 * I1

D1*

T1*

* W1

* F1

U1*

* V1

* C1

* E1

1 *

L1 *

P1

*

* O1

2 *

* 5

* Q1

* B1

M1 *

* N1

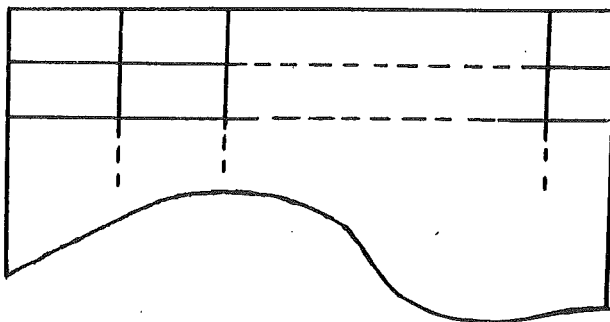
3 *

* 4

* EXERCISE 9

Cut out the rectangle (shape (i) on p 19). By placing it on p 21 and drawing around it, see how many times you can fit it on the page.

e.g.



How many rectangles were you able to fit on the page?
 _____. Work out a way of including all the bits of
 rectangles at the edge of the page. How did you do this?

Do the same with shapes (ii), (iii), (iv) and (v) from p 19.²

Try : Shape (ii) on p 22. Shape (iii) on p 23.

Shape (iv) on p 24. Shape (v) on p 25.

Which of these shapes will cover a page without overlapping
 or without any gaps in between them?²

Shape (ii) Yes or No? _____. Shape (iv) Yes or No? _____.

Shape (iii) Yes or No? _____. Shape (v) Yes or No? _____.

If a shape will do this it is said to tessellate.

After you have tessellated each page, colour it in carefully
 and write your name on the back

IMPORTANT NOTE : 1. Keep the shapes in a plastic bag or con-
 tainer. You will need them later (see
 p 39.)

2. Ignoring the parts of shapes which are
 necessary at the edge of the page.

Here are some more helpful hints :

POLY means MANY, so POLYGON means a shape with MANY ANGLES.

SCALENE means UNEQUAL sides or angles.

QUADRILATERAL means FOUR SIDES.

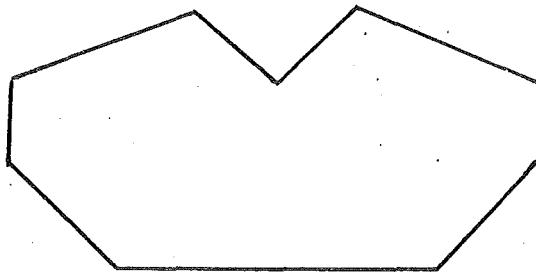
OCTAGON means "eight angles".

NONA means "nine".

Using your ruler join the stars on p 19 like this :

- (i) $A_1 \rightarrow B_1 \rightarrow C_1 \rightarrow A_1$. This polygon has _____ angles.
It is called a s _____ triangle. (HINT :
Not two sides are the same length.)
- (ii) $D_1 \rightarrow E_1 \rightarrow F_1 \rightarrow G_1 \rightarrow D_1$. This polygon has _____ sides.
It is called a q _____.
- (iii) $H_1 \rightarrow I_1 \rightarrow J_1 \rightarrow K_1 \rightarrow H_1$. This polygon has _____ sides.
It is called a q _____.
- (iv) $L_1 \rightarrow M_1 \rightarrow N_1 \rightarrow O_1 \rightarrow P_1 \rightarrow Q_1 \rightarrow L_1$. This polygon has _____
angles. It is called a _____.
- (v) $R_1 \rightarrow S_1 \rightarrow T_1 \rightarrow U_1 \rightarrow V_1 \rightarrow W_1 \rightarrow X_1 \rightarrow Y_1 \rightarrow R_1$. This polygon
has _____ equal angles. It is called a r _____
o _____.
- (vi) $1 \rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow 5 \rightarrow 1$. This polygon has _____
angles. It is called a reg _____.
(HINT : The sides and angles are all the same size.)

Cut out the shapes.



THIS SHAPE IS
CALLED A

_____ GON

EXERCISE 11

(Parts of this exercise are difficult but fun to try! Just do whatever you can!)

- * (i) Put a mark on one face of shape (i) on the previous page, and, keeping this face up at all times, see if you can tessellate a blank sheet of paper.
Can you see a repeating pattern? Colour the page in a way which shows the repeating pattern. (This is important. If you don't get a repeating pattern, you haven't really shown you could keep going forever.)
- * (ii) Repeat the above with shapes (ii) — (iv). Remember: do not flip the shape.
[N.B. (i), (ii) and (iii) do tessellate.]
- * (iii) A regular octagon (shape (v)) will not tessellate on its own. Find out what other shape is needed by trying to tessellate with your regular octagon.
What other shape do you need?

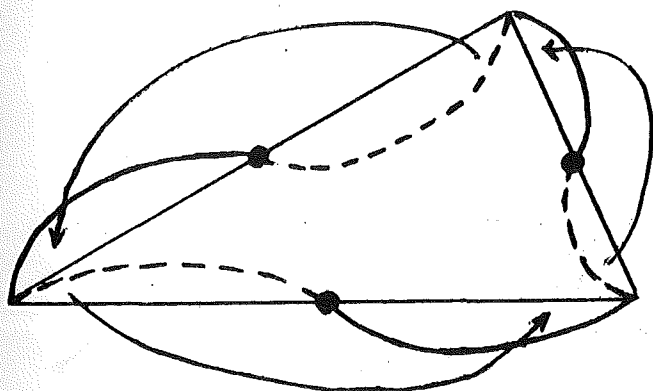
Try tessellating with your regular pentagon. (shape (vi)). What happens?

NOTE : When you have finished, put the shapes in the plastic bag containing the shapes used on p 20.

EXERCISE 12

1. Using thin card (use p 30.) cut out a shape you know tessellates. (Make sure it's a shape with straight sides.)
2. Find the mid points of each of the sides.
3. Cut out a part of the shape between each corner and each mid point. Rotate the part around the dot as shown and attach it to the same side like this:

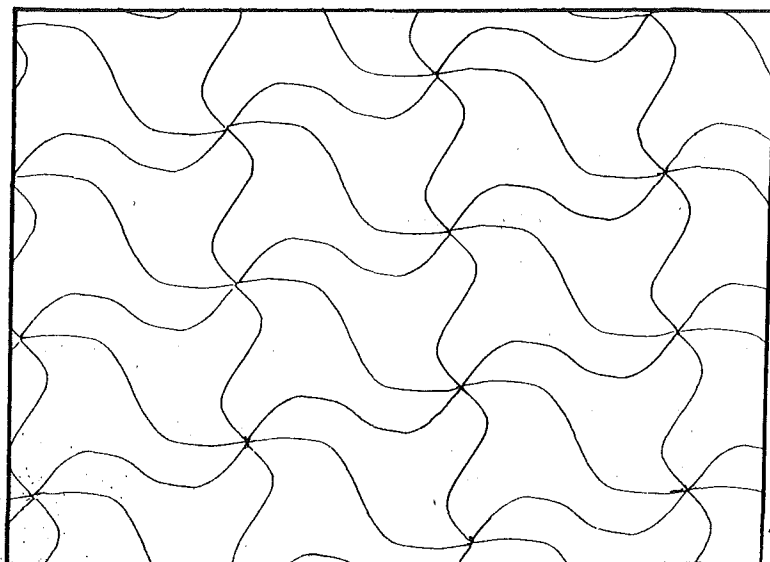
(Use sticky tape)



Example using
a triangle.

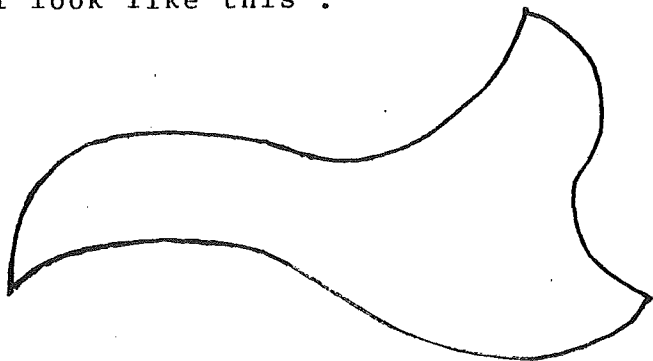
The piece you
cut out and
rotate might
be a different
shape.

4. Draw around this shape on your thin card, cut it out and see if it tessellates. If so, tessellate a large sheet of paper. *e.g.*

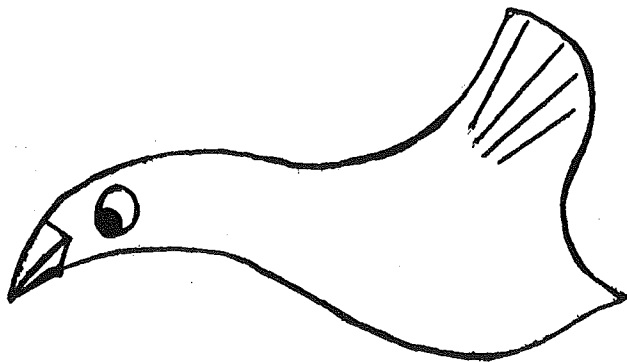


- * 5. Does your shape look like anything you've seen before?

e.g. the shape shown on the previous page will look like this :



It looks like a bird now, so :



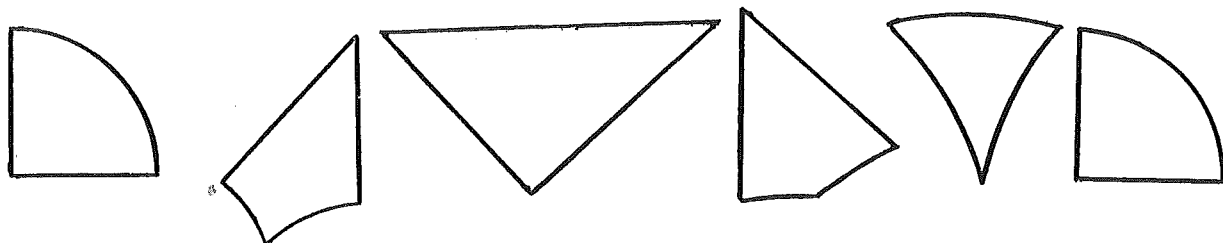
Do the same to each shape on the sheet of paper.

Your large sheet of paper should be a page of tessellating birds when you have finished. Colour the repeating pattern you can see.

- * 6. Try this exercise again with another shape. Use paints and/or textas to decorate the tessellation.

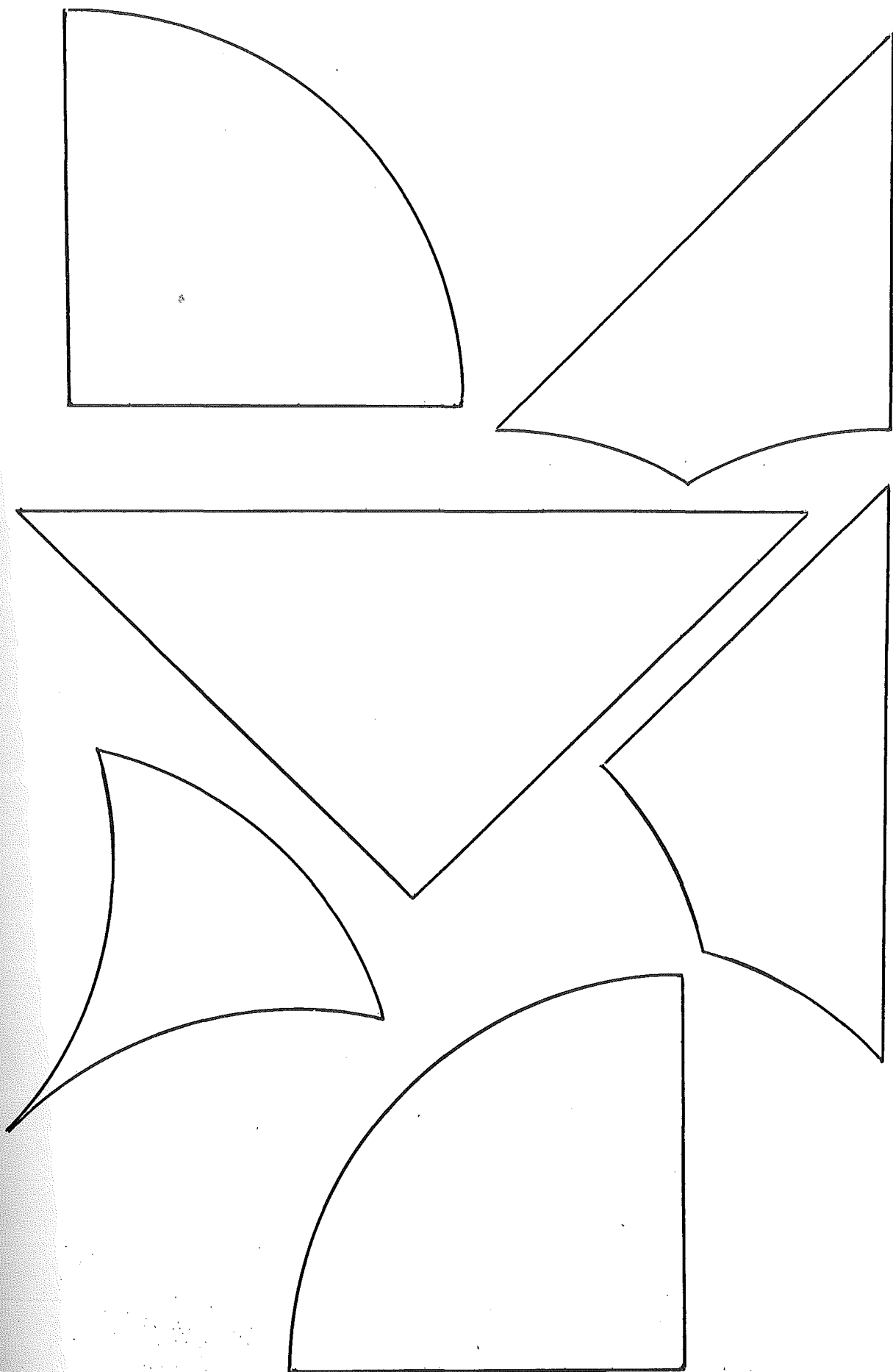
EXERCISE 13

- * (i) Colour the shapes on p 32. They look like this:



Cut the shapes out and fit them together to make a shape you know tessellates. (Make sure that the coloured face is up at all times.) When you have found the shape, glue the pieces into this shape on p 33.

- * (ii) On p 34. draw a shape you know tessellates. Make it as large as you can fit on the page. Colour the shape, cut it out, and then cut it into pieces (similar to those above). See if you can re-assemble them into their original shape, and glue them onto a sheet of paper.

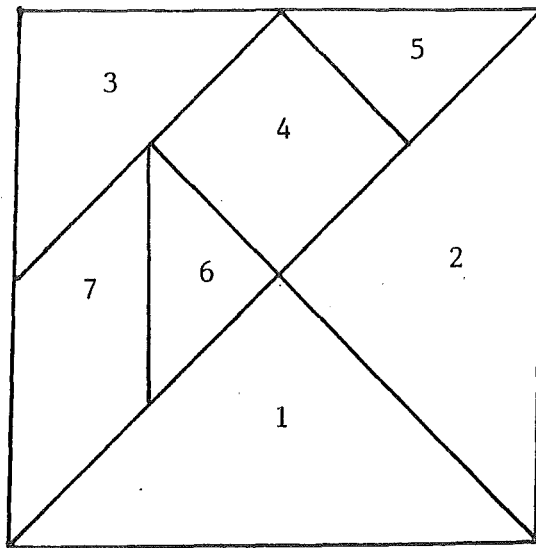


* EXERCISE 14

Cut out the seven polygons on p 37. Can you name each shape?

1. 1 is a large triangle. 2 is a _____.
- 3 is a medium t_____. 4 is a s_____. 5 is a small t_____. 6 is a _____.
- 7 is a p_____.

p 37 has this
shape drawn on
it



The seven shapes are called TANS, and are used for making shapes called TANGRAMS.

For the exercises to follow, make sure you keep the face with the number on it facing up at all times.

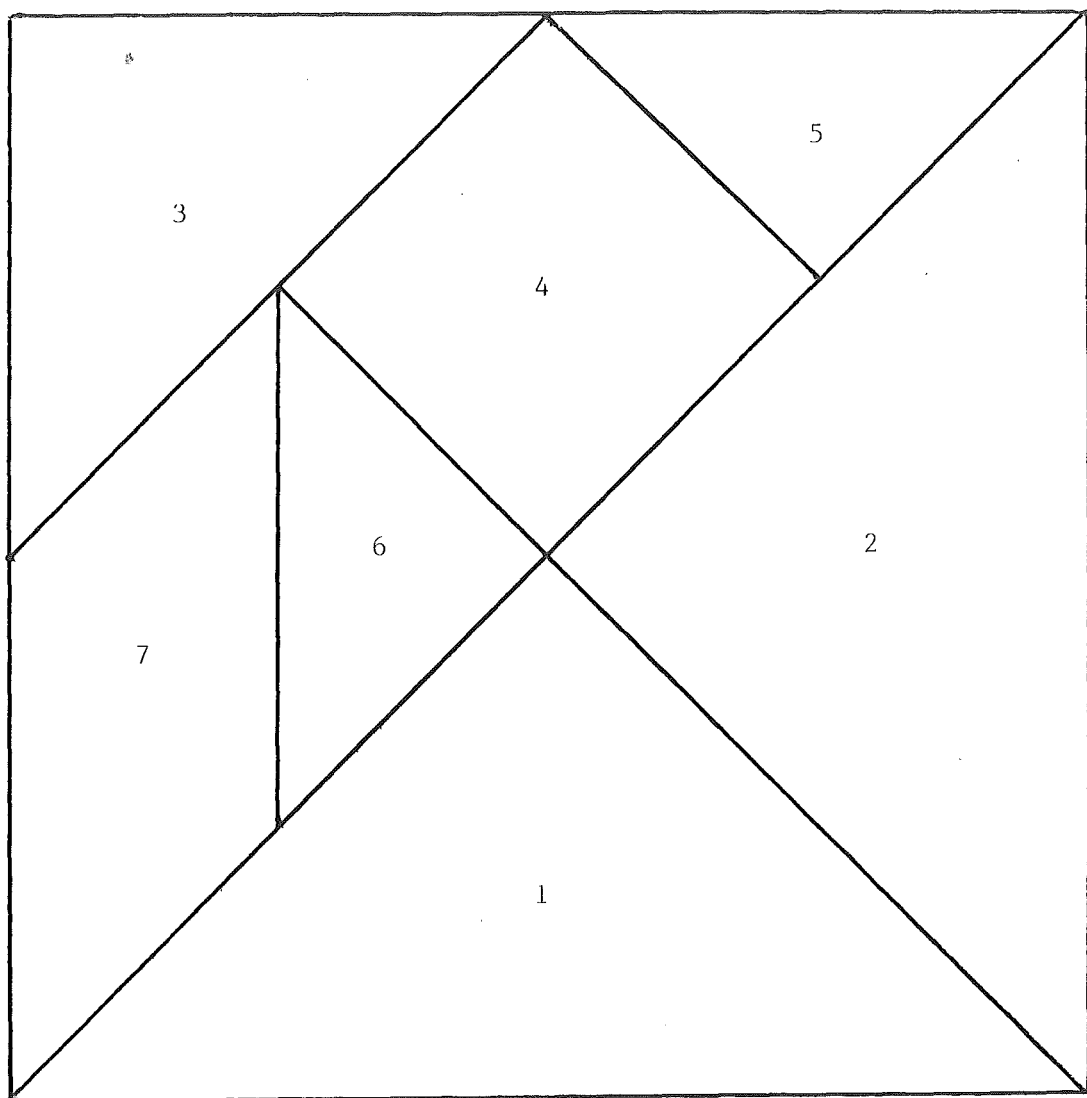
- * 2. By using all seven tans, make a variety of shapes, e.g. house, aeroplane, etc. NO OVERLAPPING OF SHAPES. Draw two of your best shapes on a sheet of paper. Show the number of each tan in your drawings.
- * 3. Using five tans, make any shape you like on p 38 and draw around its outline. (It doesn't have to look like anything in particular - see p 54 for an example.)

Remove the tans and then see if you can fit them back into the outline. When you have done this, draw in on the outline (on p 38) where each tan goes. Don't forget to number the tans as above.

- * 4. Show that tan 1 can be exactly covered by
- (a) tans 4, 5, and 6
 - (b) tans 3, 5, and 6
- Draw a small sketch on the back of p 38 for each one.
- * 5. (a) Make a triangle with 2 tans
- (b) Make a square with 3 tans
- (c) Make a rectangle with 4 tans
- (d) Make a parallelogram with 3 tans
- (e) Make a trapezoid with 3 tans
- Draw a small sketch of your solution on the back of p 38.
- * 6. (i) Make a triangle using two tans
- (ii) Make a triangle using three tans
- (iii) Make a triangle using four tans
- (iv) Make a triangle using five tans
- (v) Make a triangle using six tans
- (vi) Make a triangle using seven tans
- Use another sheet of paper to draw these if you need to.
- * 7. Each of the shapes in 5. can also be made with all seven tans (although they will be a different size of course). See how many you can make. Sketch your solution on p 38 each time. (Use another sheet of paper if you need to.)

NOTE : Parts of exercises 5 and 6 are difficult, but they are all fun to try. If you keep trying whenever you have any spare time, you might eventually get them all!

T A N G R A M S



EXERCISE 15

- * (i) Use the polygons you cut out on p 19 for these exercises.¹

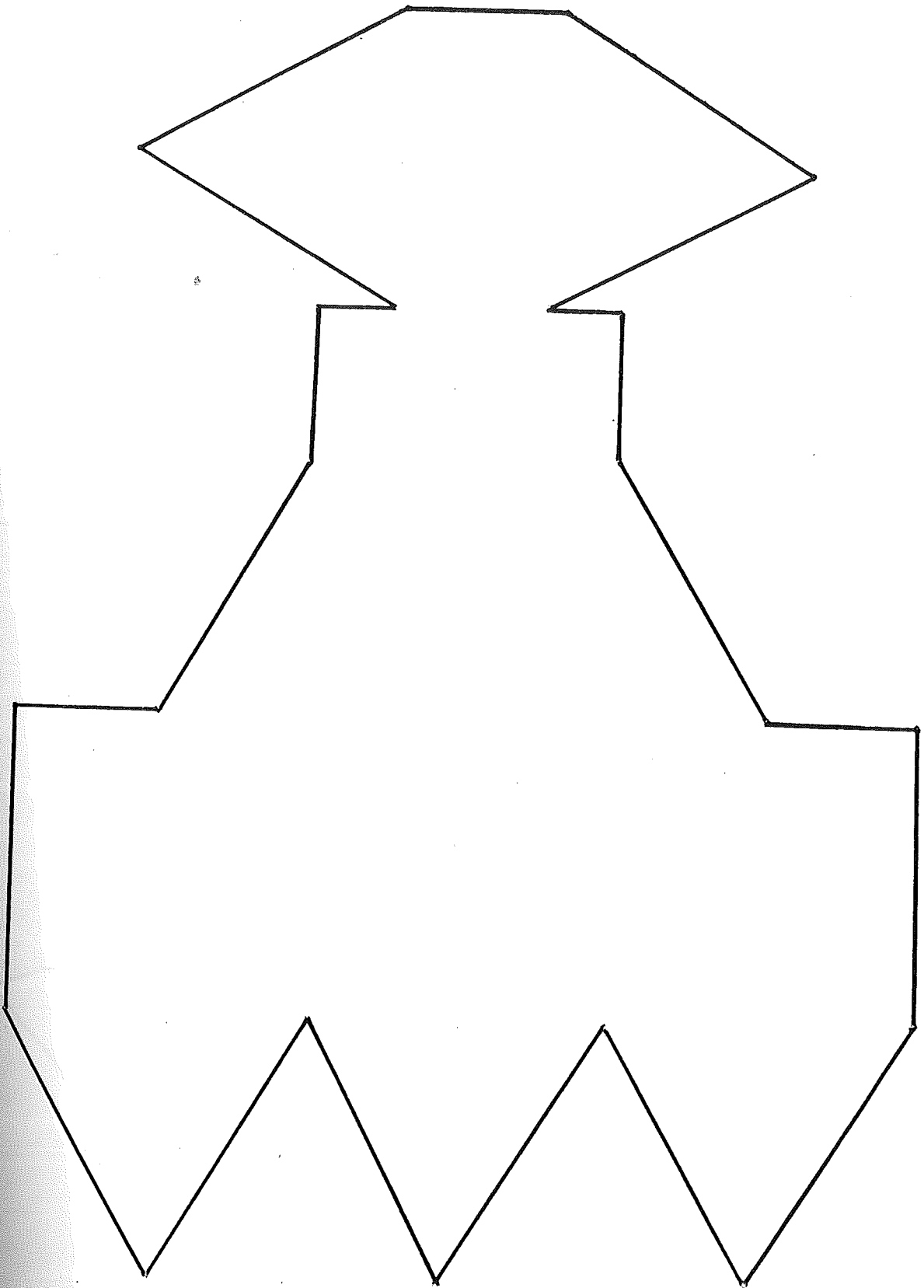
Print the name of each shape on it.

- (i) See if you can fill the shape outline on p 40 using two different polygons. (HINT : one is regular, the other isn't). Draw around each polygon as you place it inside the outline, shifting it to a new position each time. Colour in the mosaic you now have.

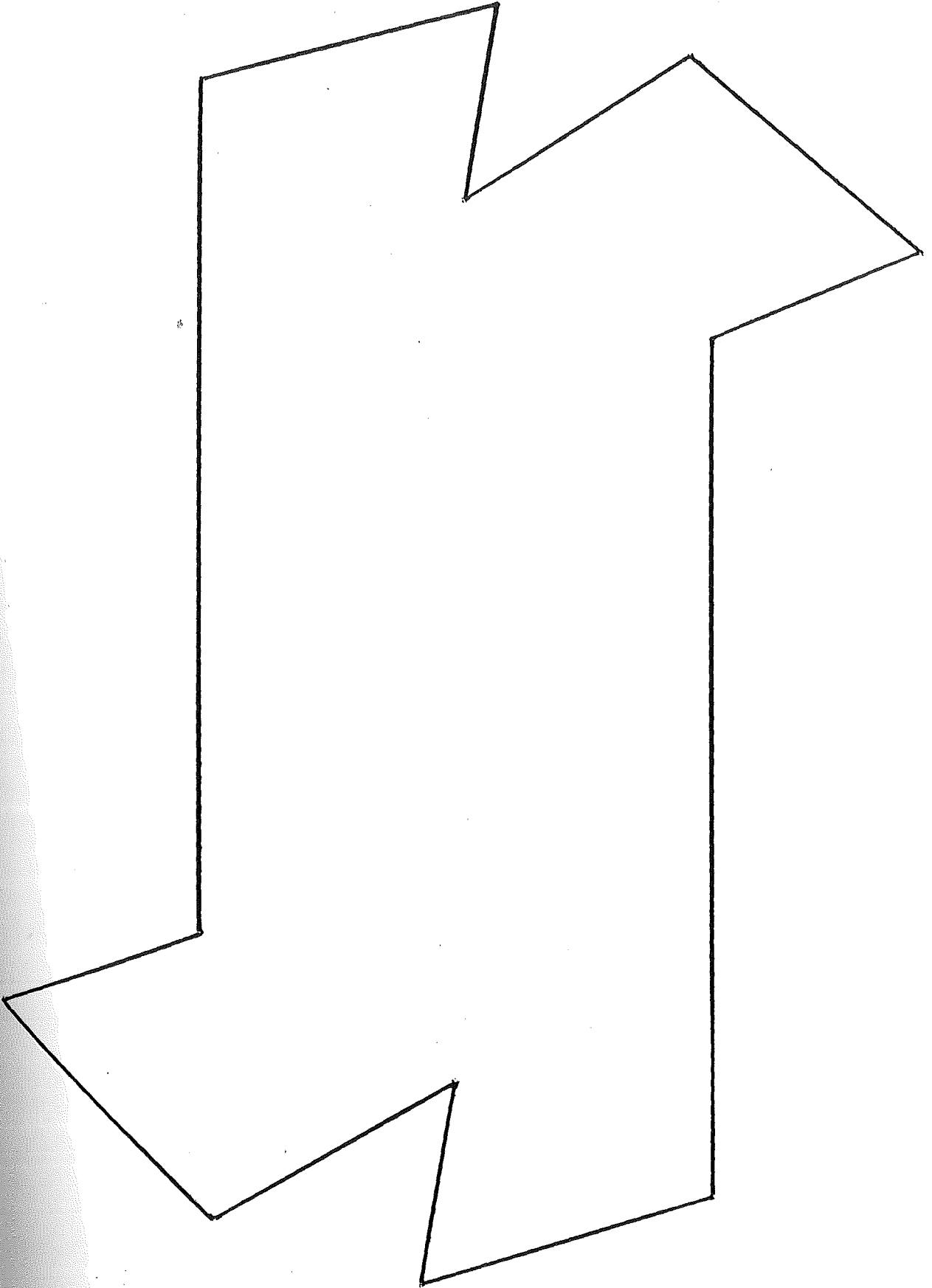
- * (ii) Fill in the shape outline on p 41 using two different polygons. Create a mosaic as you did in (i).

- * (iii) Create your own mosaic on p 42 using whatever polygons you like.

NOTE : 1. The polygons should be retained for later use.



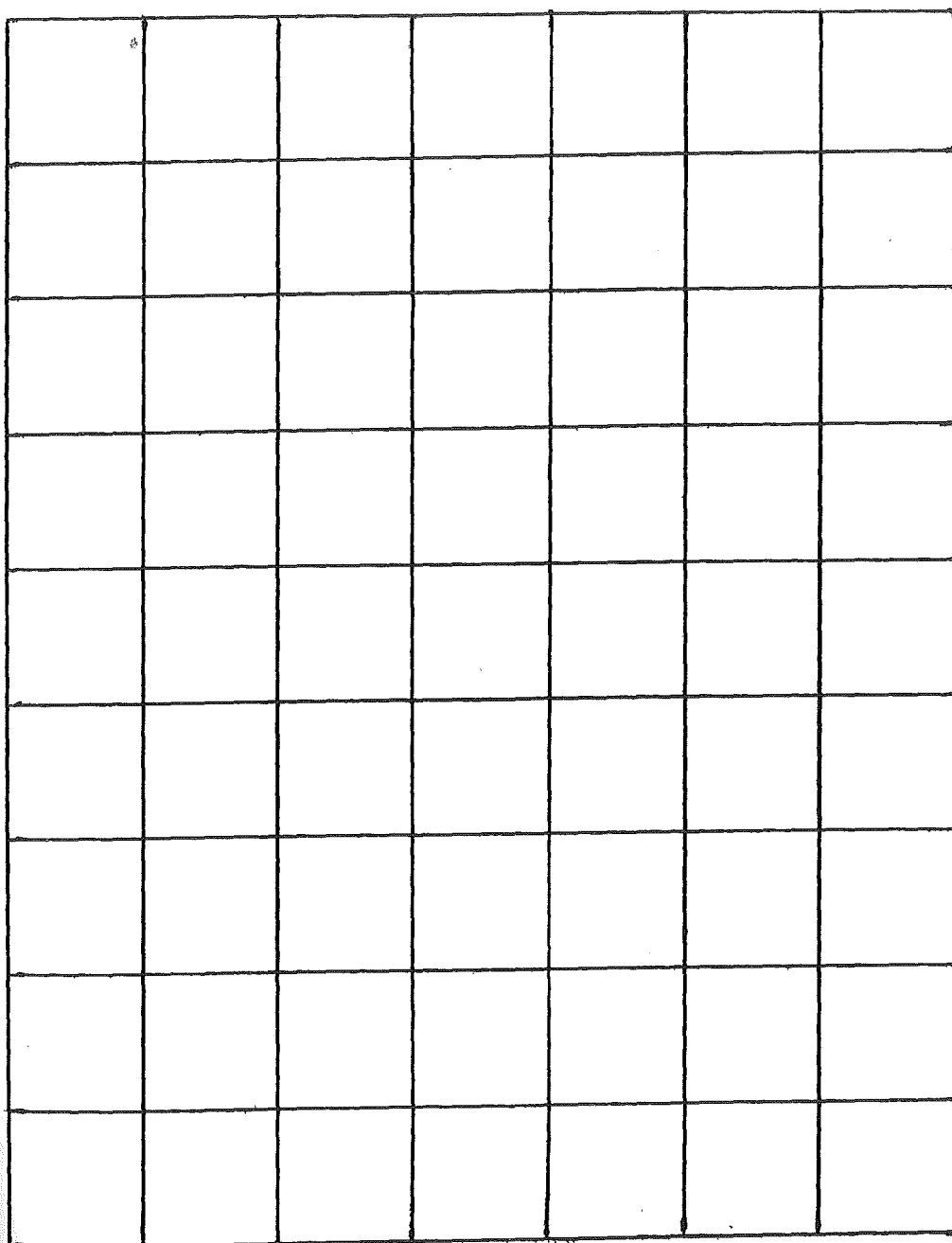
HINT : Use one regular polygon
and one other polygon



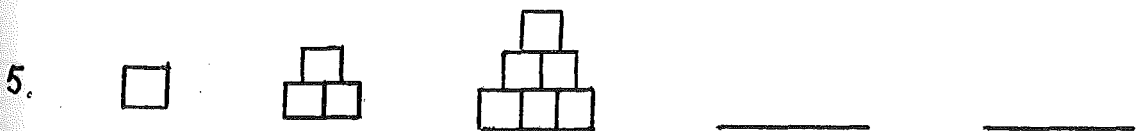
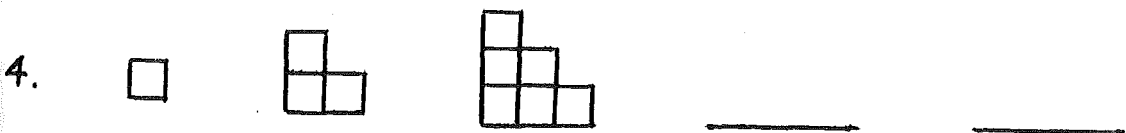
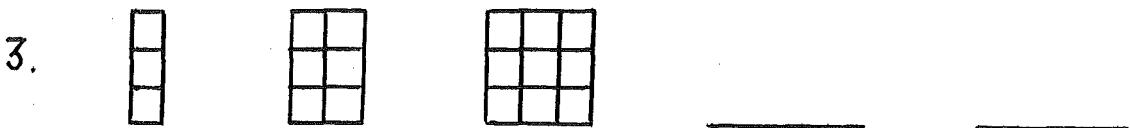
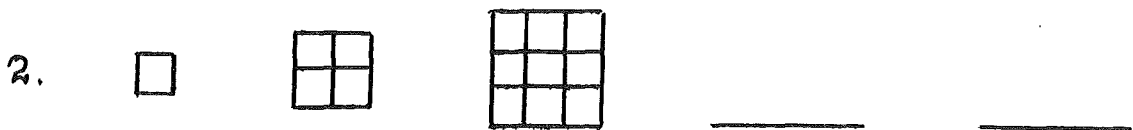
USE TWO
POLYGONS ONLY.

EXERCISE 1.6

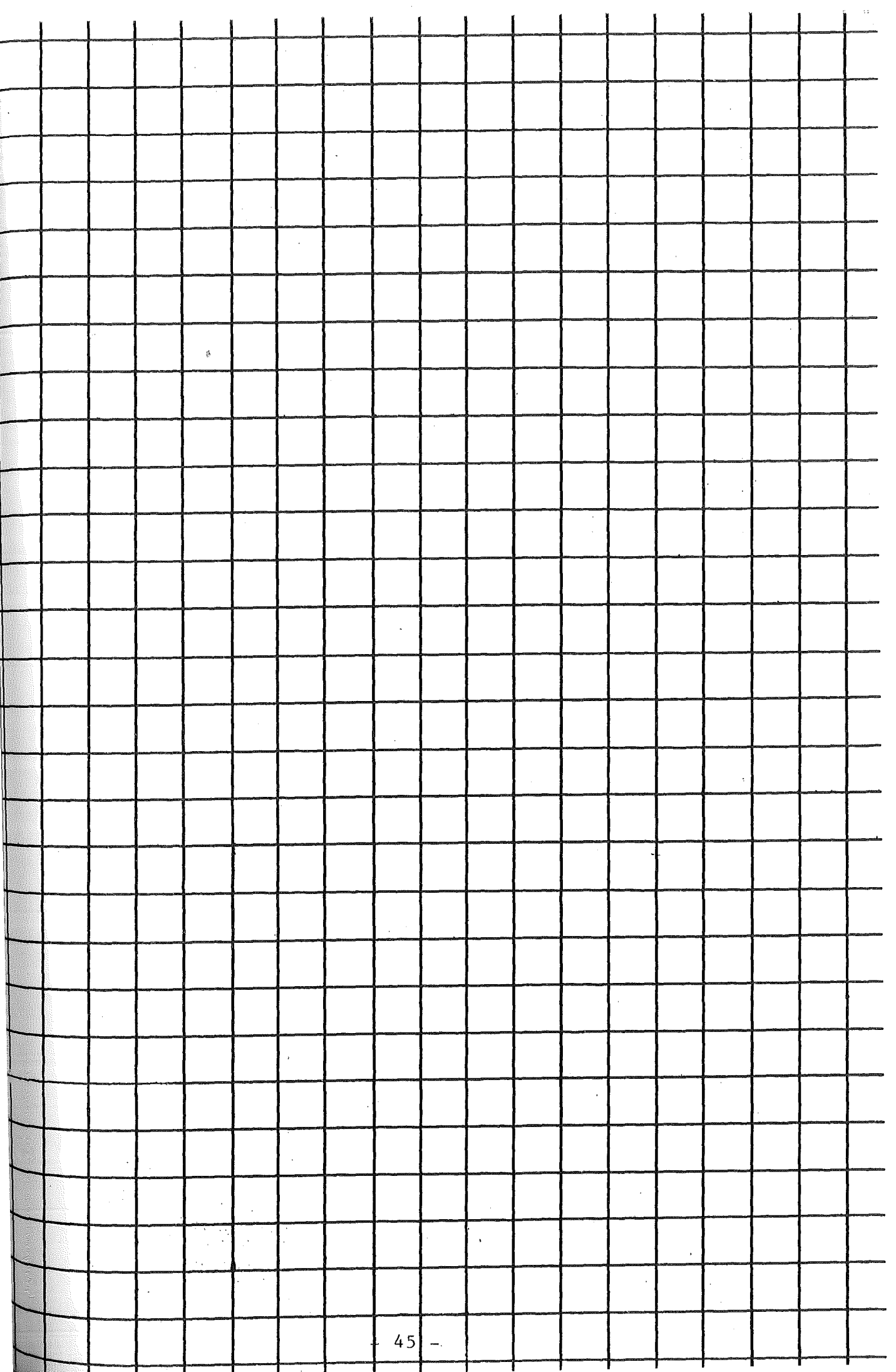
- (i) Neatly cut out all the squares below. We will call each square a tile.



(ii) Make up the next two steps in each of the following patterns with your tiles.



* (ii) Using the sheet of squared paper on p 45, colour in squares to show each of the above patterns. Show by numbering them, which pattern they belong to. You will need to draw pattern 5 on the back of p 45.



(iv) Describe each of the patterns you made on p44 below.

DESCRIPTION OF PATTERN 1

DESCRIPTION OF PATTERN 2

DESCRIPTION OF PATTERN 3

DESCRIPTION OF PATTERN 4

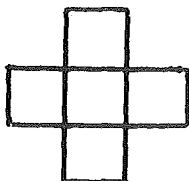
DESCRIPTION OF PATTERN 5

(v) Using your tiles, make the first five parts of your own pattern (as on p 45). Draw how you did it on the back of p 45, or on a separate sheet of paper.

EXERCISE 17

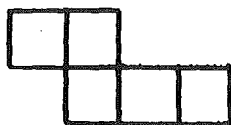
(You need a sheet of squared paper for this exercise.)

- * (i) Using five of your square tiles, make this shape;



Copy this shape onto squared paper. Colour it in.

Make this shape:



Copy it on squared paper. Colour it in.

See how many different shapes¹ you can make with five tiles. As you discover each new shape, copy and colour it on squared paper. (N.B. If you can get any one of your shapes by flipping or turning another shape, it is not allowed.)

NOTE:

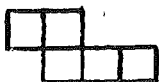
1.



is the same shape as



The first shape has been flipped over.



is the same shape as



The first shape has been turned around.

Each tile must meet at least one other tile along full length of one side.

(There are twelve different shapes possible.)

Each shape is called a pentominoe.

- * (ii) Both of the shapes drawn on p 47 will fold to make an open box. By drawing around a tile on a piece of paper, make all of the shapes on your sheet of squared paper.¹ Cut them out, and see if they will fold to make a box.

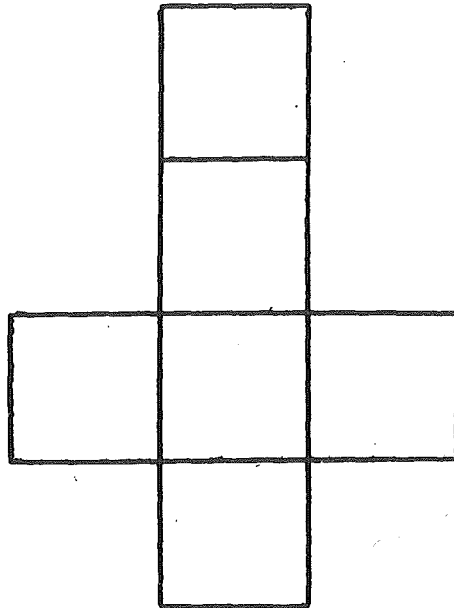
Draw a ring around those shapes on your sheet of squared paper which do fold to make a box.²

- * (iii) Take a new sheet of squared paper.

This shape will fold to make a cube. Trace it on a piece of paper, cut it out, and fold it into a cube.

Using your square tiles, make some other shapes which

fold to make a cube. Draw how you did each one on squared paper. Print "CUBE" next to each one.



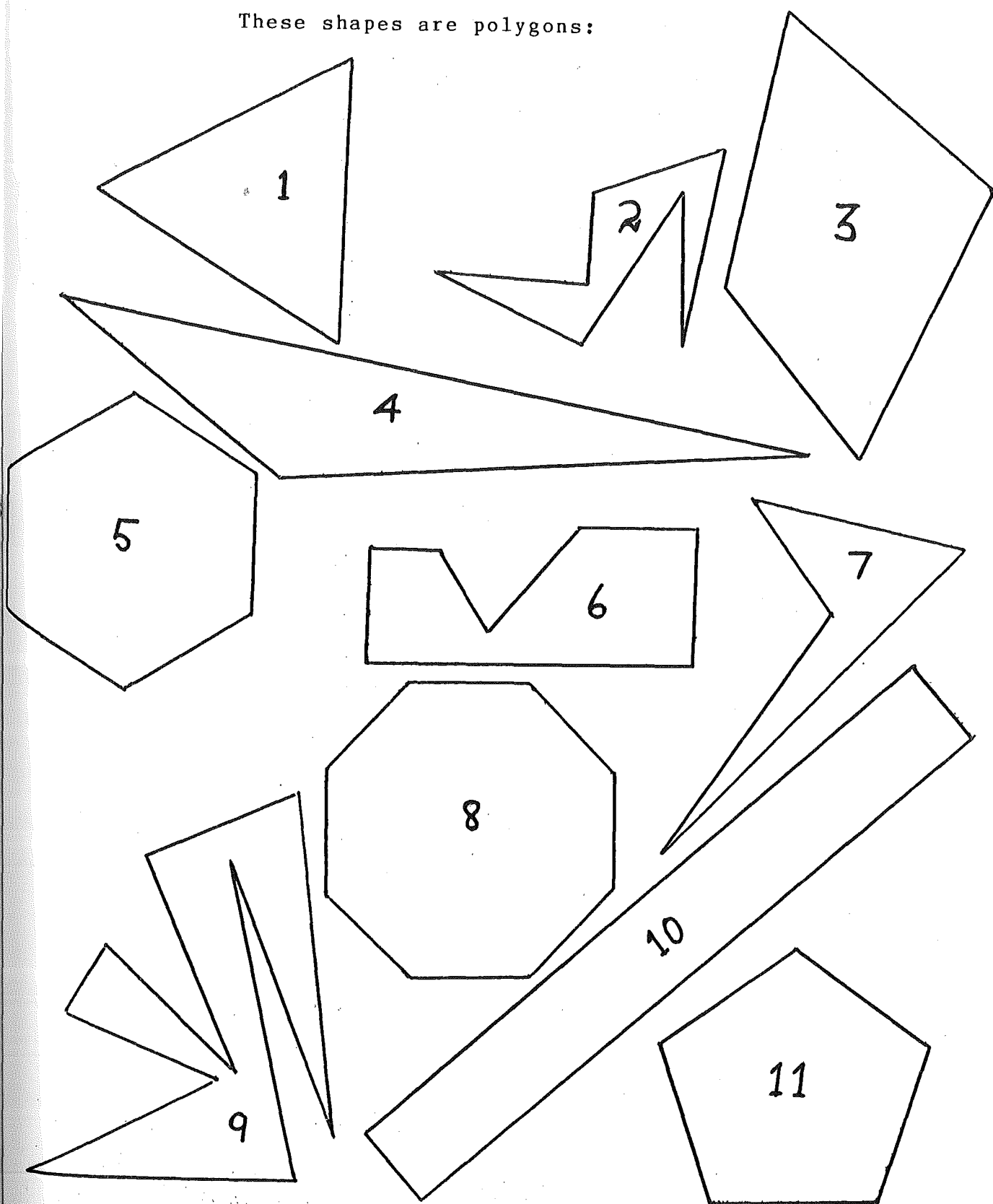
NOTE THAT
YOU NEED
SIX SQUARES
FOR A CUBE

NOTE : 1. Those you made with five (5) tiles.

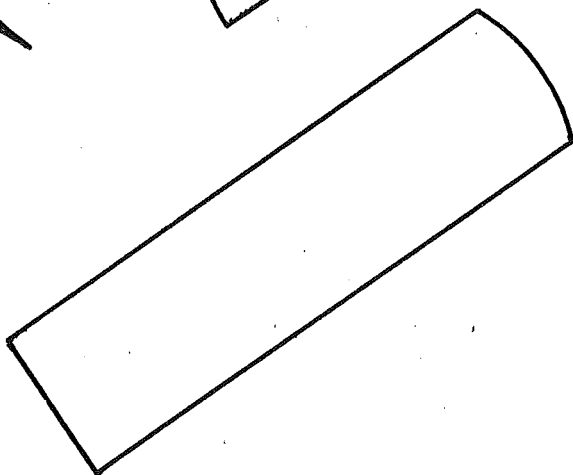
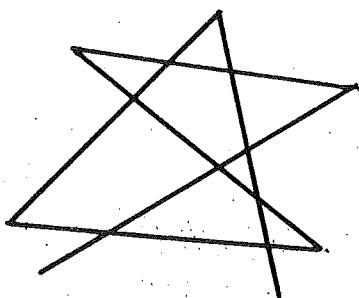
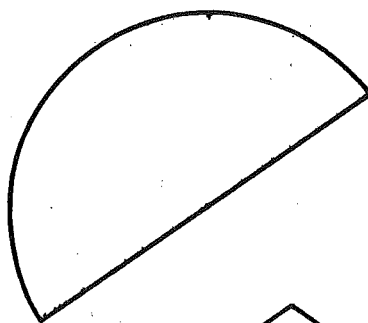
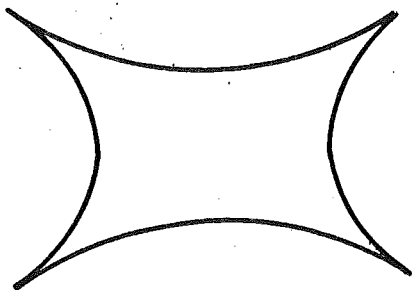
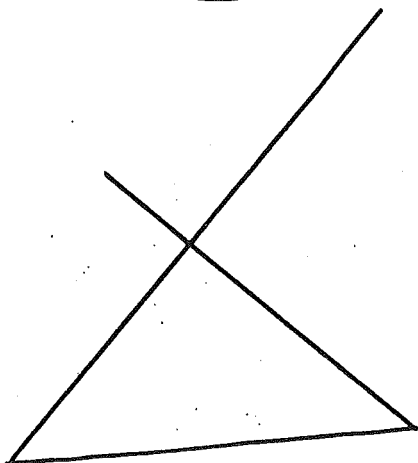
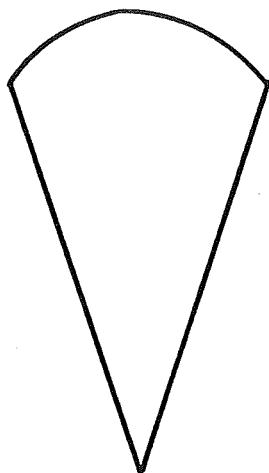
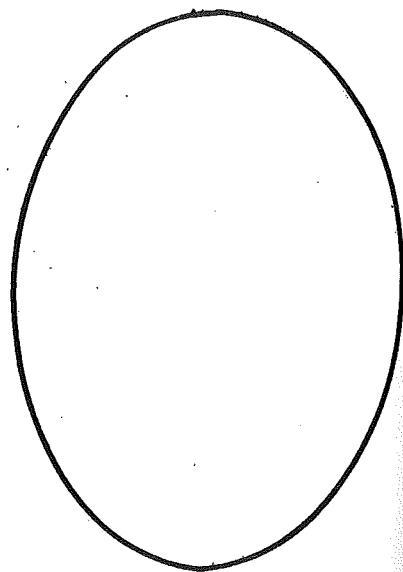
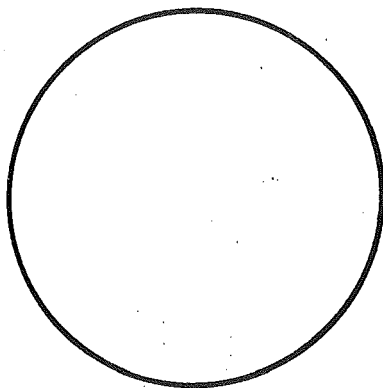
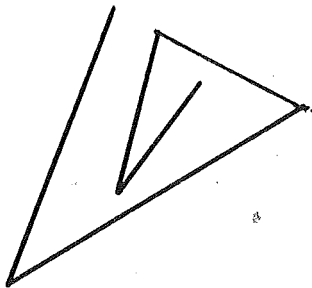
2. There are EIGHT (8) out of the TWELVE (12) that will fold into a box.

EXERCISE 18

These shapes are polygons:



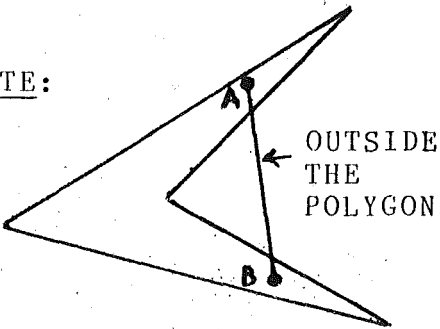
These shapes are not polygons: (Non-polygons)



* (i) Look carefully at the polygons and non-polygons on the previous two pages.

Write down your description of a polygon in the space below.

NOTE:



THIS IS A
CONCAVE POLYGON

If you can find two points (like A and B) in a polygon which have part of the line segment joining them outside the polygon, then the polygon is CONCAVE.

* (ii)

CLASSIFICATION OF POLYGONS

Each of the polygons on p 49 is numbered.

Put the number of each polygon in the correct box below.

	3 angles		4 angles		5 angles		6 angles		7 angles		8 angles		9 angles		10 angles	
	C	NC	C	NC	C	NC	C	NC	C	NC	C	NC	C	NC	C	NC
REGULAR		1														
NOT REGULAR									2							

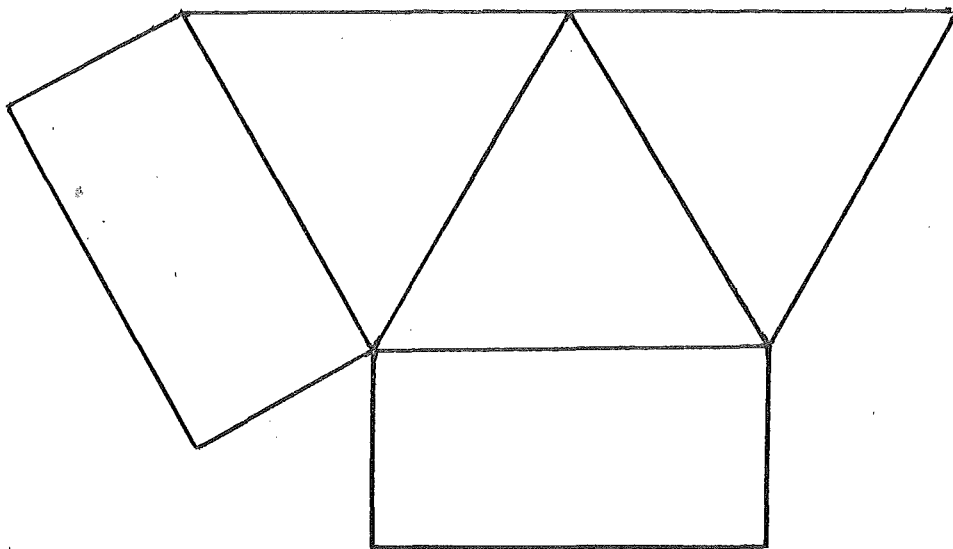
(Polygons 1 and 2 have been placed for you.)

NOTE : C means CAVED (or CONCAVE)

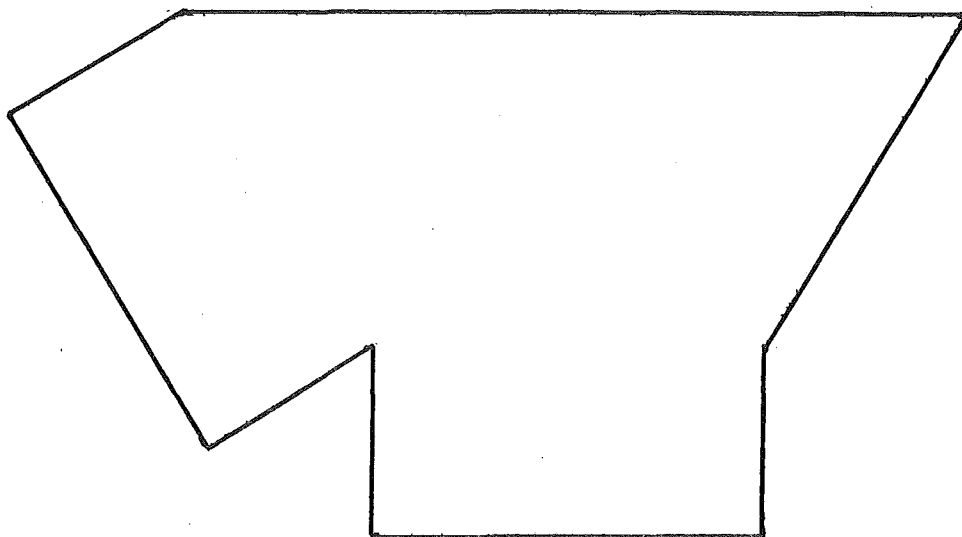
NC means NOT CAVED (or CONVEX)

1. (i) Use the polygons you cut out on p 19.
Make a shape using any combination of polygons you like.

e.g.



Here I have made two extra equilateral triangles and an extra rectangle to make this shape. You can do the same if you like. Draw around the outline on a piece of paper so that you get :



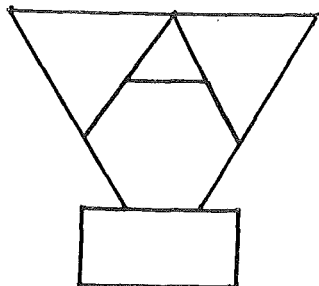
- * (ii) Inside the outline carefully draw in the polygons you used. Do a second outline the same as the first and see if a different group of polygons will fit inside. Draw them in carefully.

(iii) Draw around all your polygons on a separate sheet of thin card, and cut them out so that you have two sets of polygons.

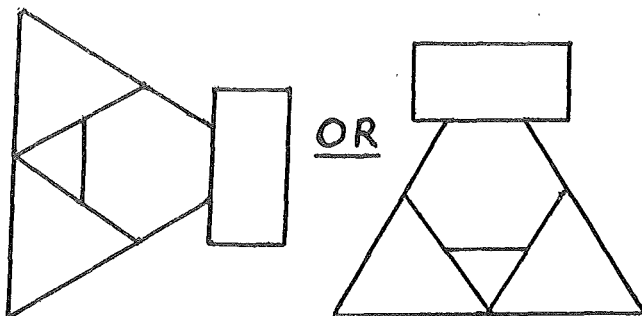
Construct a shape using a combination of polygons as before.

Now make the same shape with the same polygons, but have the shape on its side (or upside down.)

e.g. YOUR FIRST SHAPE



YOUR SECOND SHAPE



Now turn your first shape so that it looks the same as your second shape. Repeat several times with different combinations of shapes.

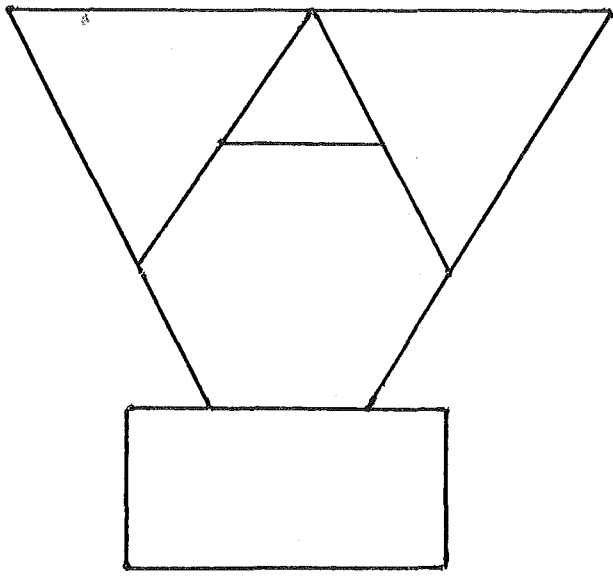
* (iv) Select any one of the shapes you made and draw its outline below. Then draw the same shape upside down next to it.

A SHAPE I MADE

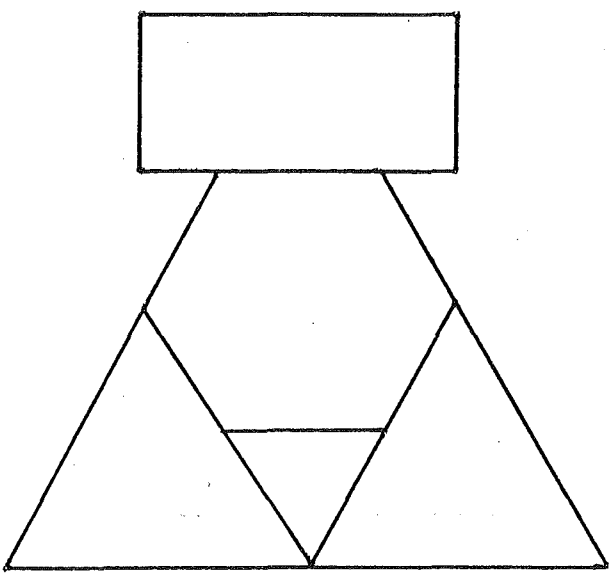
THE SAME SHAPE UPSIDE DOWN

(v) Construct a polygon using a combination of shapes as before.
Make the shape again underneath, but this time flip it so
that the bottom is the top.

e.g.

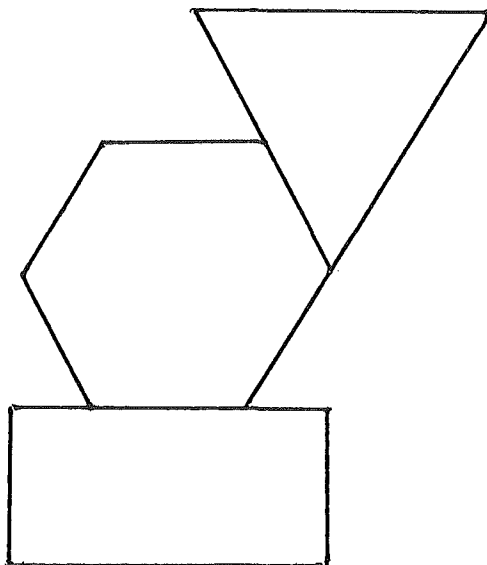


your first shape



your second shape

(vi) Make this shape:



Then make the flip shape directly underneath.

Repeat several times with different combinations of shapes.

If you are unsure whether your flip is right, cut a shape out of paper which matches your first shape, flip it over, and see if it matches the flip shape you constructed.¹

- * (vii) Select the shape you made which interests you most, and draw around it's outline on p 57.² Underneath draw the flip of the shape. Draw in the polygons you used each time. Colour and label the polygons in each diagram. (Use paper cut outs if you need to.)

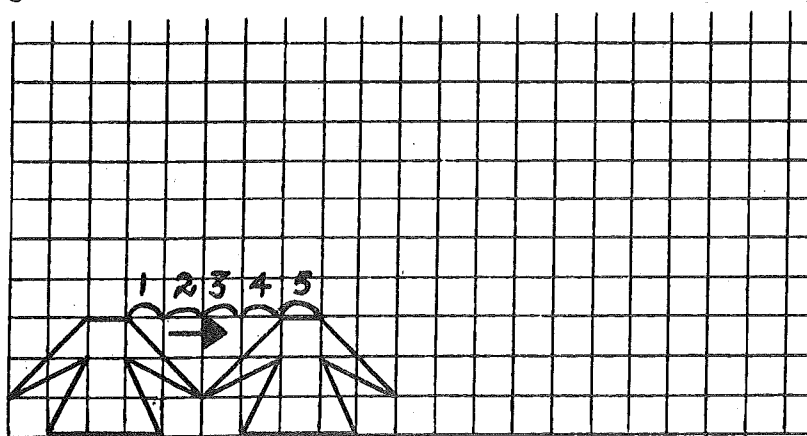
NOTE: 1. Using a small mirror placed on the flip line is considerably quicker but perhaps less value initially.
2. At the top of the page.

2.(i) Each day we slide things around. You probably slide your chair in and out several times each day. (Sometimes you turn it as well!)

Make a list below of the things which people often need to slide in order to use them. (It doesn't matter if they are turned at the same time.)

(ii) Cut out the shapes on p64. Select any shape, place it in the bottom left hand corner of the squared box at the top of p60., and draw carefully around it.

e.g.



Make sure a corner of the shape is put on the intersection of two of the lines.

Slide the shape 5 units to the right and draw around it.

Select two points in the first shape outline and see if the corresponding points 5 units to the right are in the same position in the second shape outline.

(NOTE : A unit is the distance between two lines as shown in the diagram.)

Draw arrows showing where the two points in the first shape have been shifted to.

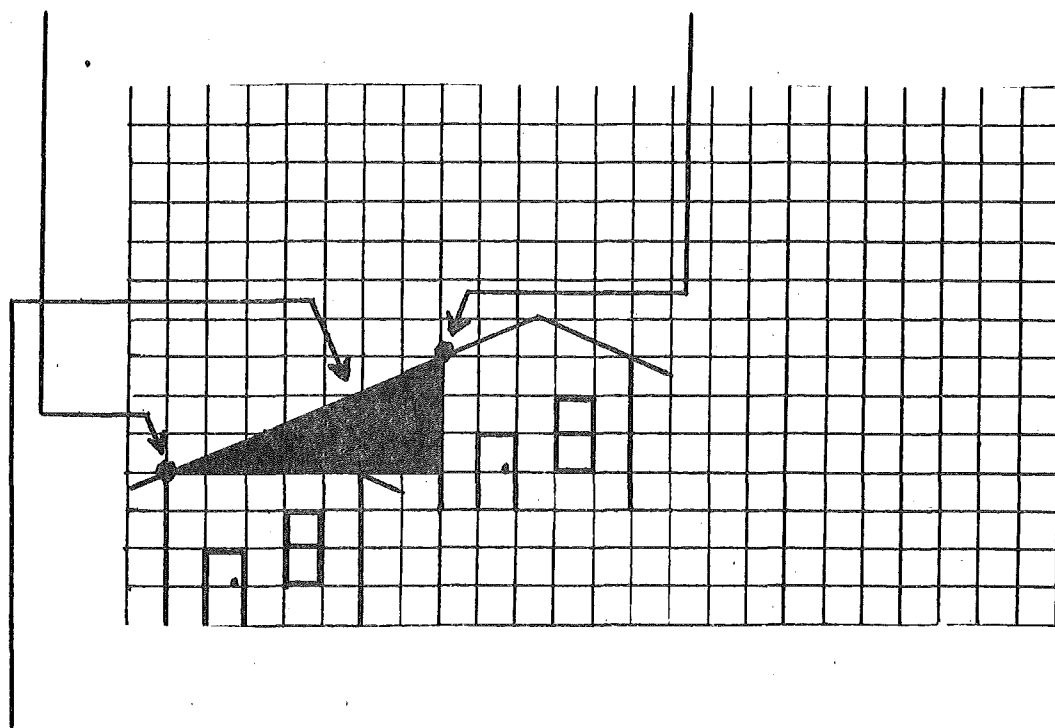
Repeat the above with a different shape, this time starting in the top left hand corner of the squared box at the bottom of p 60. and going down 6 units.

Select another shape, and draw it's outline in the bottom left hand corner as before. This time slide it 7 units to the right, and then 3 units up, before drawing around it's outline. (Use the top of p 61.)

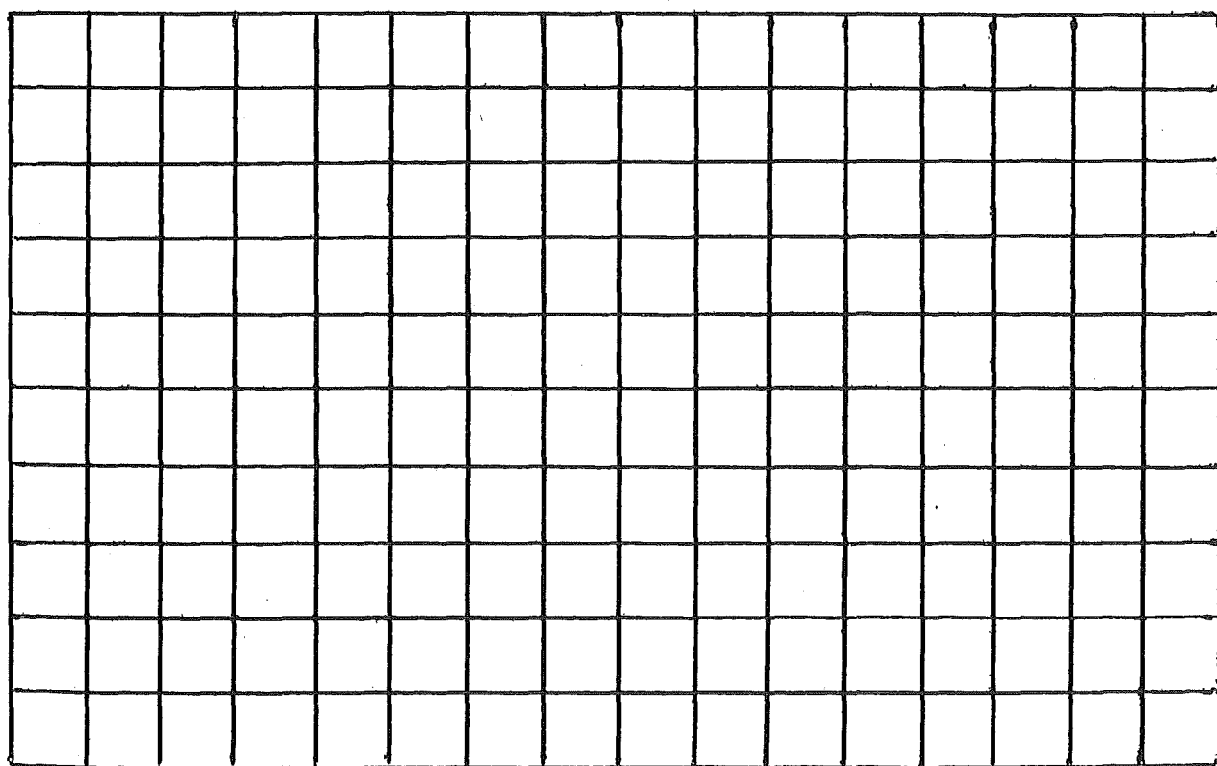
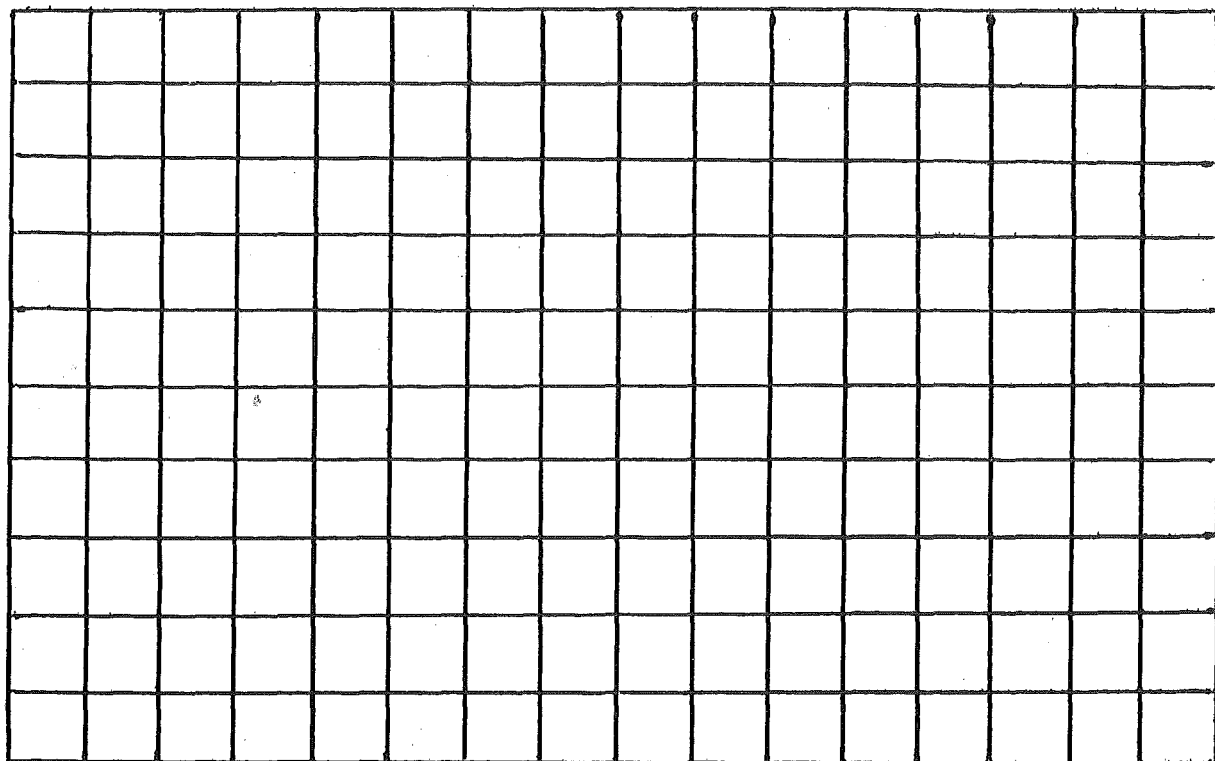
e.g.

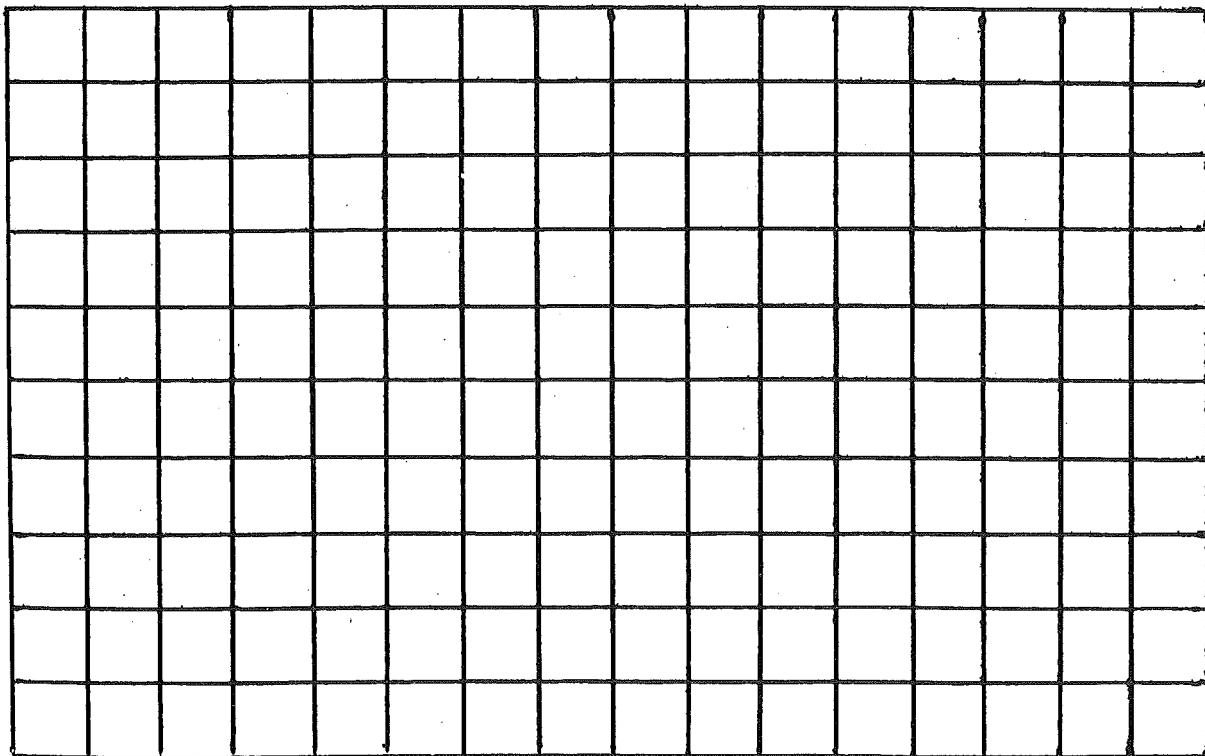
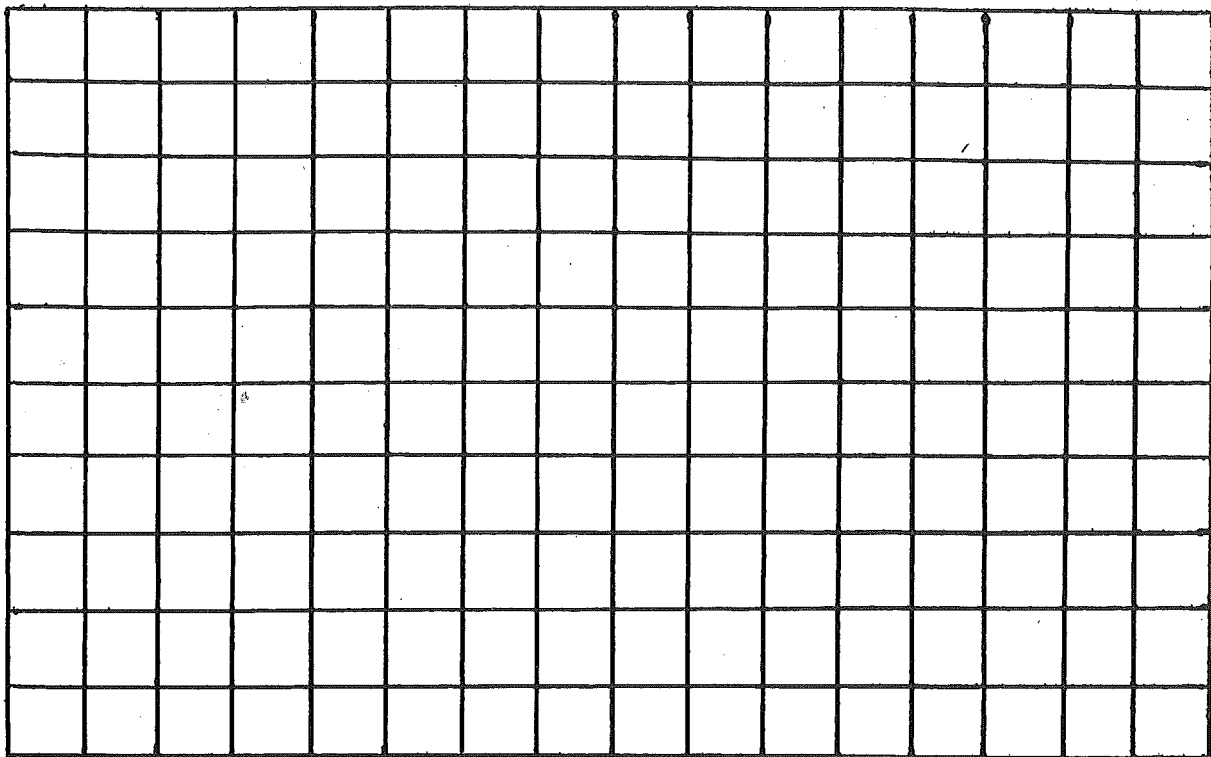
POINT IN FIRST SHAPE

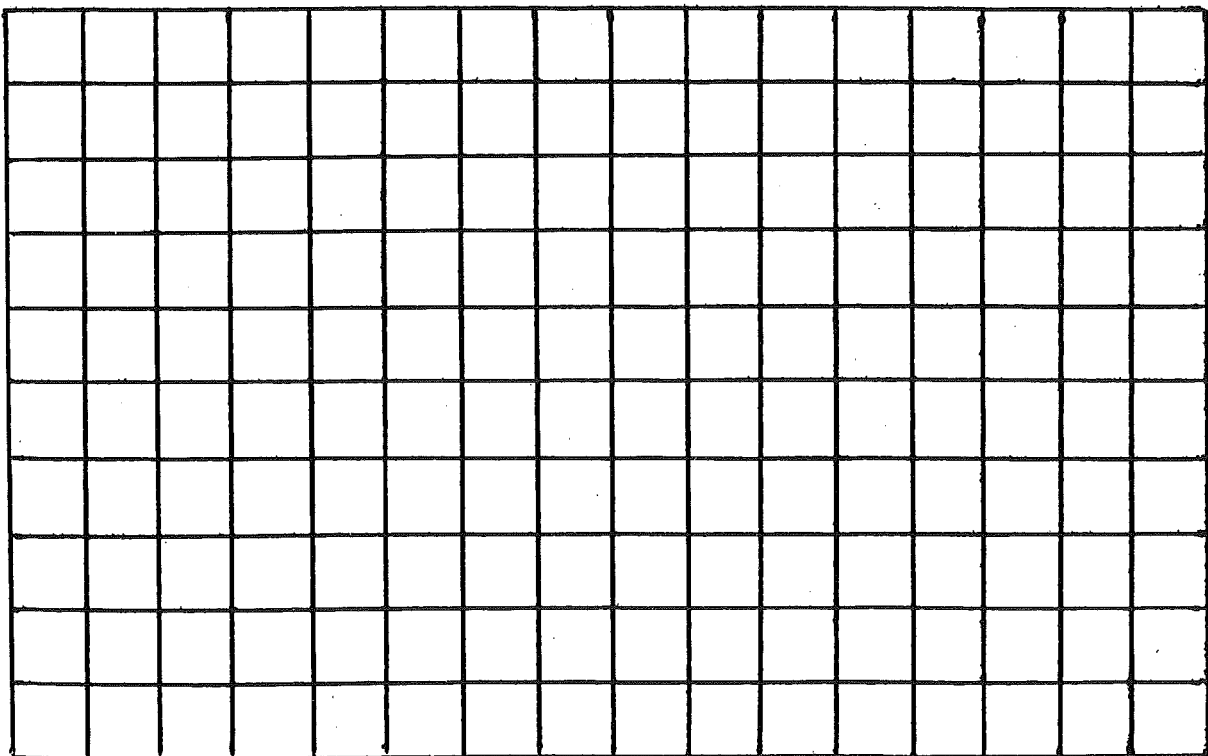
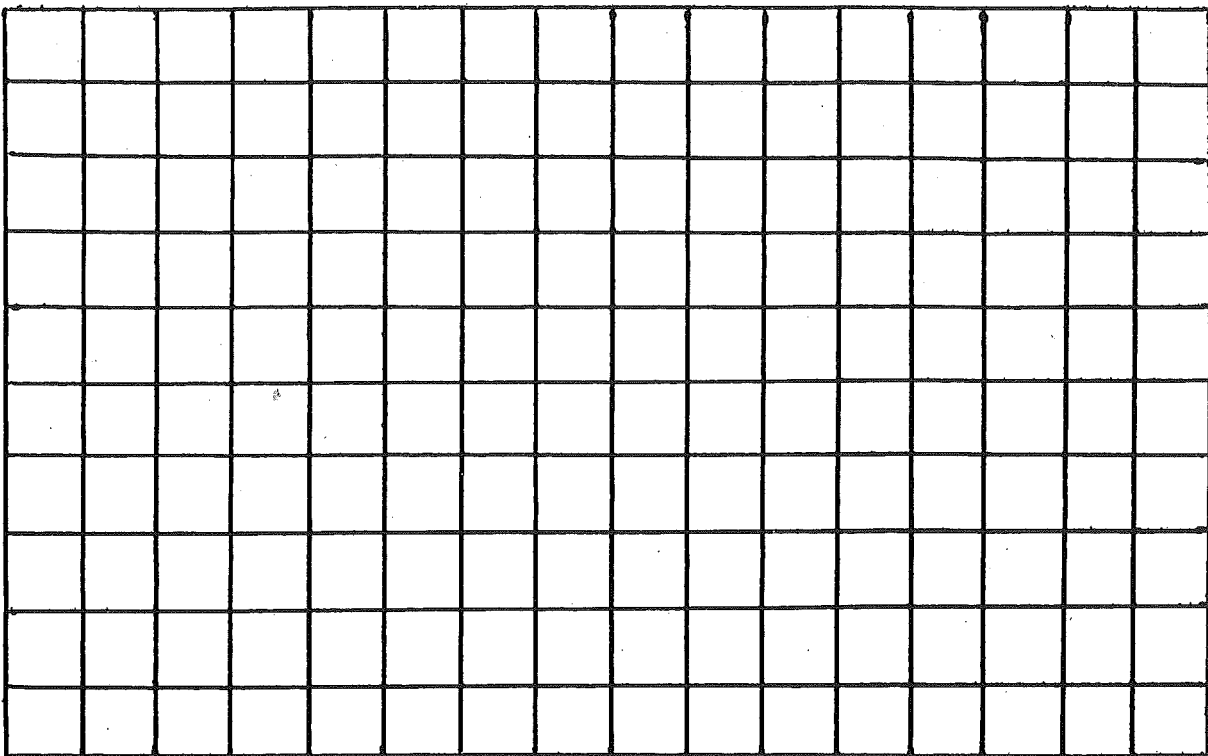
SAME POINT IN SECOND SHAPE



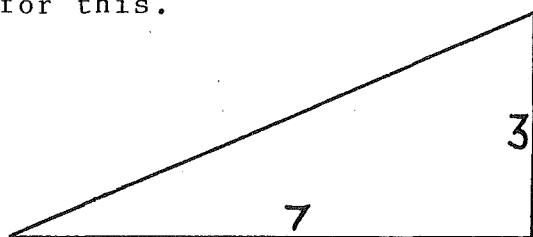
This is a point marker. Instructions for making it are on p. 63.







Cut out a right angled triangle where the sides are 7 units and 3 units as shown. Use the squared box at the bottom of p 61 for this.



This is called a POINT MARKER for a slide of 7 across and 3 up.

The longest side shows the distance and direction each point has shifted. Use it to check several different points as in the diagram on p 59.

* (iii) Select any two shapes and do these "slides" on p 62.

(i) right 4, up 5. (Top of p 62)

(ii) left 2, down 7 (Bottom of p 62)

Make a point marker for each one if you like.

N.B. You will need some more squared paper for the rest of this section.

What happens if you slide a shape two lots of (right 4, up 5)? Try it and see. Is it the same as (right 8, up 10)?

YES/NO _____

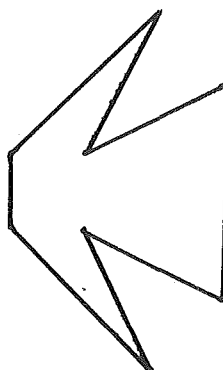
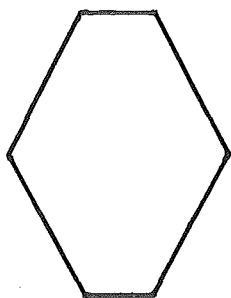
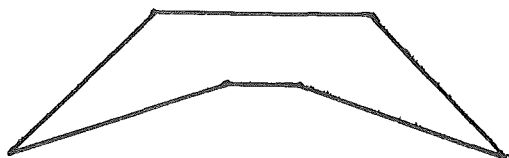
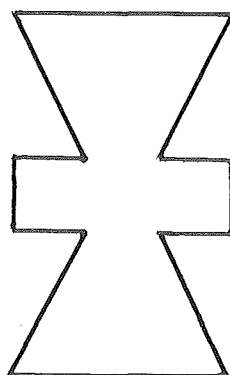
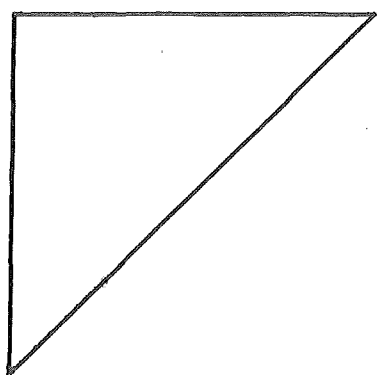
* (iv) Do these with a variety of shapes :

(iii) Two lots of (right 1, up 3) This is the same as
(right __, up __)

(iv) Three lots of (left 2, down 2) This is the same as
(left __, down __)

(v) Four lots of (right 3, down 3) This is the same as
(right __, down __)

(vi) Three lots of (left 4, up 4) This is the same as
(left __, up __)



(i) Make a list of things in your classroom or home which look:

- (i) level (or horizontal)
- (ii) upright (or vertical)
- (iii) on a slope (i.e. in between level and upright).

HORIZONTAL (H)	VERTICAL (V)	SLOPING (S)

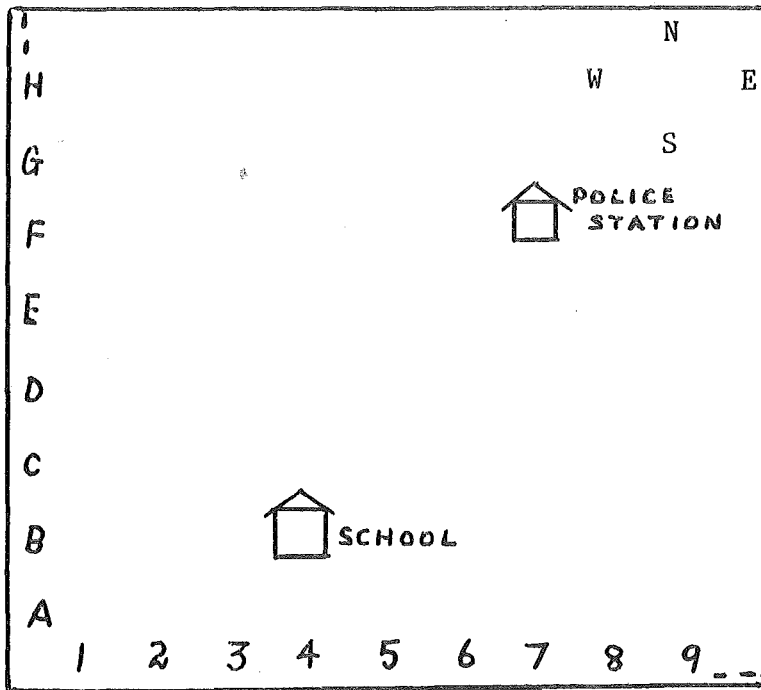
(ii) Using a picture from a magazine or newspaper, a ruler and a biro or pencil, draw a horizontal, vertical or sloping line on each object in the picture, showing whether it is horizontal, vertical, or sloping.

(e.g. most trees would probably have a vertical line drawn down the centre of their length. Many rooftops would have lines drawn along horizontal sections, a foot-path on a hill would have a sloping line, etc.)

Label each line as horizontal, upright, or sloping.

(iii) Some things need to be horizontal, upright or sloping, depending on what they are meant to do. List one of each in the box below. Next to each one write a sentence explaining why it is necessary for it to be like that.

WHETHER HORIZONTAL, UPRIGHT OR SLOPING	OBJECT	WHY IT NEEDS TO BE HORIZONTAL, UPRIGHT OR SLOPING
horizontal		
upright (vertical)		
sloping		



Here is a drawing of part of a model town like the one you made earlier.

← This is the cardboard sheet on which you built your town.

In the drawing you can see the school is level with the number 4 and the letter B, so it is at (4,B). The police station is at (7,F).

- (i) On your model town print capital letters and numbers along two sides as above. Make the letters and numbers evenly spaced.

Put enough letters and numbers so that each building, park, street, etc. can have a number and letter level with it, or not far from it.

- (ii) Make a list of all the buildings, parks, streets, etc. in your model and write next to them their number and letter in a bracket. (You will need to put the number and letter which is closest to being level sometimes.)

* EXERCISE 22

Select four families in your model town. Make sure they are widely spread. Work out the best way for the children living in each of those homes to get to school. You will need to think about things like distance and road safety. (Does your town have any cross walks?)

Describe each route below and on the next page.¹

(i) FAMILY

(ii) FAMILY

NOTE: 1. You should say something like: "West along Cliff Street, North along Main Street, over the cross walk near.....".

(iii) FAMILY

(iv) FAMILY

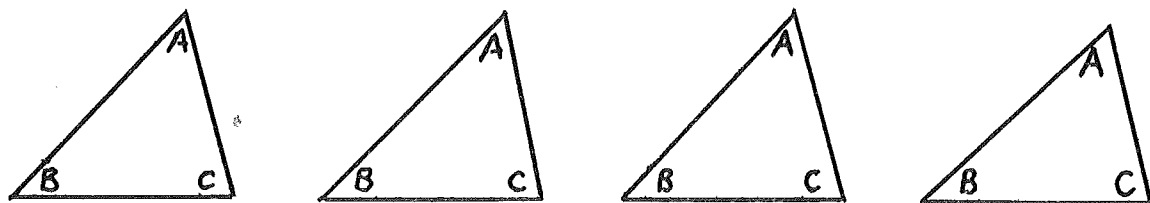
EXERCISE 23

- * (i) Have you ever noticed how a small apple looks the same shape as a big one, or a doll looks the same shape as a little girl, or a real car looks the same shape as a toy car? Sometimes we use the word "similar" instead of "same shape". Make a list below of 10 objects which are similar, but are a different size.

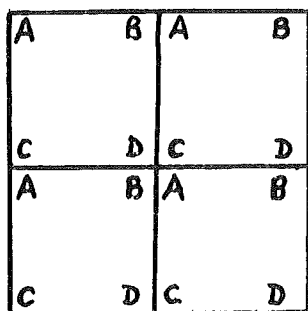
OBJECT		SIMILAR OBJECT
Car	SMALLER →	Toy Car
Doll	BIGGER →	Little Girl

- (ii) Cut out the shapes on p 71 . By drawing around each one on a scrap piece of paper, cut out another three of each shape. The four squares you have are not only the same shape, they are the same size as well. We say each of the squares is CONGRUENT to the other three (same size and same shape). Check this by placing the squares on top of each other. Do the same with all of the shapes you cut out.

Now label all the angles in all the shapes. Use the same letter if the angle is the same size, e.g. your triangles will look like this:



Take the four squares and join them together to make a large square like this:



This large square is similar to the small square you started with.

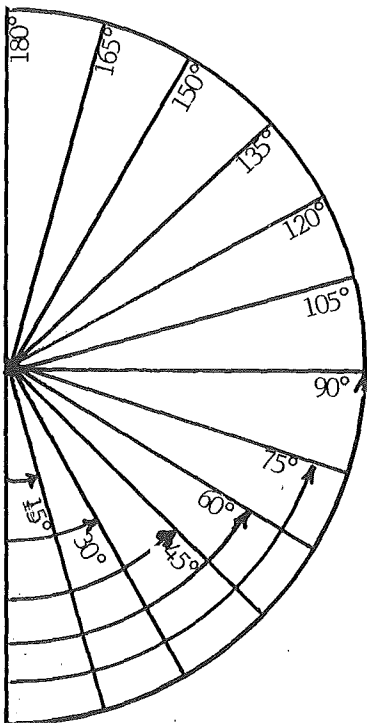
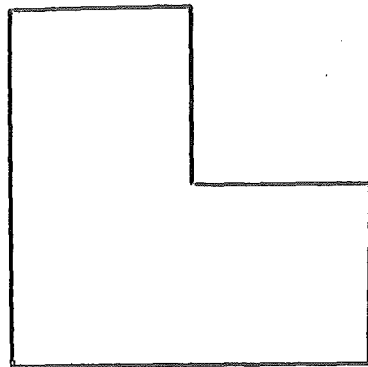
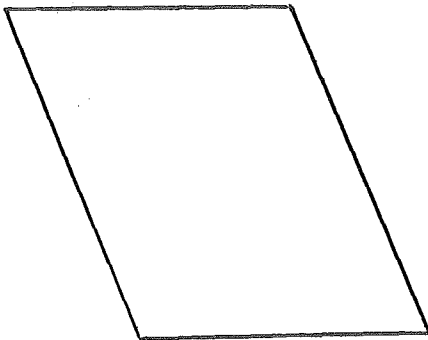
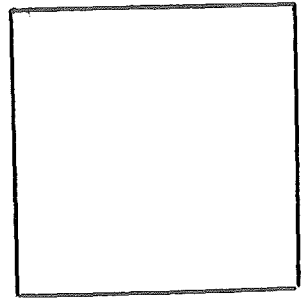
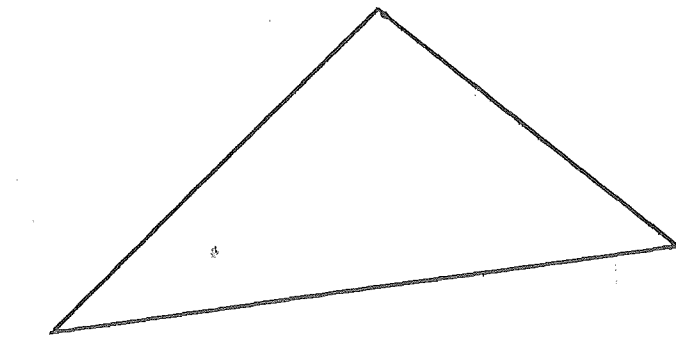
Do the same with the other shapes (i.e. join the triangles to make a large triangle similar to the small one, etc.)

(iv) Carefully draw how you did each one on p72 . Print the letters in the angles as shown above.

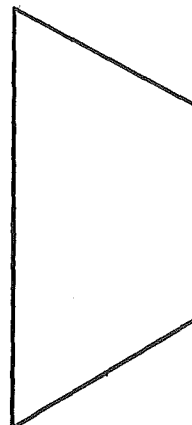
Notice how each angle in the large shape is the same as the angles in the smaller shape? i.e. your small triangle has angles A,B,C, and so does your large triangle.

Check this by fitting the angles of the small shapes over the same angle in your large shapes.

The angles are congruent (but the shapes are not).

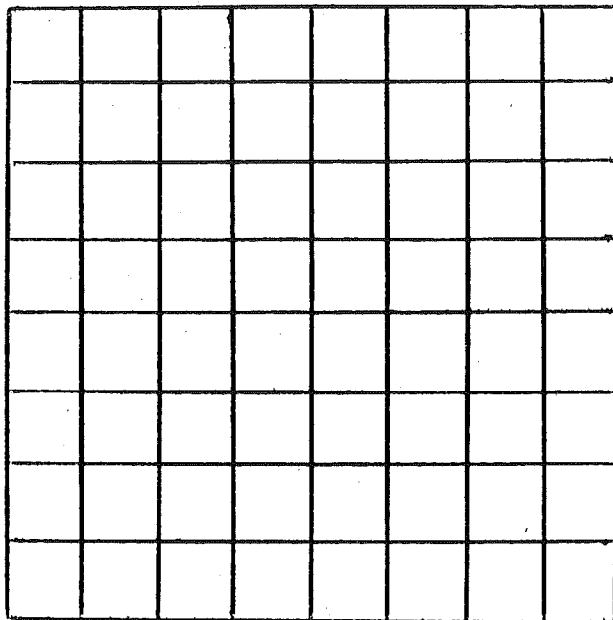
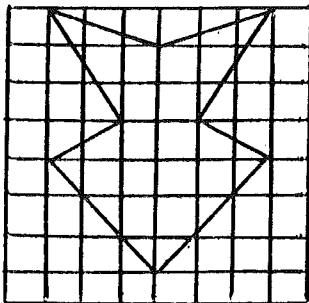


PROTRACTOR



Using the protractor on p71. measure the angles in the small shapes. (You will need to put the shapes on the protractor, not the other way around.) Write in the angles on your drawings on p 72.

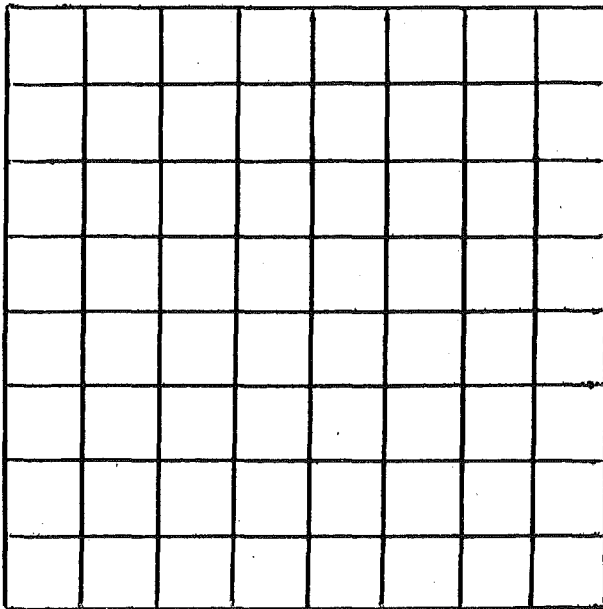
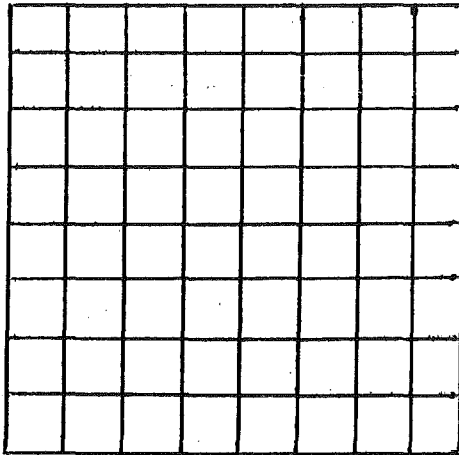
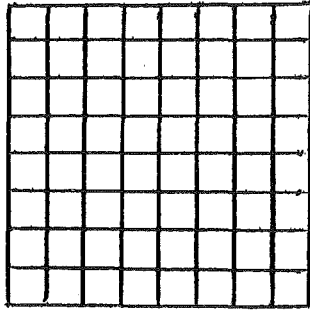
* (iv) Copy the shape on the left onto the grid at the right.



Are the shapes similar or congruent? _____

Are the angles similar or congruent? _____

* (v) Draw your own shape in the centre grid and copy it in the top and bottom grids. (Use a ruler as much as possible.)



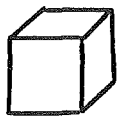
GETTING
SMALLER



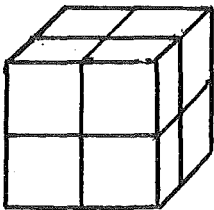
GETTING
BIGGER

(vi) You can build shapes which are similar using wooden cubes.

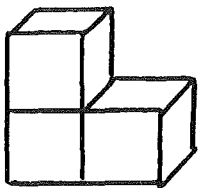
e.g.



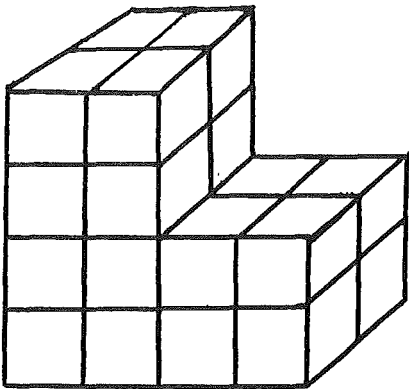
If I double the length, width and height of one cube, I get this:



The shapes are similar



If I double the length, width and height of this shape, I get:

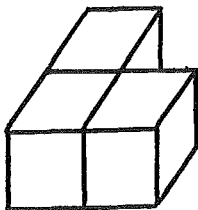


The shapes are similar

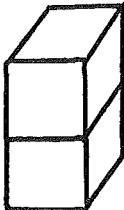
Use cubes to make two similar models for each shape below.

The first should have edges twice as long, and the second should have edges three times as long.

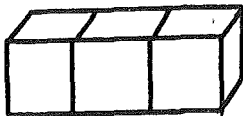
1.



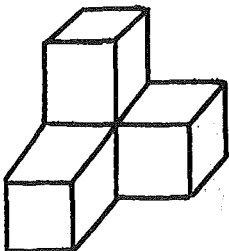
2.



3.



4.



(vii.) Fill in this table after you complete each model.

SHAPE NO.	NO. OF CUBES IN ORIGINAL SHAPE	NO. OF CUBES IN MODEL TWICE THE SIZE	NO. OF CUBES IN MODEL THREE TIMES THE SIZE
1	3		
2	2		
3	3		
4	4		

Use the space below for working if you need to.

(i) Fold a piece of paper in half as in FIG. 1.

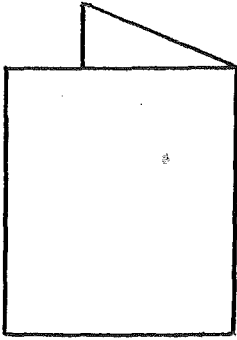


FIG. 1.

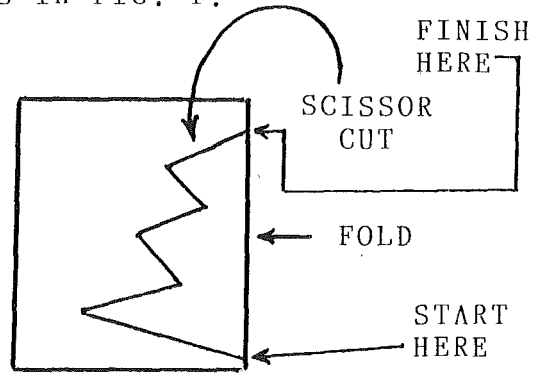


FIG. 2.

Starting and finishing at the fold, cut out any shape you like, e.g. FIG. 2.

The shape in FIG. 2. will look like FIG. 3. when it is opened up.

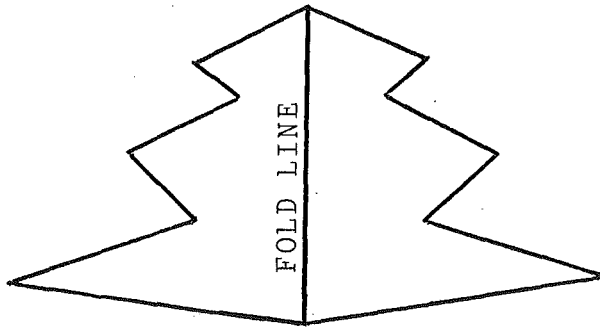


FIG. 3.

You have made a shape where the fold line is called a line of symmetry. You know a shape has a line of symmetry if you can fold it¹ so that one half sits exactly on top of the other half. It is said to be a symmetrical shape.

NOTE: 1. Or imagine yourself folding it.

(ii) Using several different colours, colour the whole shape in so that when you fold it, the differently coloured sections match exactly. See FIG. 4. This is called colour symmetry. Keep this shape somewhere in this book for the time being.

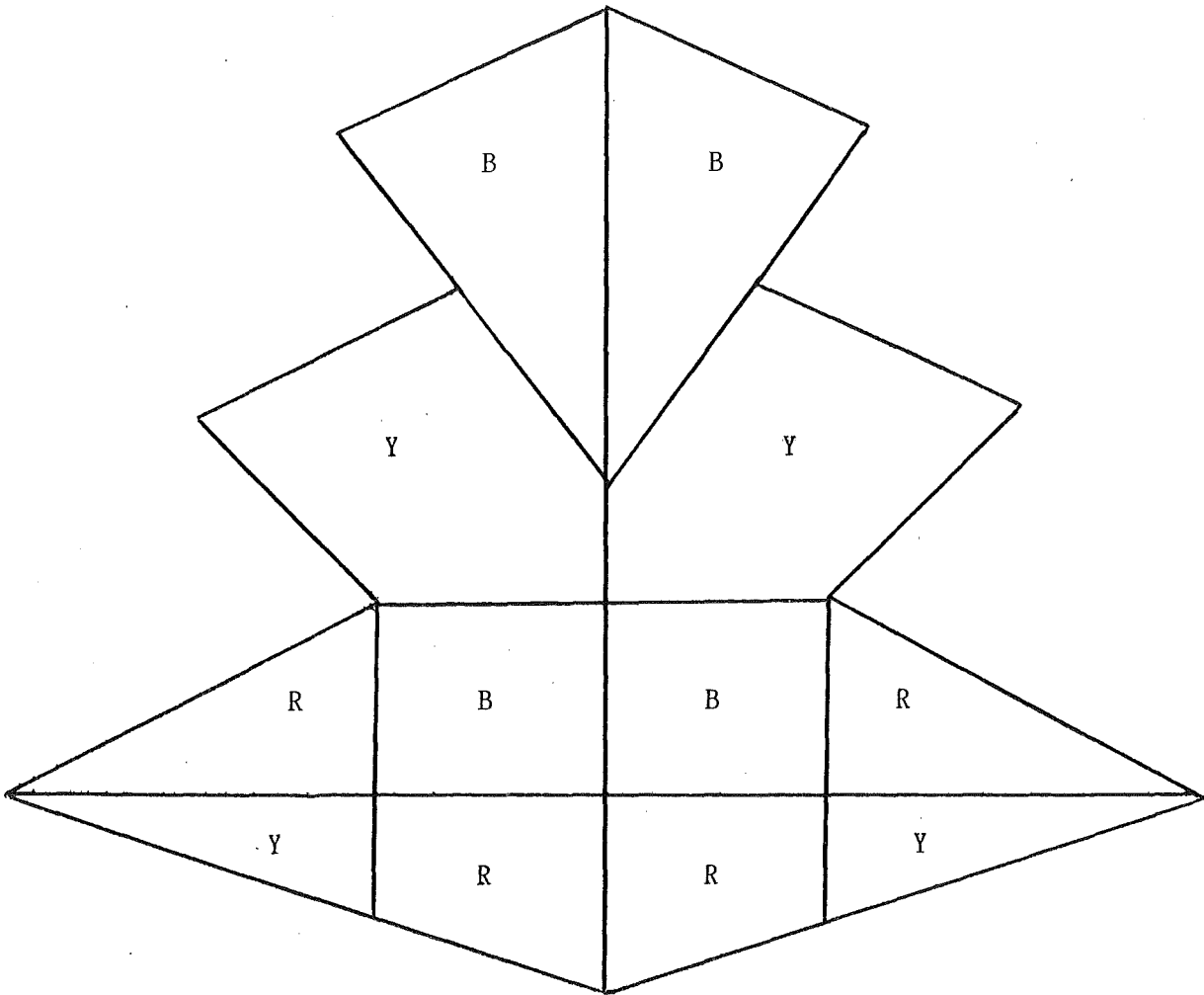


FIG. 4.

R is RED
Y is YELLOW
B is BLUE

- * (iii) For this section use the shapes you cut out on p 19.
The equilateral triangle has three lines of symmetry as shown in FIG. 1.

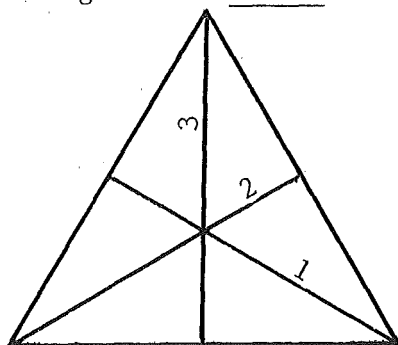


FIG. 1.

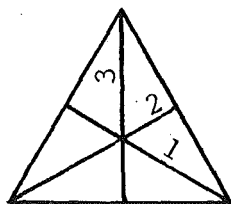
Fold your equilateral triangle to show these lines of symmetry. Test each of the other shapes by folding¹ to see if they have lines of symmetry, and if so, how many.

Draw around each shape on scrap card, colour each one, draw in the lines of symmetry, and then cut them out.²

Glue all of the shapes (including the one you put in the book) onto a sheet of paper using the headings below.

SHAPES WITH LINE SYMMETRY

Equilateral Triangle



3 lines of symmetry.

SHAPES WITHOUT LINE SYMMETRY

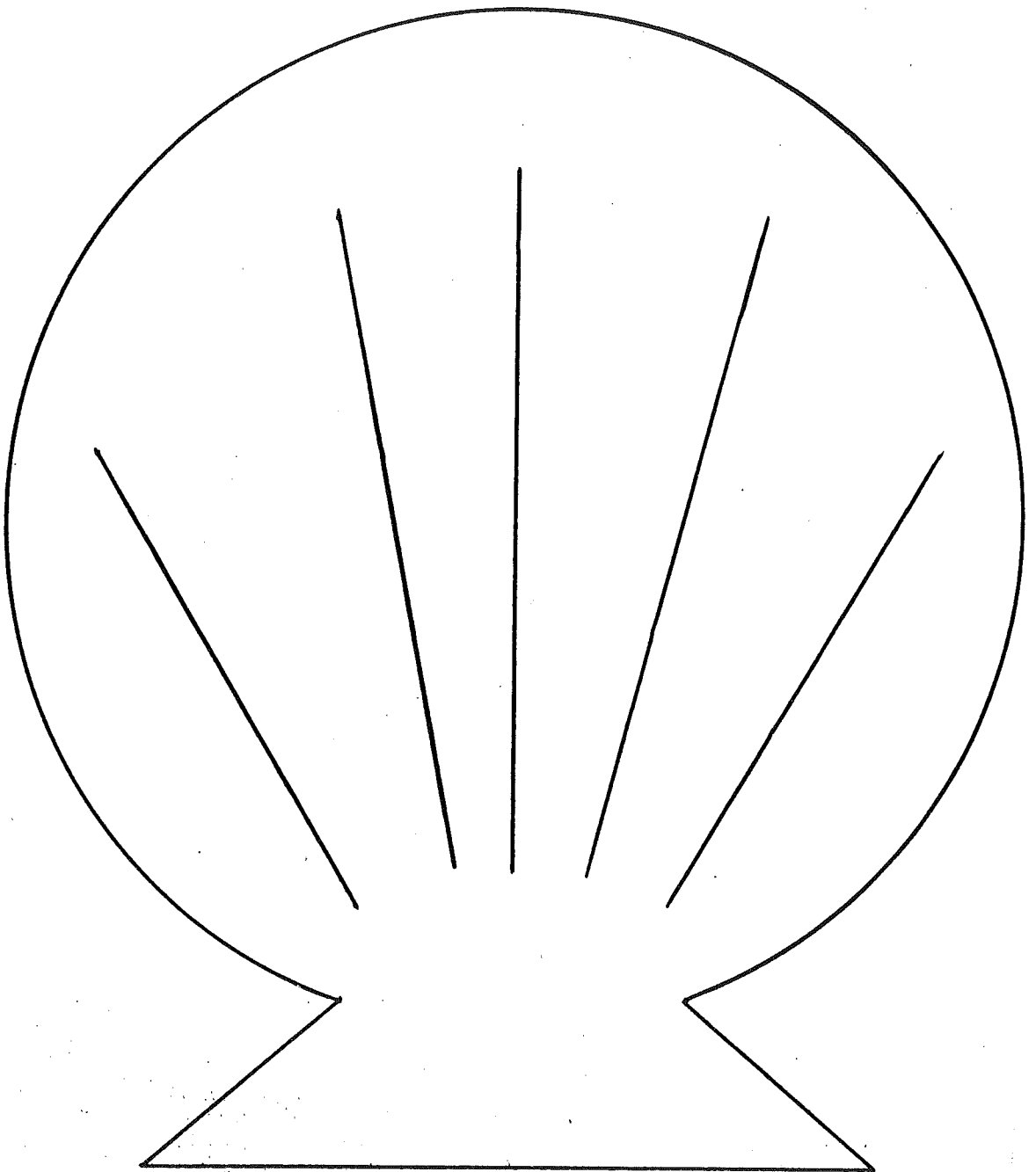
Scalene Triangle



NOTE: 1. If a mirror is placed vertically along a line of symmetry, the reflection on the mirror will match the part of the shape behind the mirror. If they do not match, then the mirror is not sitting on a line of symmetry.

2. Retain the original shapes in their plastic bag.

* (iv) A well known oil company uses the symmetrical shape shown below as it's trademark. Using newspapers, magazines, or an old yellow page edition of the telephonedirectory, find examples of trademarks which have a line/lines of symmetry and those which do not. Cut them out and glue them on a sheet of paper (with headings) as you did on the previous page. State how many lines of symmetry each trademark has and draw them in.



For this section use the polygons you placed in a plastic bag after working p 79.

(i) Take the equilateral triangle, put a mark (e.g. a letter) in each corner (See FIG. 1.) and draw around it on p82.

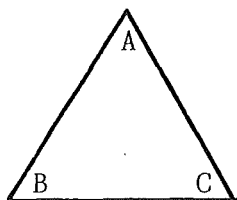


FIG. 1.

By carefully noting the position of the letters each time, find the three different ways your equilateral triangle will fit into the outline you drew. (DO NOT FLIP THE SHAPE OVER.)

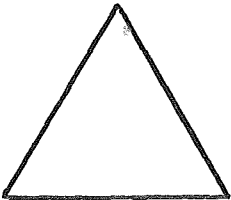

Did you notice that you turned or rotated the shape to make it fit a different way? If you can do this with a shape it is said to have rotational symmetry. The number of different ways it will fit it's outline is called the ORDER. An equilateral triangle has rotational symmetry of Order 3.

If a shape will only fit into it's outline in ONE way, it does NOT have rotational symmetry.

By drawing around all the other polygons (use pp 82 to 83) and testing them as above, find out which ones have rotational symmetry (and their order of rotation), and which do not.

N.B. You can only rotate the shapes. Keep the same face up at all times.

* (ii) Colour the shapes, cut them out and glue them onto a sheet of paper with the following headings:

SHAPES WITH ROTATIONAL SYMMETRY	SHAPES WITHOUT ROTATIONAL SYMMETRY
EQUILATERAL TRIANGLE	SCALENE TRIANGLE
	
ORDER 3	

Label them as shown.


* (iii) We see or use things each day which use rotational symmetry (or the lack of it) to make them work effectively. Make a list below of 6 - 10 things you can think of which are like this, and say why it makes it more effective.

THINGS HAVING ROTATIONAL SYMMETRY WHICH MAKES THEM WORK EFFECTIVELY	THINGS NOT HAVING ROTATIONAL SYMMETRY WHICH MAKES THEM WORK EFFECTIVELY
e.g. Lid on a margarine container - it goes on 4 different ways!!	e.g. electrical plug socket, (so you don't plug it in the wrong way!)

* (iv) A lot of the shapes you have used in this section have line symmetry and rotational symmetry. Some have only line symmetry, and some have no symmetry at all. There are other shapes (which you haven't used in this section) which have rotational symmetry, but do not have line symmetry.

Carefully draw an example of each shape under the headings on the next page.

Use the space below for any rough drawings if you are in doubt.

A SHAPE HAVING LINE SYMMETRY AND <u>ROTATIONAL</u> SYMMETRY.	A SHAPE HAVING <u>ONLY</u> LINE SYMMETRY.	A SHAPE HAVING <u>NO</u> SYMMETRY.	A SHAPE HAVING <u>ROTATIONAL</u> SYMMETRY BUT <u>NO</u> LINE SYMMETRY.
			 <p data-bbox="1488 1129 1888 1243">Part of this shape has been drawn for you. Can you complete it?</p>

DATE DUE

30. JUN. 1985

~~6 MAY 1986~~

...Z...OCT. 1983.

28 SEP 1987

~~14-001-1987~~

~~-7 JUN 1988~~

3 MAY 1950

~~12. OCT. 1990~~

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EDITH COWAN UNIVERSITY



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