

# SMILE WORKCARDS

## Reflection Pack Two

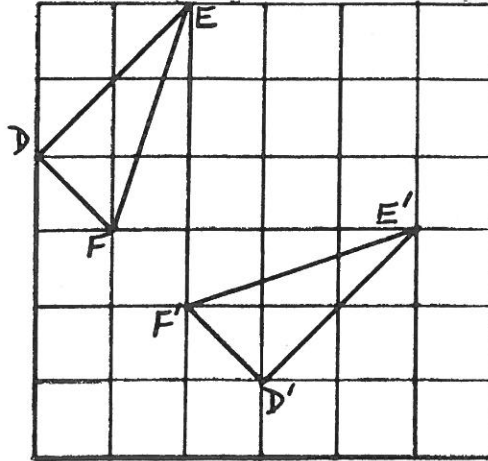
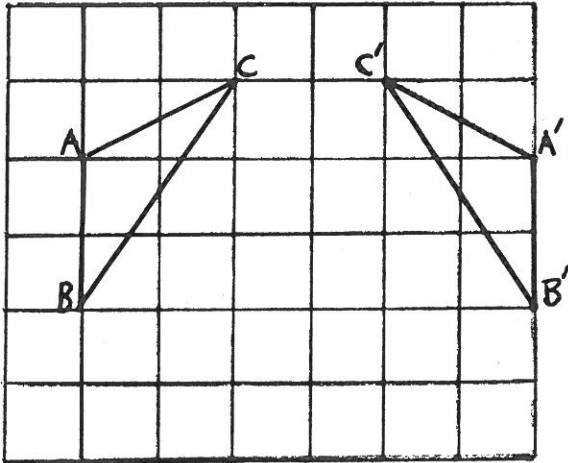
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You will need: tracing paper

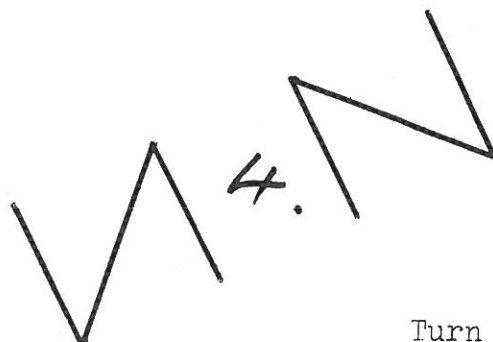
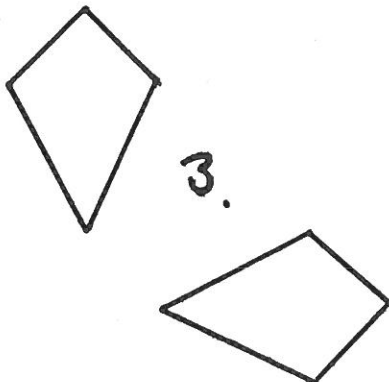
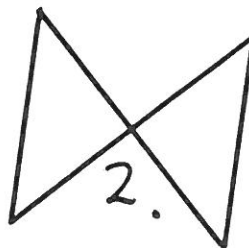
Points and their images

- (1) Trace the 2 drawings drawn below.
- (2) Join A to A', B to B', and so on.
- (3) Mark the middle point of these lines.
- (4) Join these middle points in each drawing by a line.



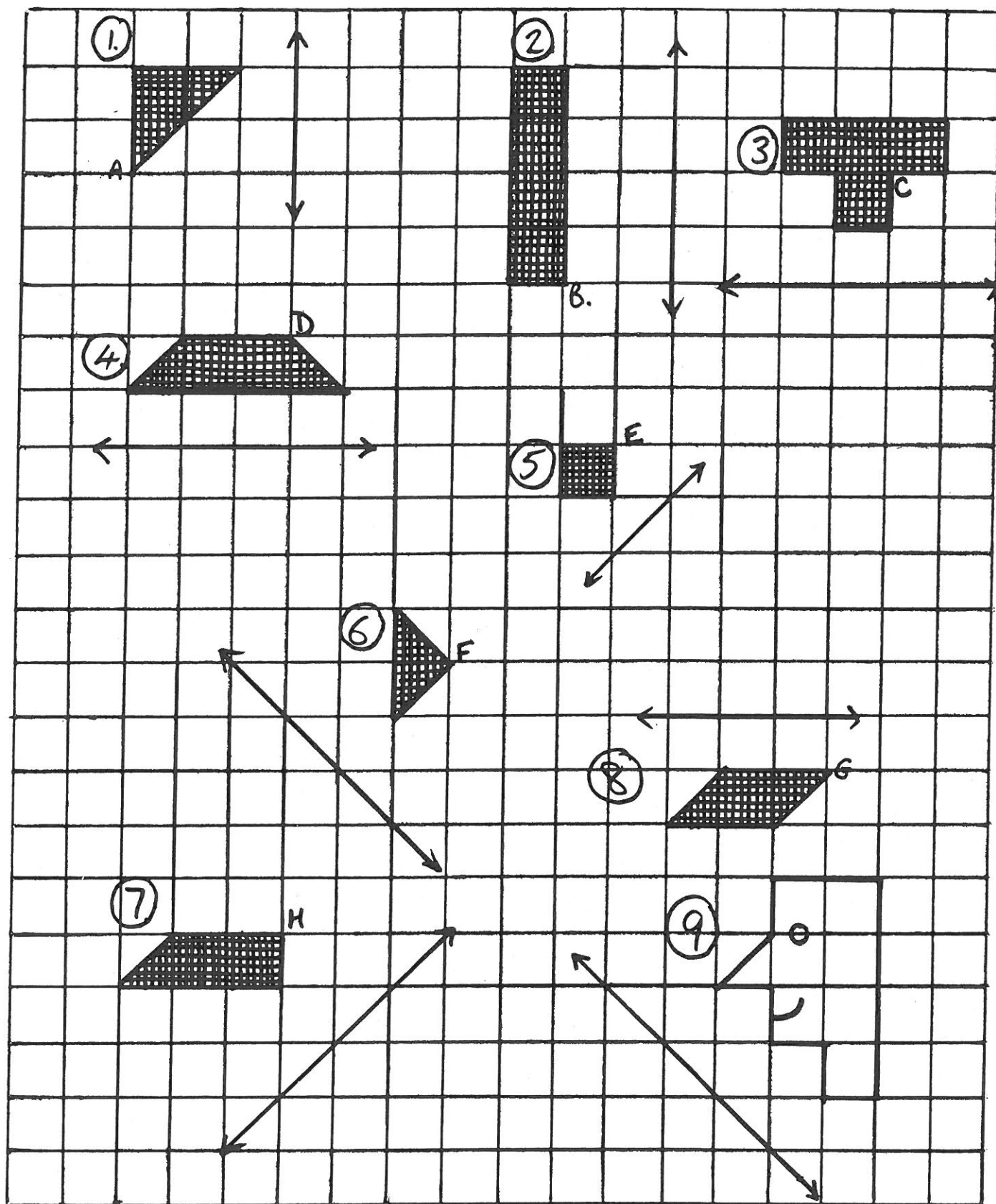
What are the lines from question (4) called?

Trace the drawings below and by joining points to their images draw in the mirror lines accurately.



Turn over

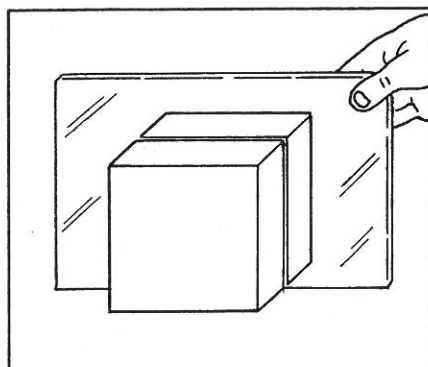
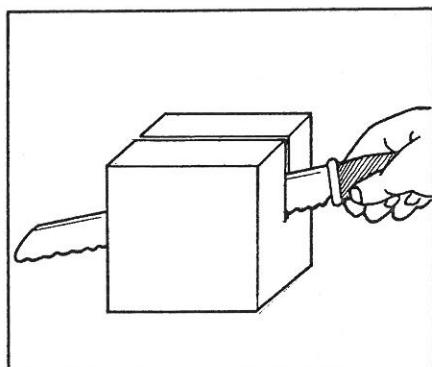
Draw exactly the images of the following shapes in the mirror lines. Label the images of the points marked.  
(A' for A, B' for B etc.)



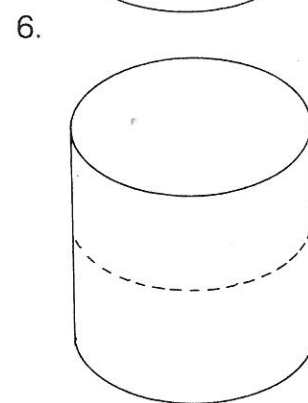
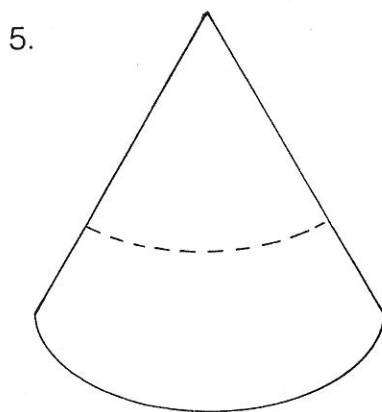
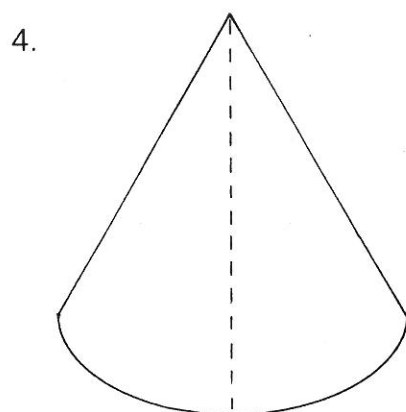
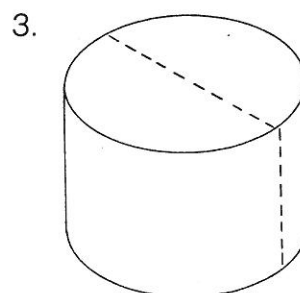
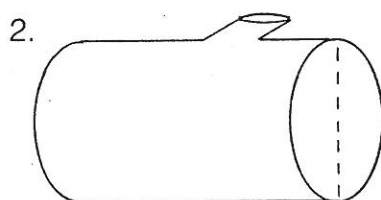
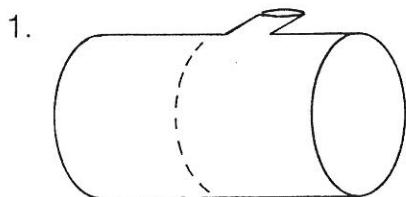
Check each time that the mirror line is exactly half way between points and their images.

# Symmetrical Cross Cut

It is possible to cut some shapes symmetrically so that one half is the reflection of the other.



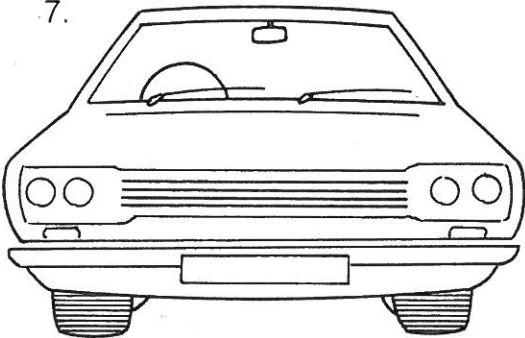
Which of the following cross-cuts would give symmetrical halves?



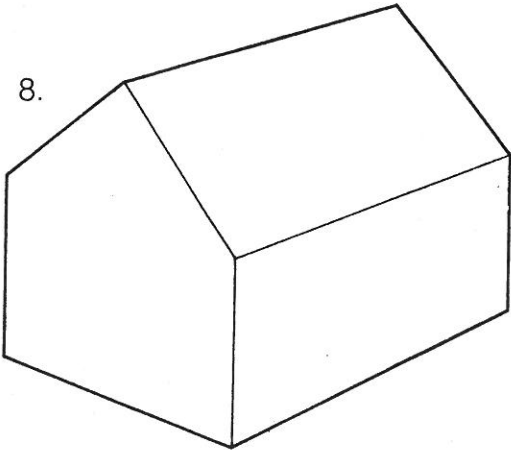
A cut which separates two halves symmetrically is called a **plane of symmetry**.

Which of these could be cut with a plane of symmetry?

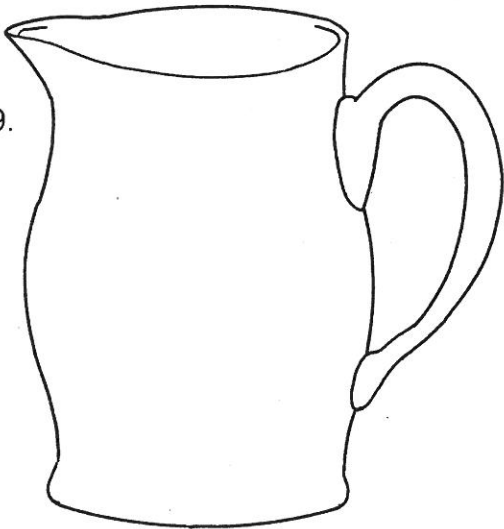
7.



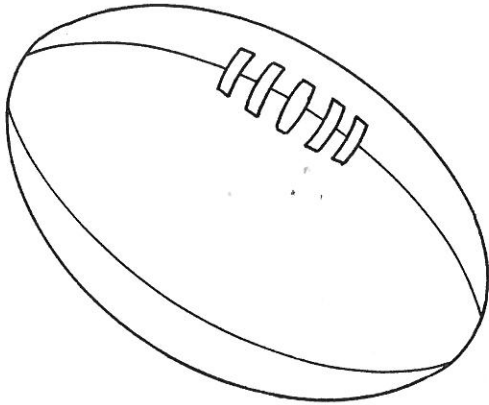
8.



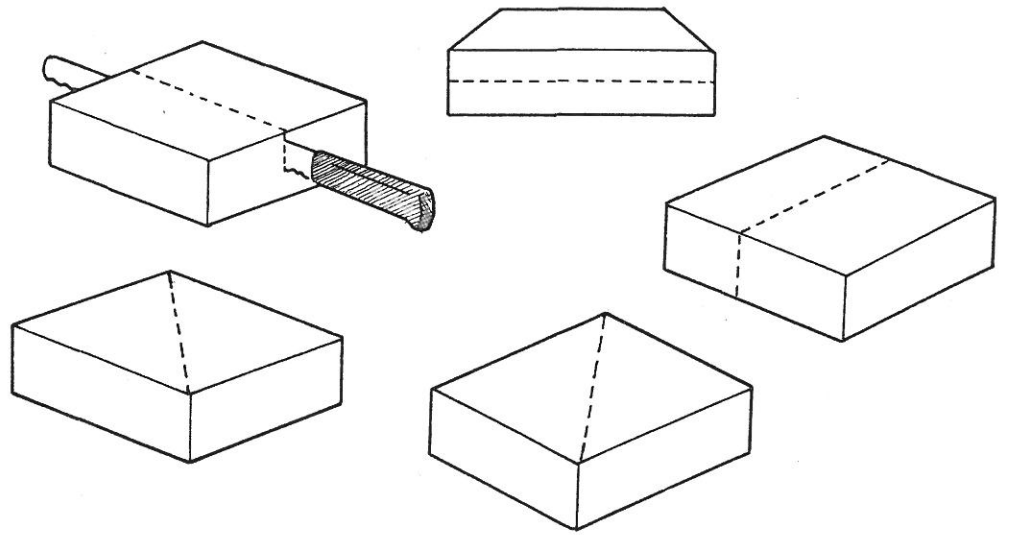
9.



10.

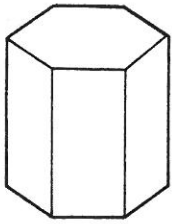


Some solids can be cut by more than one plane of symmetry:

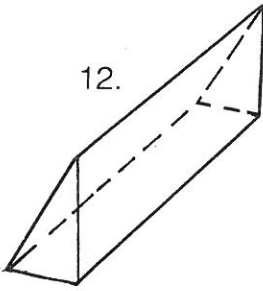


How many planes of symmetry can you find for each of these?

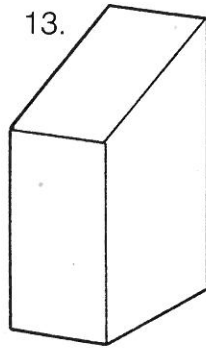
11.



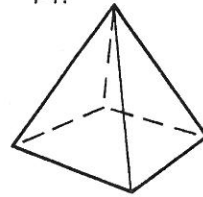
12.



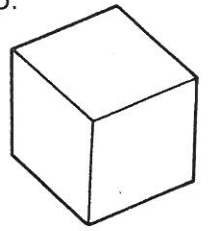
13.



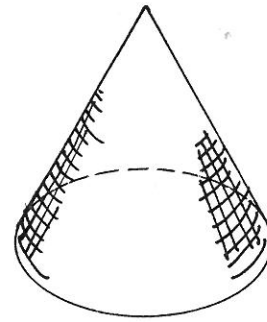
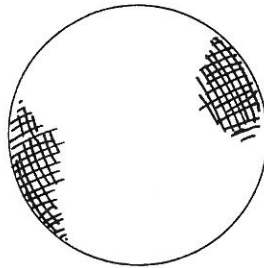
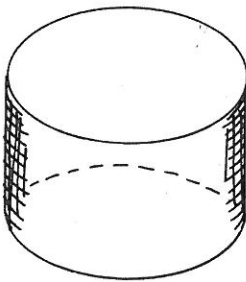
14.



15.

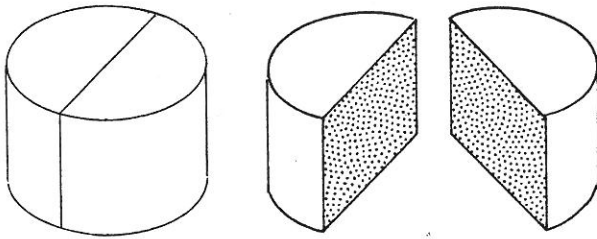


16. What is special about these three solids?



Find the number of planes of symmetry for some objects in the room.

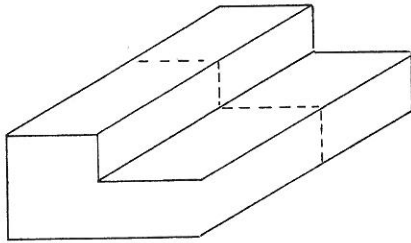
A symmetrical cross-cut exposes 2 new surfaces.  
In the case of this cylinder...



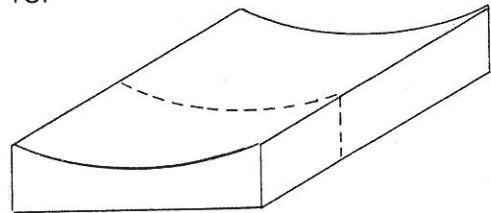
...the cross-section of both surfaces is a rectangle.

Sketch the cross-section that would be made by a cut through the plane of symmetry of these four solids;

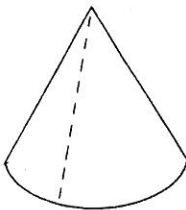
17.



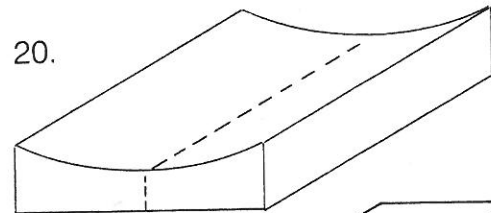
18.



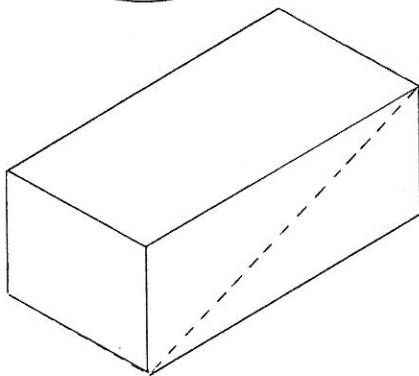
19.



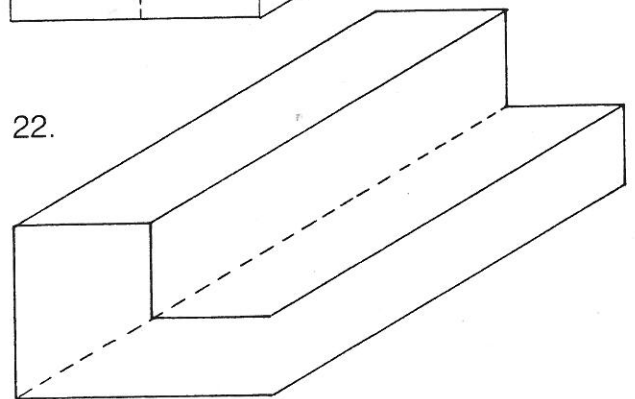
20.



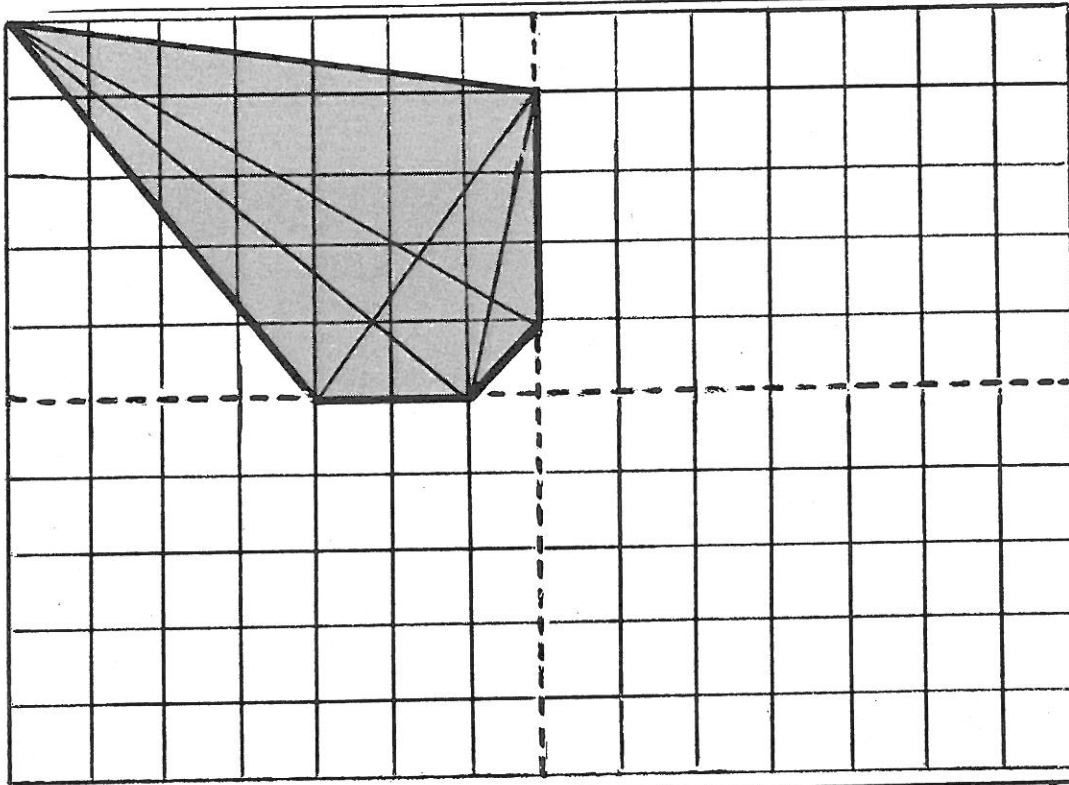
21.



22.



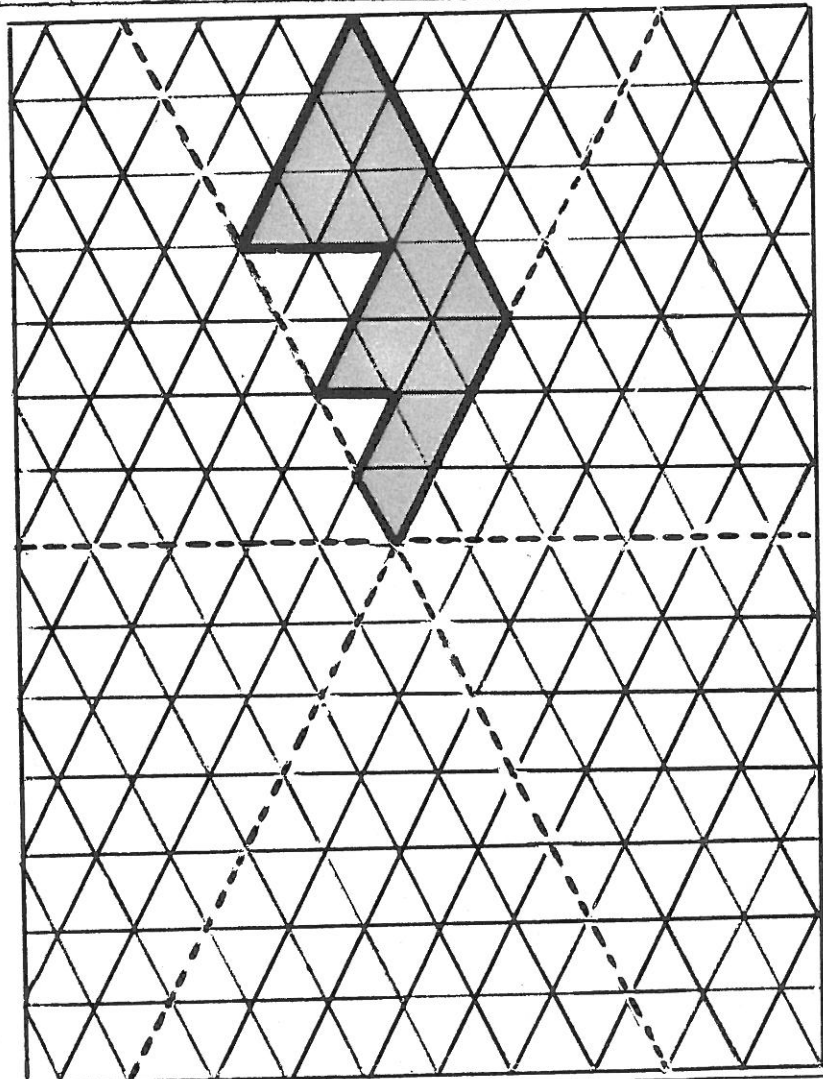
You will need:  
Squared paper, isometric paper, colours



## REFLECT

- (1) Copy the design onto squared paper
- (2) Reflect it about the dotted line
- (3) Colour it. Make sure the colours are reflected too.
- (4) Start again with a design of your own.

(5) Try this one.



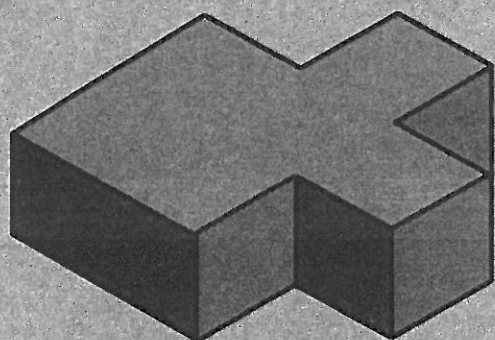


You will need some DIME Tricubes and isometric dotted paper.

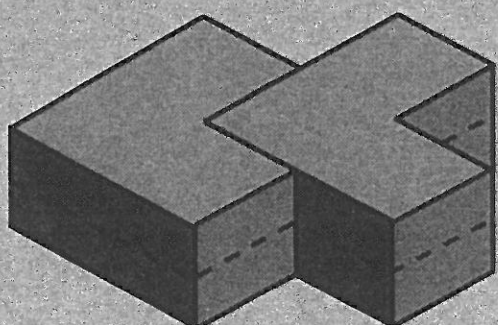
# Tricube Symmetry

You may like to work in a group.

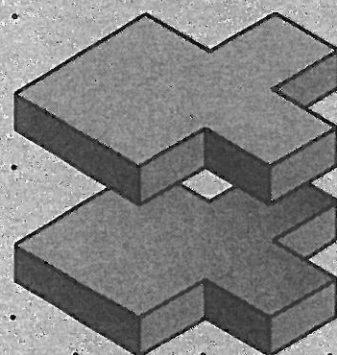
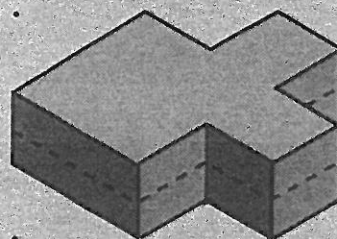
This solid . . .



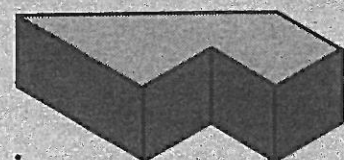
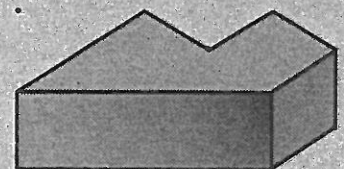
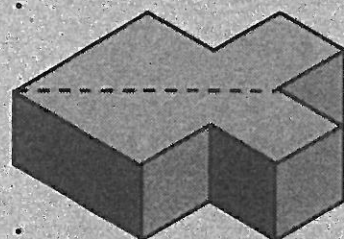
. . . has been made by fitting 2 tricubes together.



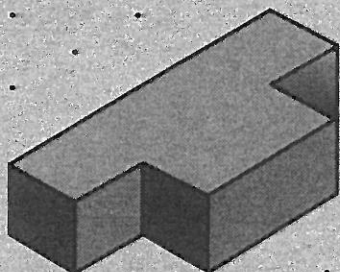
It has 1 horizontal plane of symmetry.



It has 1 vertical plane of symmetry.



1. Build the solid below with 2 tricubes. Draw it and mark in the horizontal and vertical planes of symmetry.



2. Using 2 tricubes make as many solids as you can.

Draw your solids and show any planes of symmetry.

*Can you find any solids with 3 planes of symmetry?*

*Can you find any solids with 0 planes of symmetry?*

You may like to use *more than* 2 tricubes to make other solids with horizontal and vertical planes of symmetry.

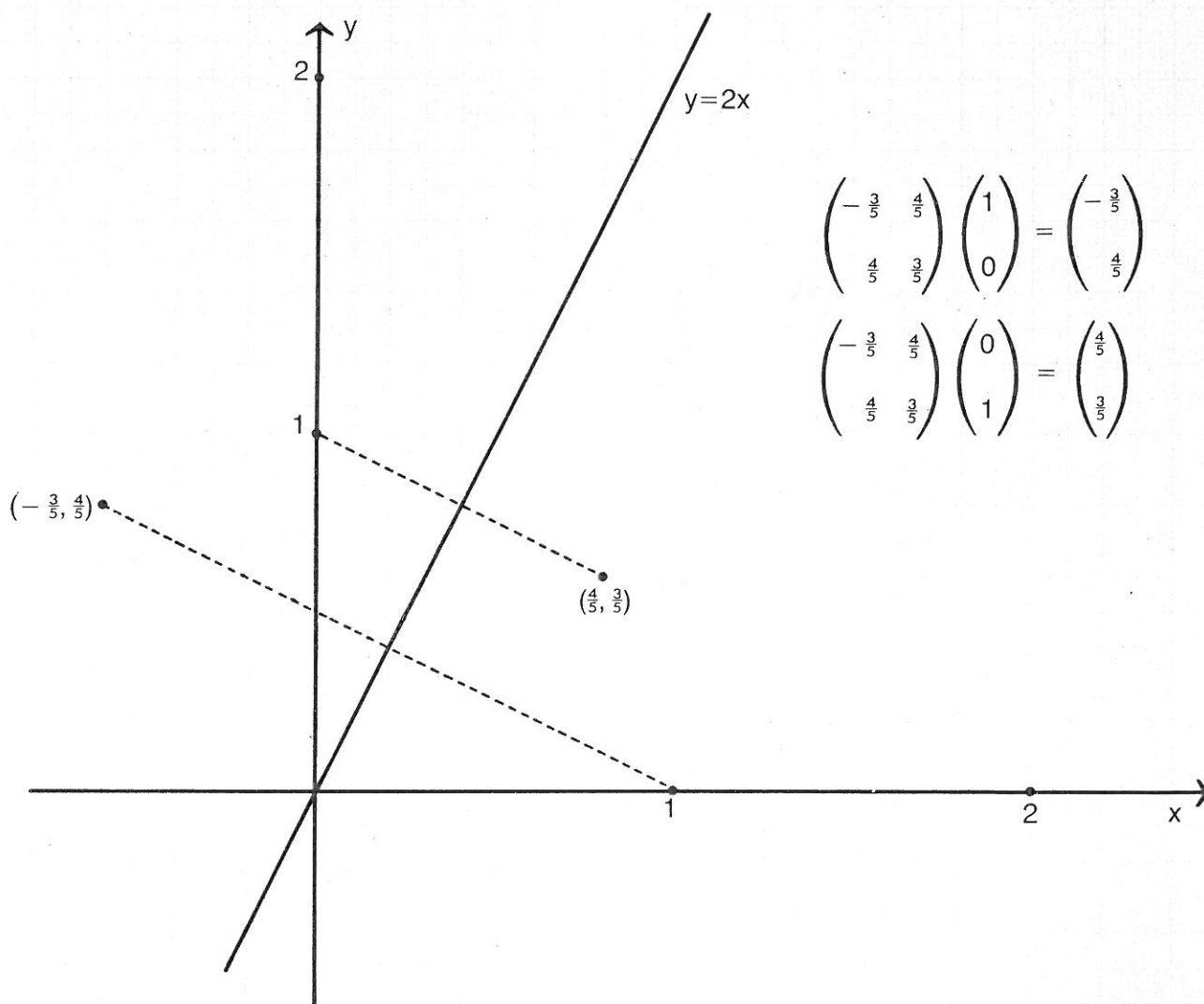
# Combined Reflections

- Draw a grid with  $x$ -axis from -8 to 8 and  $y$ -axis from -8 to 8.  
Draw the lines  $y = x$  and  $y = -x$
- Plot the points (2, 1), (7, 1) (7, 4) and join up to form a triangle.  
Label it A.
- Use the information in the table below to draw 7 more triangles.

Starting Shape	Transformation	Label of new shape
A	reflect in $y = x$	B
B	reflect in $y$ -axis	C
C	reflect in $y = -x$	D
D	reflect in $x$ -axis	E
E	reflect in $y = x$	F
F	reflect in $y$ -axis	G
G	reflect in $y = -x$	H

- Describe the single transformation to map:
  - A on to E
  - B on to G
  - D on to H
  - E on to B
- Use MicroSMILE *Transform* to check your work.

## Reflection Matrices Investigation



For a reflection in the line  $y = 2x$ , the matrix is

$$\begin{pmatrix} -\frac{3}{5} & \frac{4}{5} \\ \frac{4}{5} & \frac{3}{5} \end{pmatrix}$$

Find the matrices for reflections in some other lines

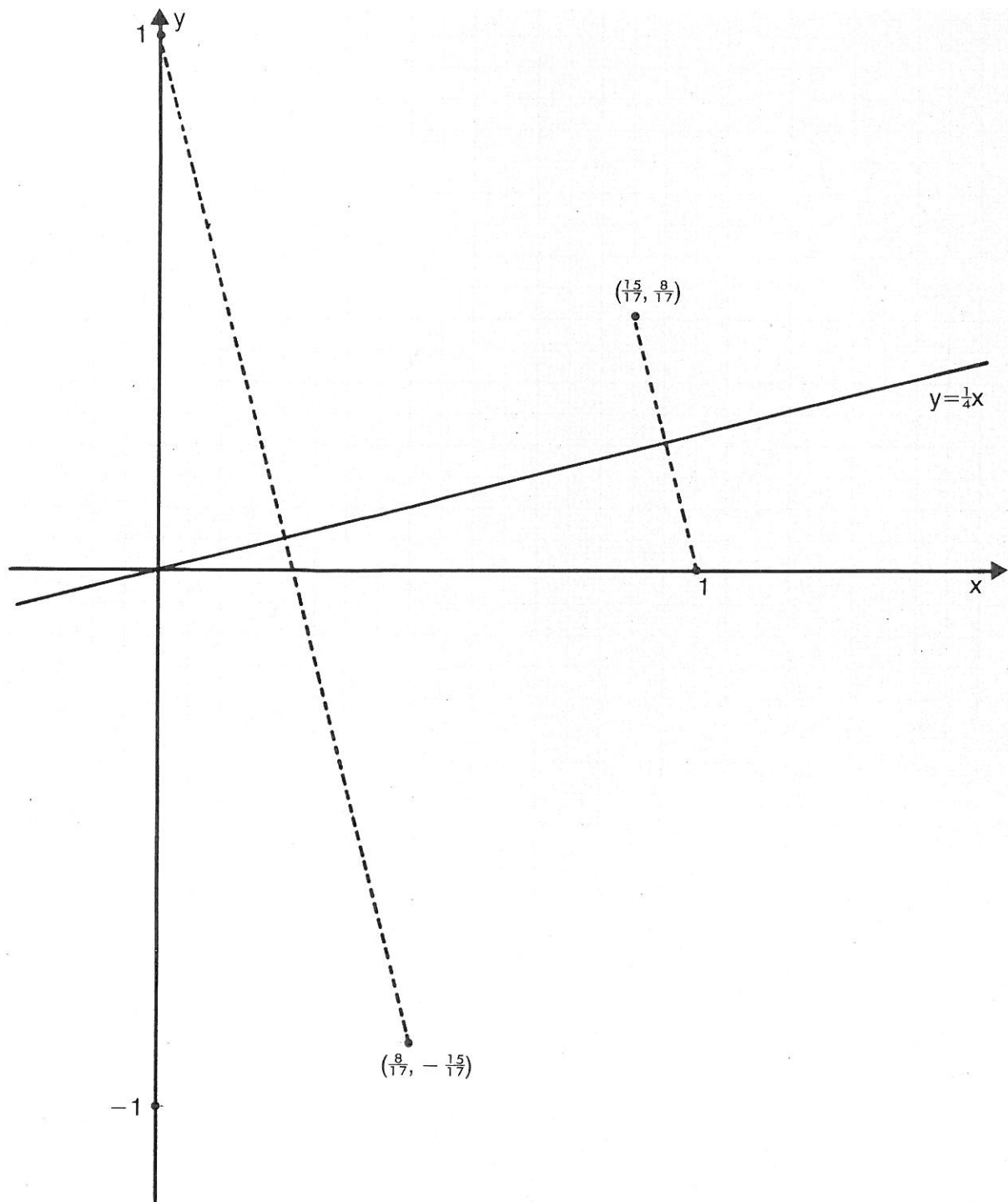
eg.  $y = x$  or  $x = 0$

and find out as much as you can about the numbers in these matrices.

*Turn over if you need a reminder about how to find the matrix for a particular transformation.*



# A useful technique to find the transformation matrix



Look at the unit vectors and see how they have been transformed.

$$\begin{pmatrix} 1 \\ 0 \end{pmatrix} \longrightarrow \begin{pmatrix} \frac{15}{17} \\ \frac{8}{17} \end{pmatrix}$$

$$\begin{pmatrix} 0 \\ 1 \end{pmatrix} \longrightarrow \begin{pmatrix} \frac{8}{17} \\ -\frac{15}{17} \end{pmatrix}$$

Use graph paper and make sure that your work is accurate.

Use the new vectors to write the matrix

$$\begin{pmatrix} \frac{15}{17} & \frac{8}{17} \\ \frac{8}{17} & -\frac{15}{17} \end{pmatrix}$$

See 1400 A Transformation Technique for a fuller description.