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1. One beam or two beams? A beam and a half? This is an adaptation of the monobeam or monobar.



When showing the beam and a half, I have shown one end at a time, which gives two quite acceptable ideas, then shown the whole and asked 'how can both ends be right, when clearly they tell very different stories? Then move onto...

2. A stack of beams? or passing through closed doors? At first glance, this seems quite acceptable. Then you notice that the pair of beams appear to be touching along their length - so how can a solid beam pass between this 'closed gap'?

3. Two Teas or to tease?

Which of the tee's is in front? Like 'two faces or a candle-stick?' The answer seems to change as you look at the diagram. The middle three shapes seem to be both sides of a plane at once.

4. The Tri-bar.

By showing one corner at a time, we appear to have three corners showing two pieces of solid wood meeting at right angles. But showing the shape as a whole, how can we have a triangle, whose 3 angles are  $90^\circ$  each? (To confuse the issue further, draw a triangle on a sphere.)

5. Impossible Frames.

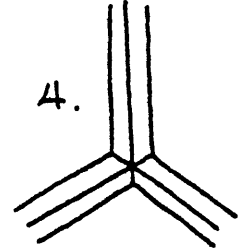
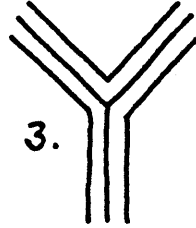
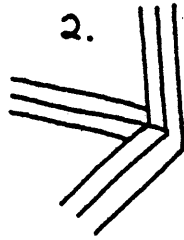
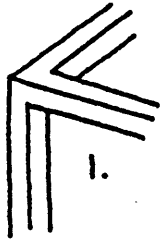
This combines well with.....

6. Real Corners.

This set of corners can be combined to give a selection of 'real' frames and 'impossible' frames. Try combining (1,1,1,1). This gives a frame seen from in front and close to it. Quite acceptable. Try (4,4,4,4) or (1,2,1,2)? This experiment can be continued with pentagons, hexagons, etc. eventually leading to an Impossible Infinity Bar. (A circle, the ultimate polygon).

## 7/8 Impossible Cuboids.

Leading on from Impossible frames into 3D. These two cuboids and other variations, can be drawn by taking the four types of corner from a real cuboid, and mixing them up.



## 9. Three planes.

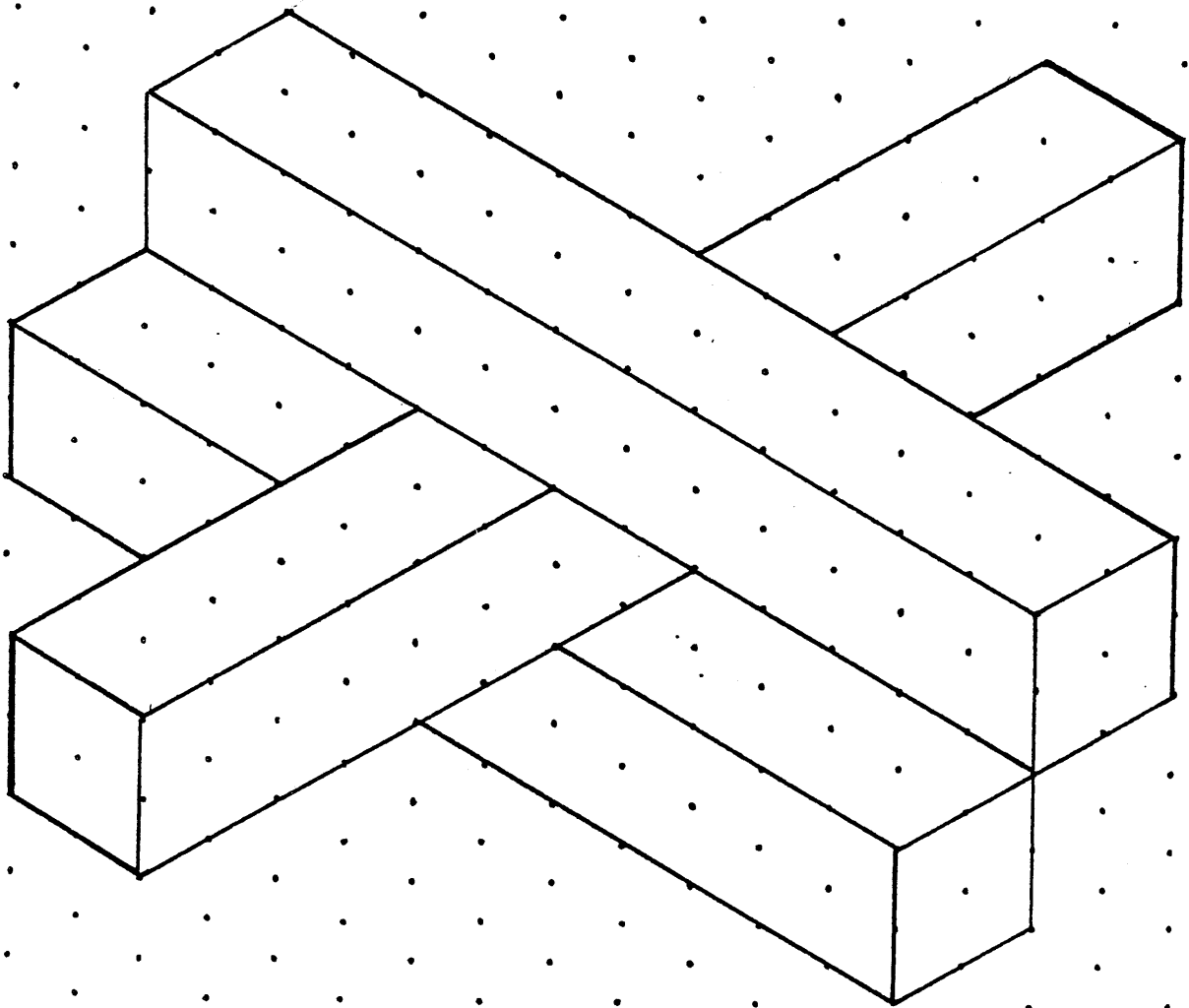
At the corner of every cuboid (room, table, etc.) three planes meet. By extending the lines a little...where does reality end and impossibility begin?

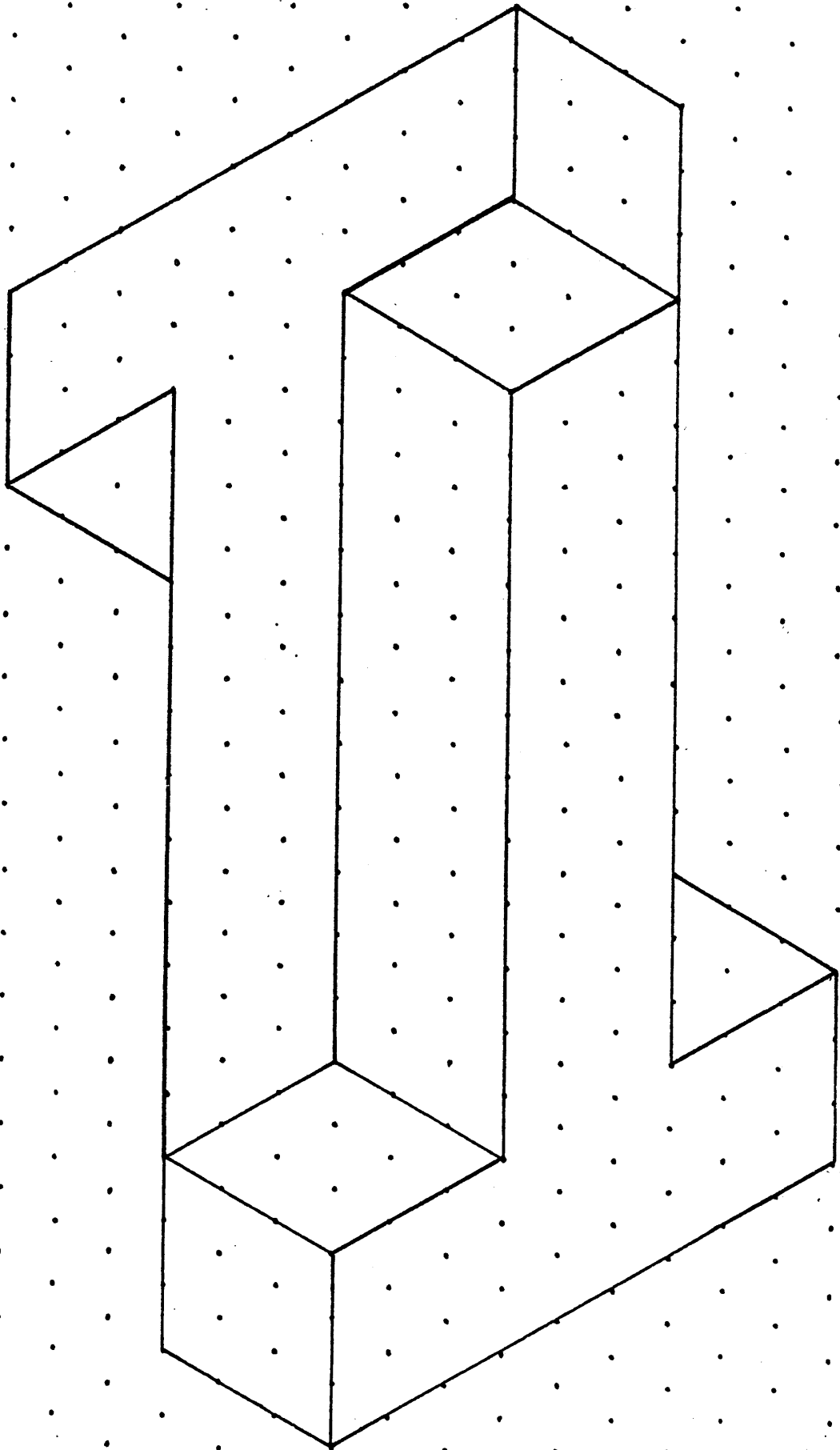
## 10. Impossible Stairs.

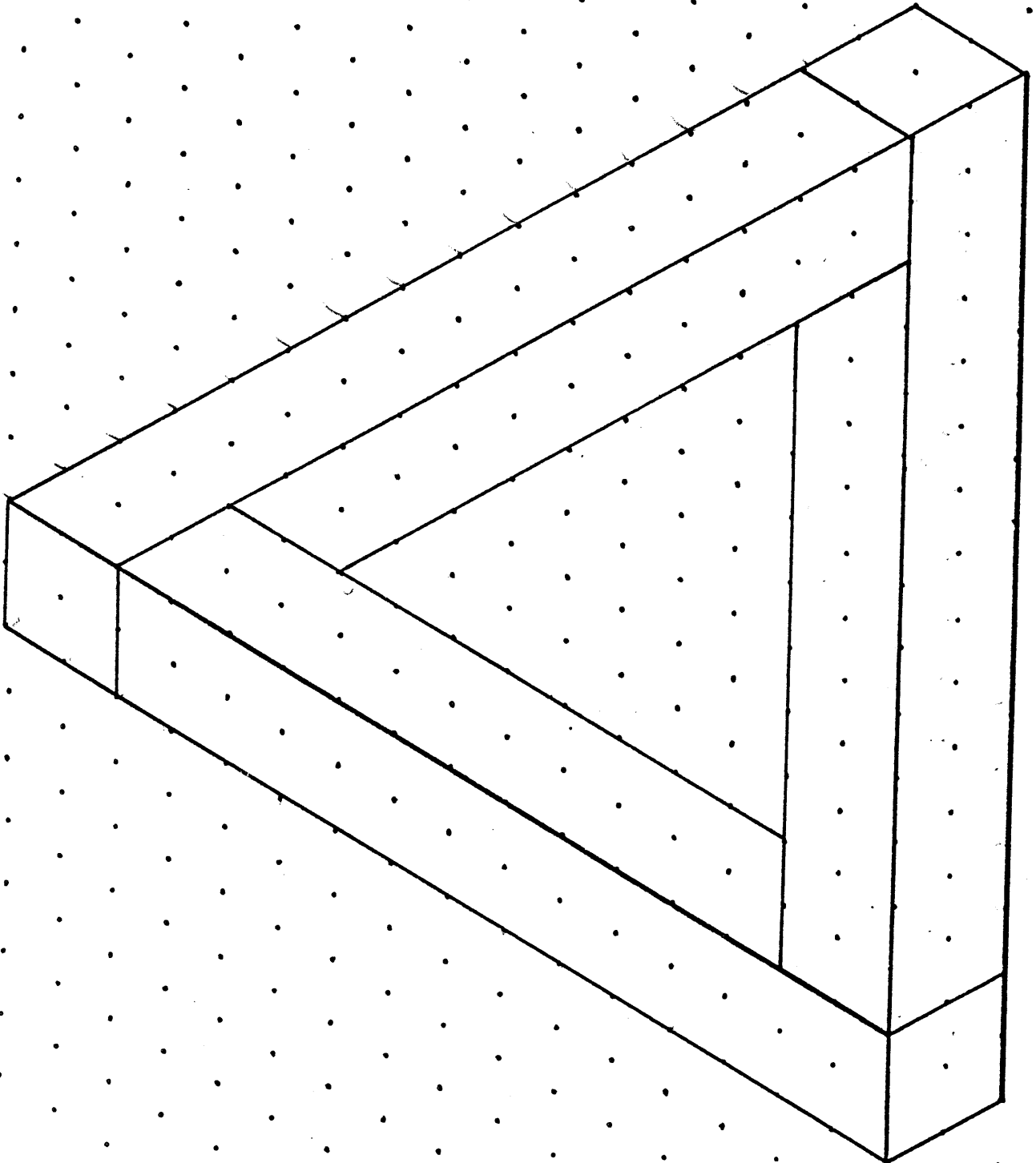
## 11. Concave and Convex.

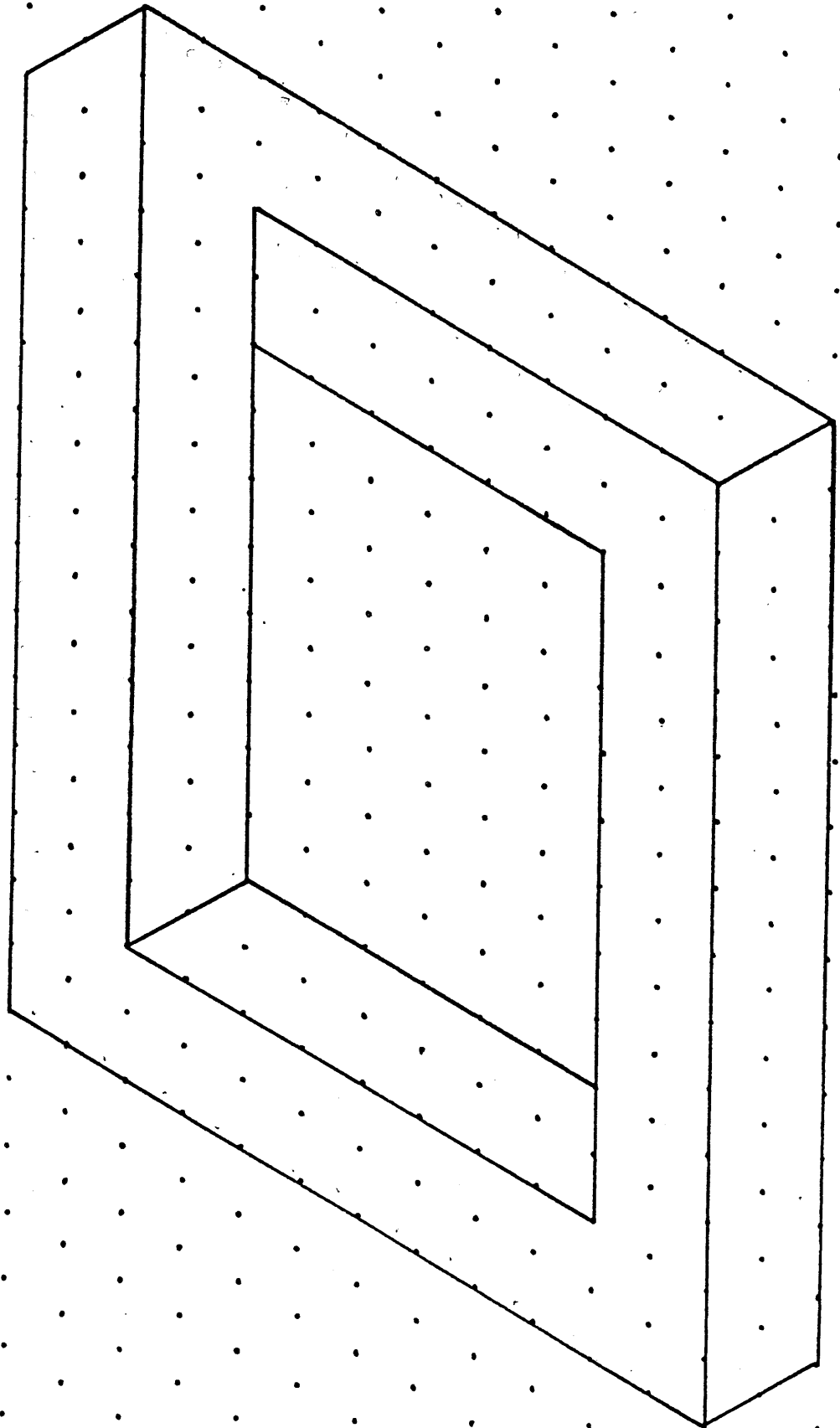
Make these two cubes into parcels or dice, and they are clearly convex. How can they be 'made' concave? By careful drawing of window frames on two sides of the same cube, that cube can appear to be both concave and convex.

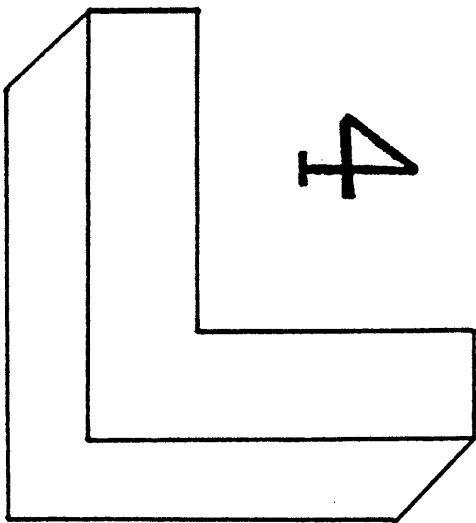
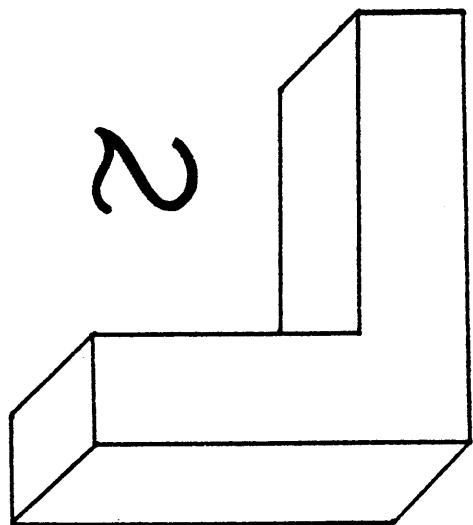
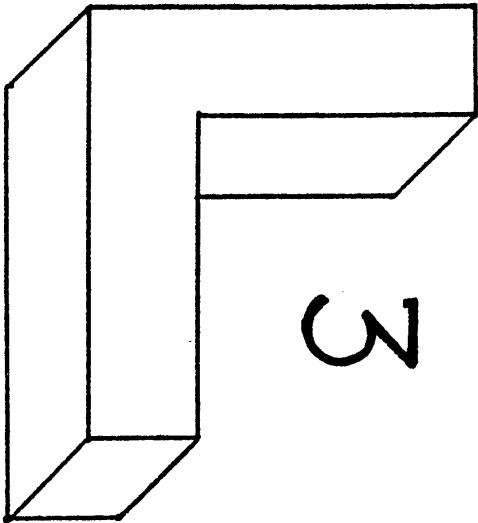
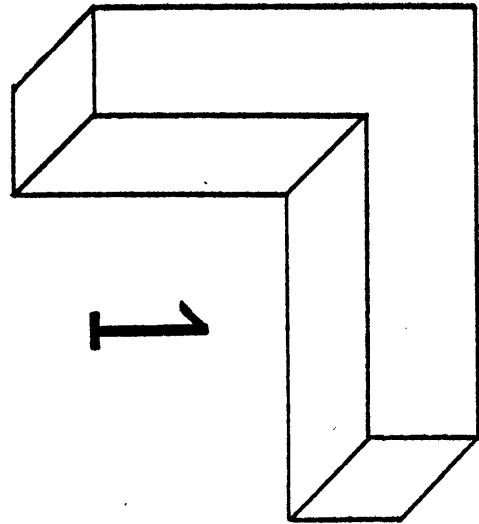
## 12/13 Fun with planes.

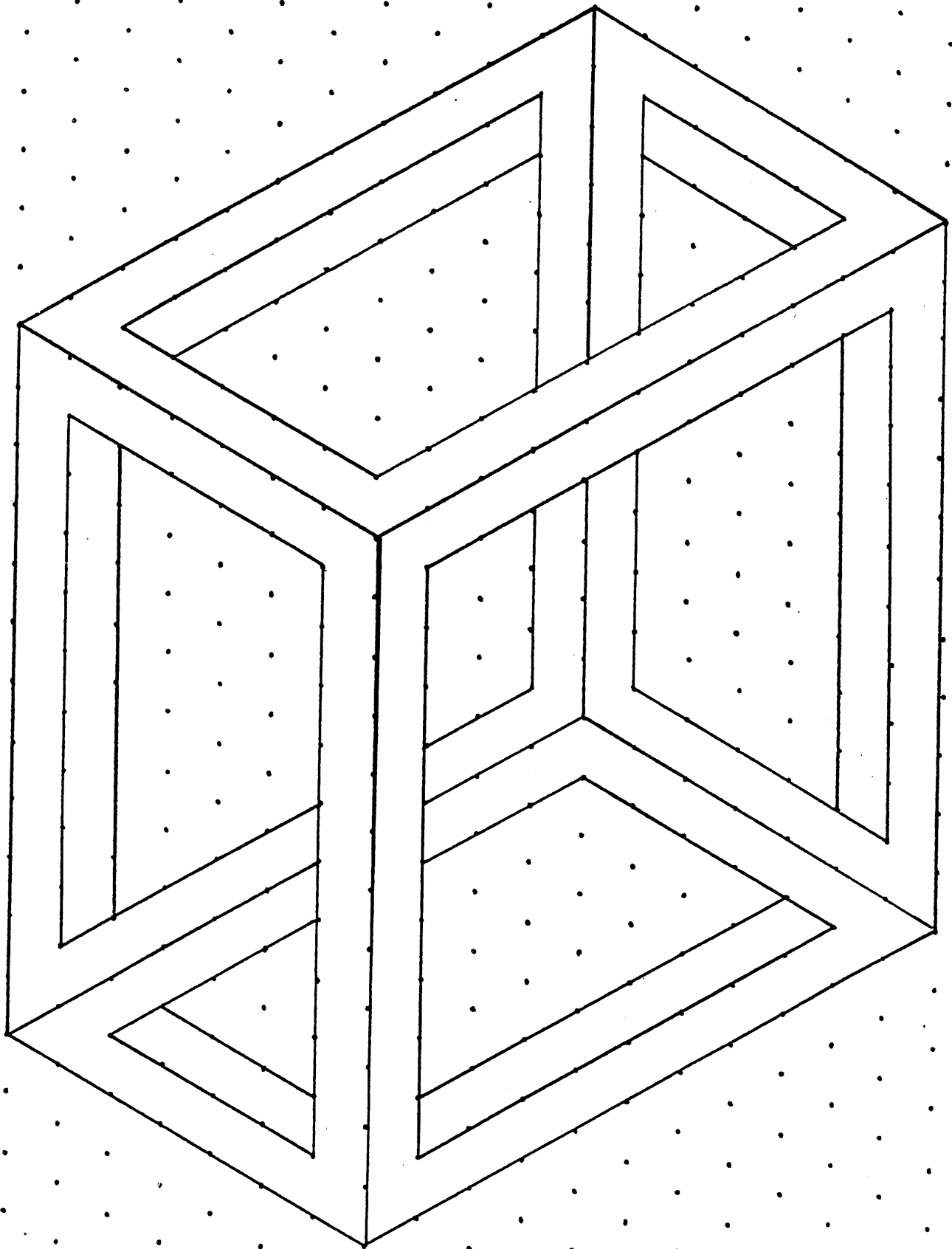




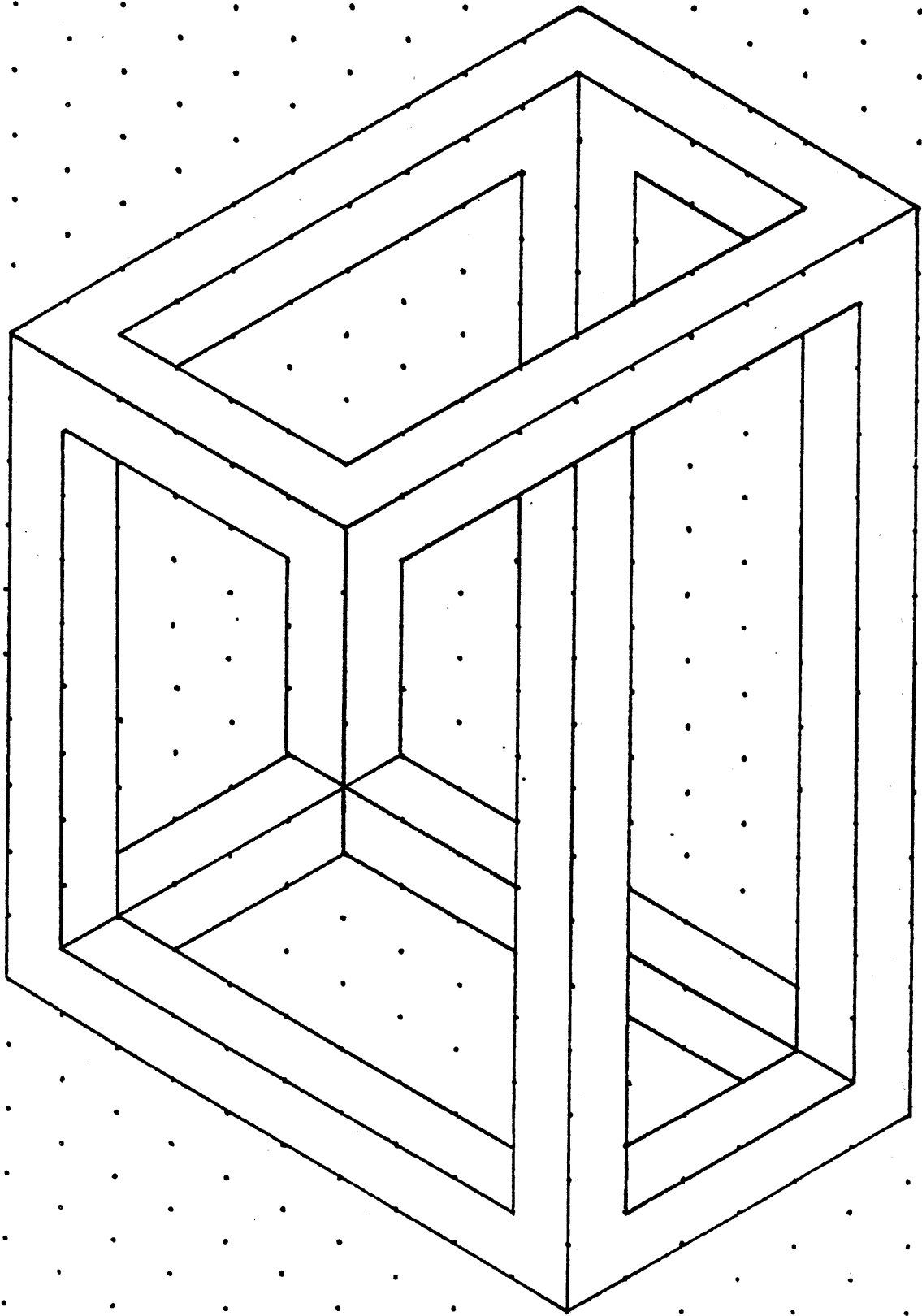


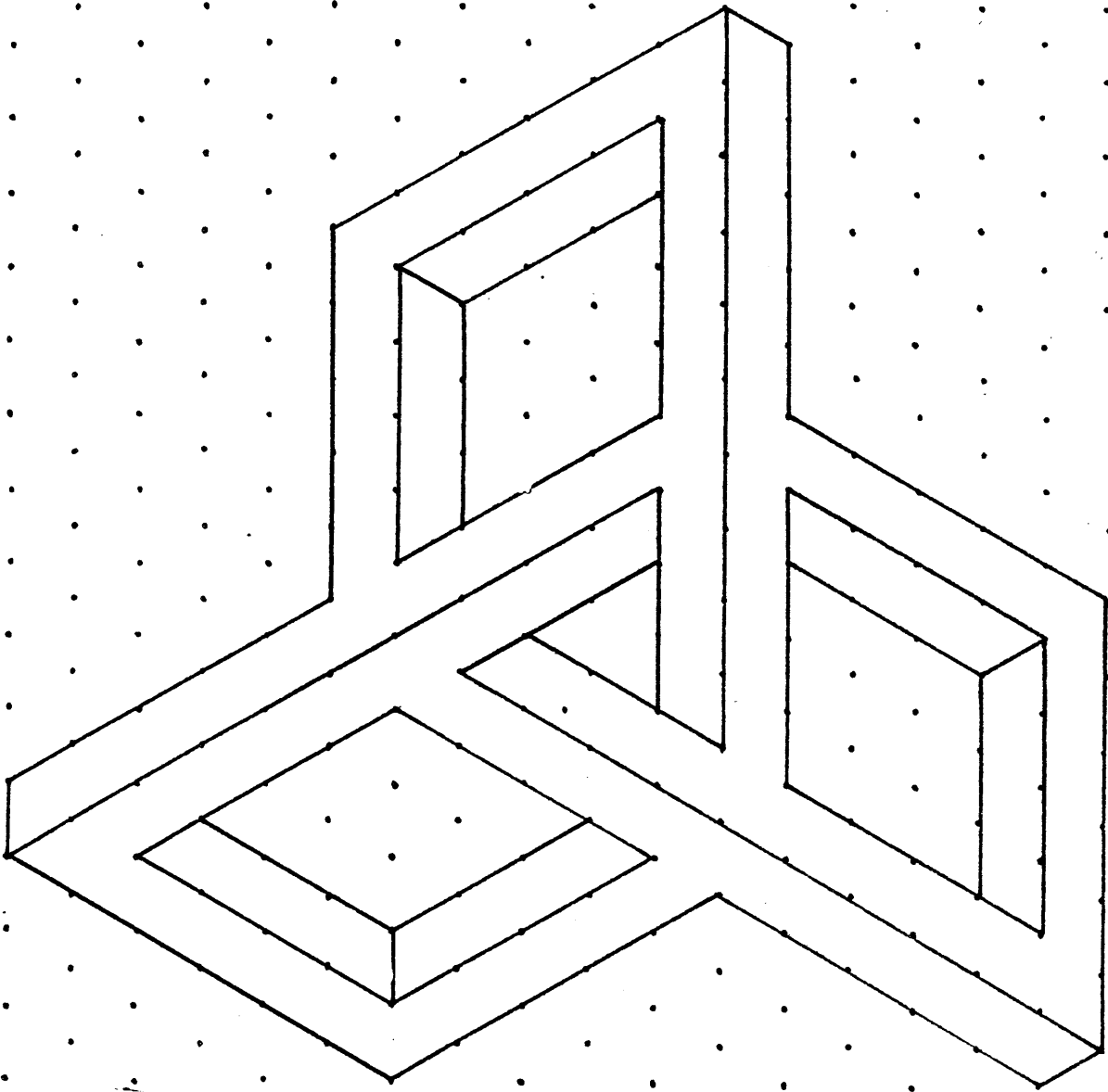


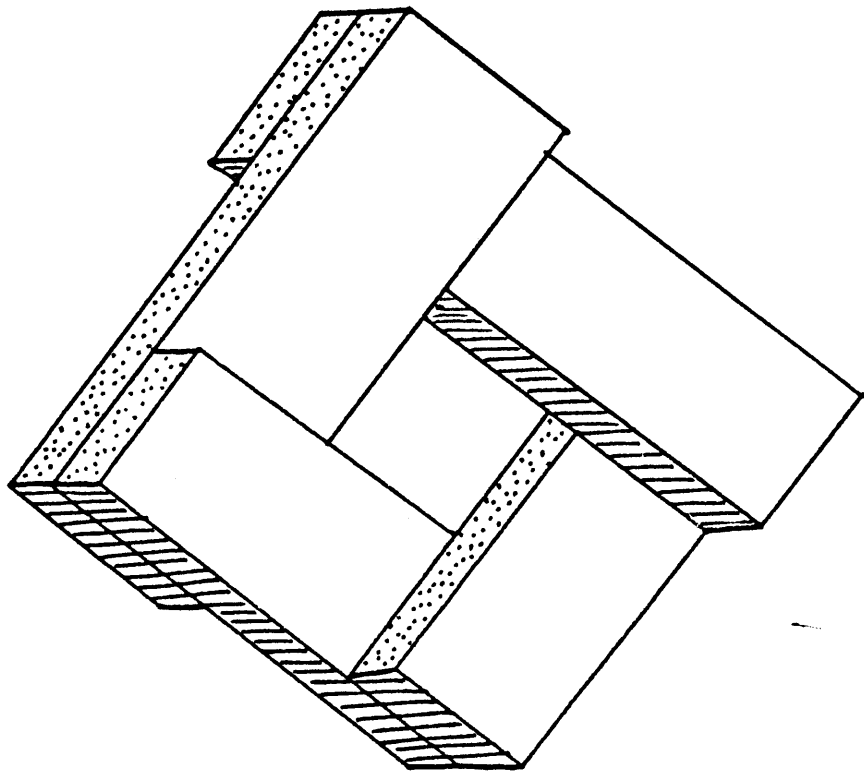
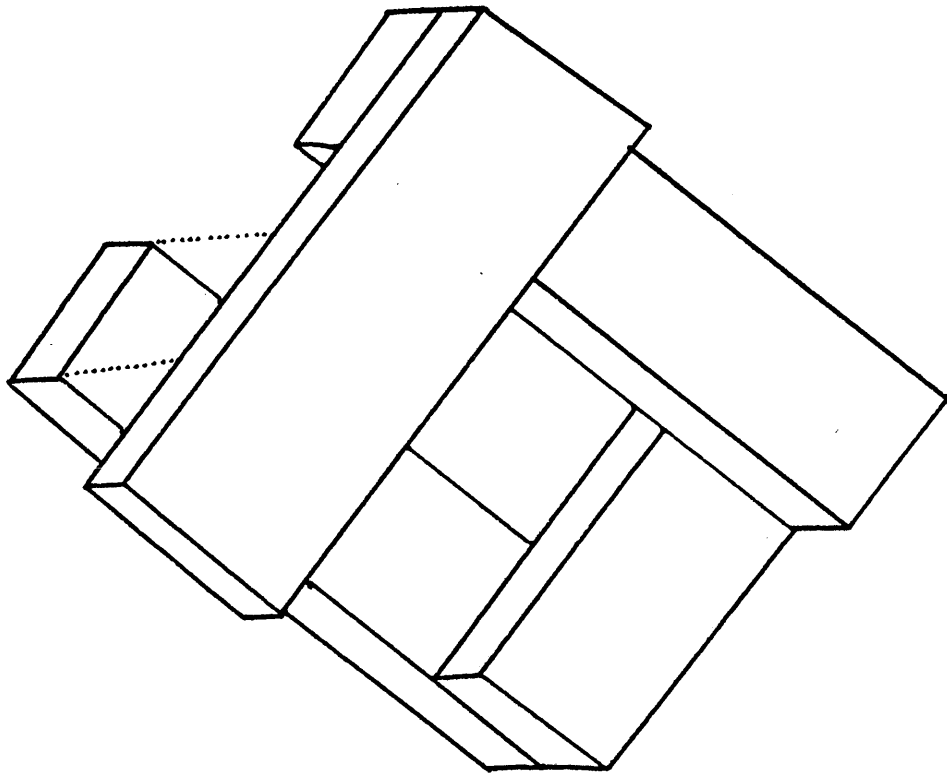


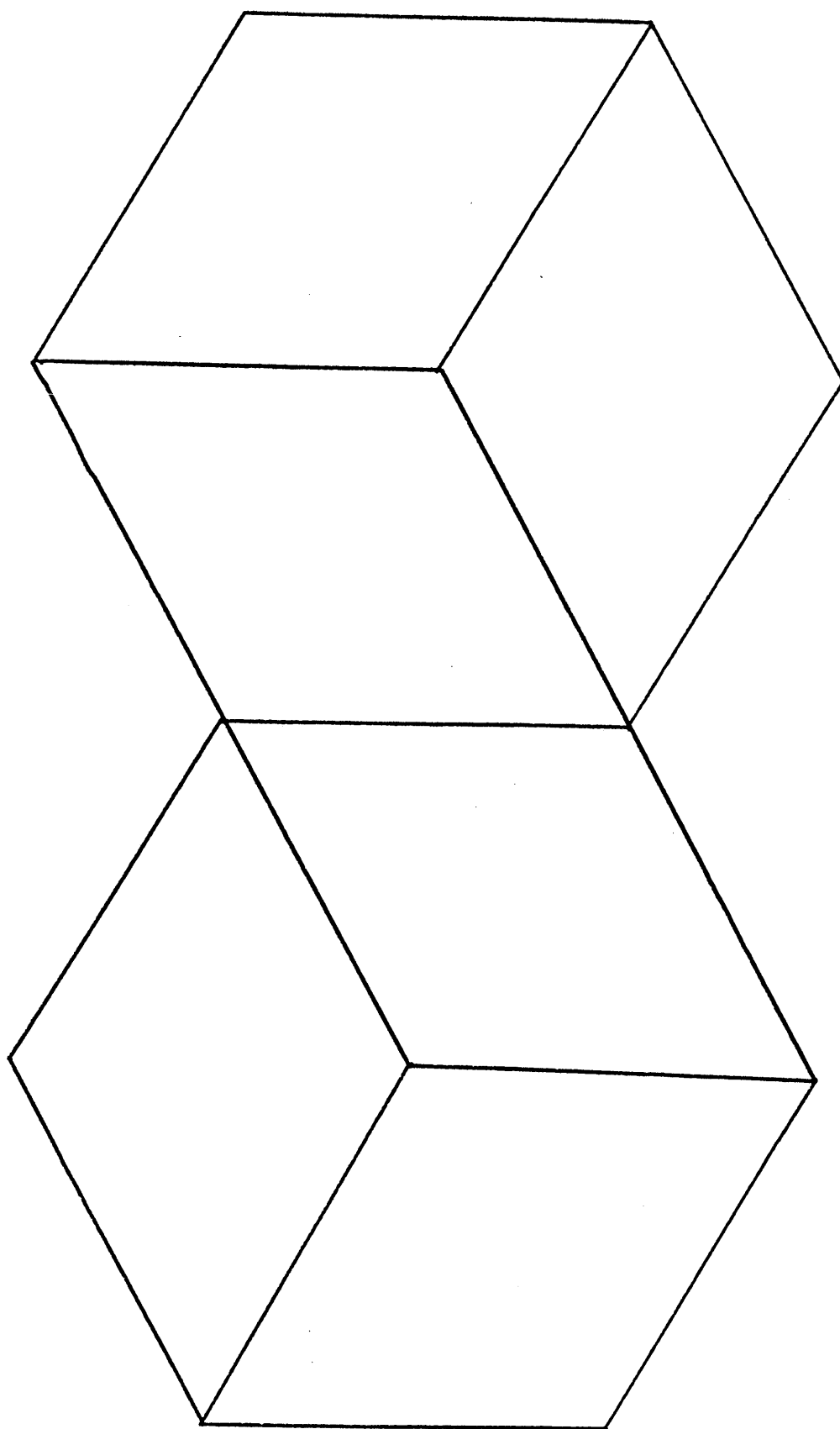




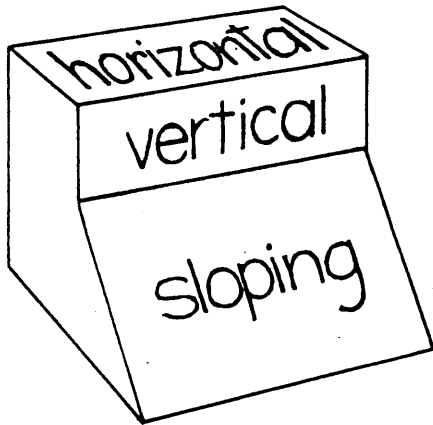




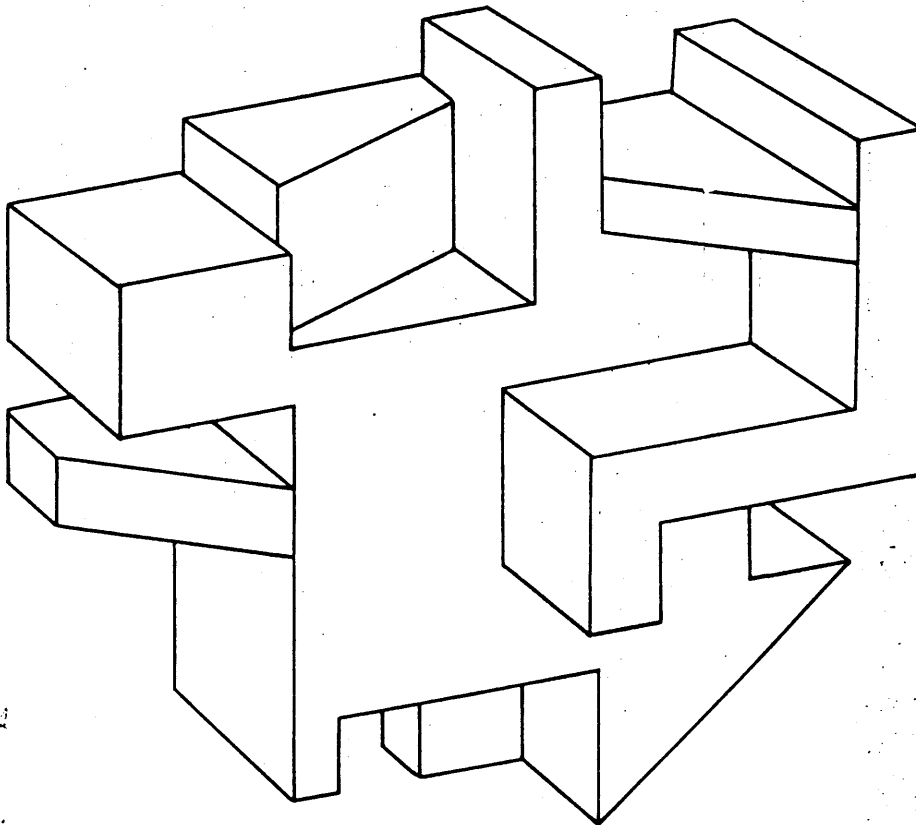
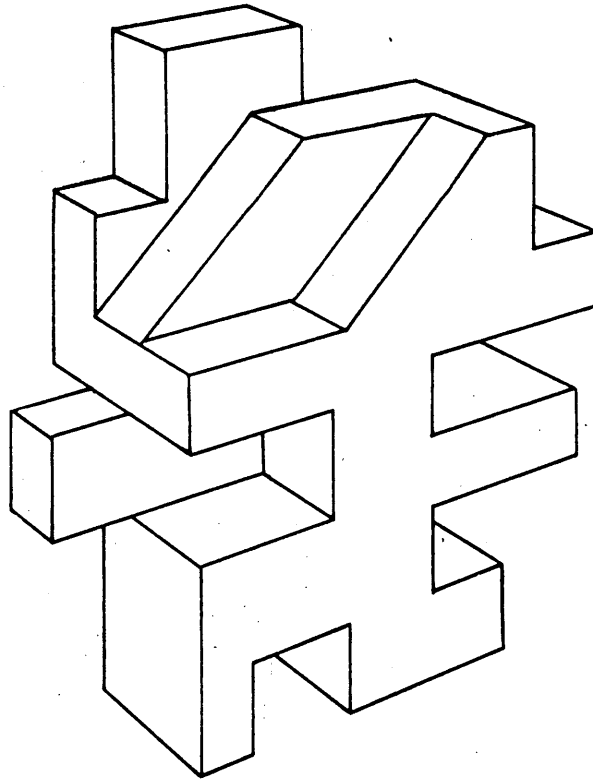


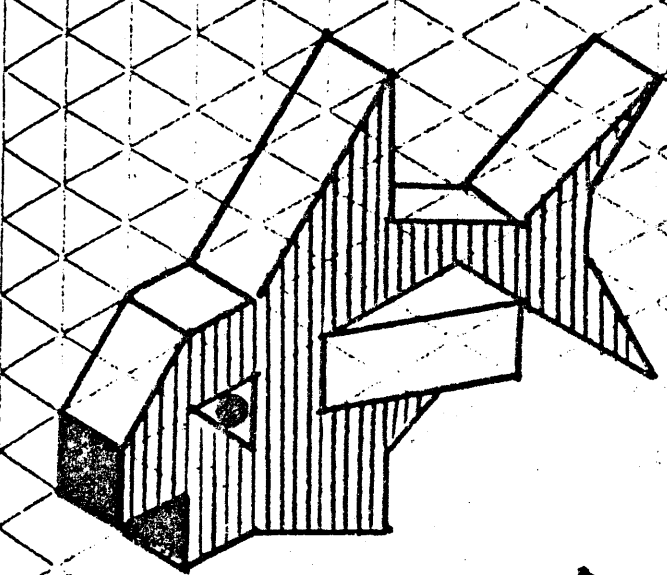


# A question of perspective

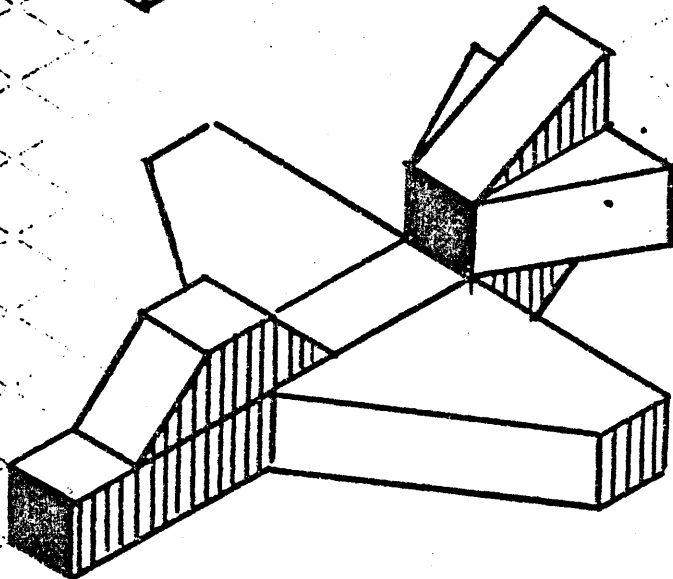


Colour the horizontal  
faces red, the vertical faces  
blue and the sloping faces  
green.

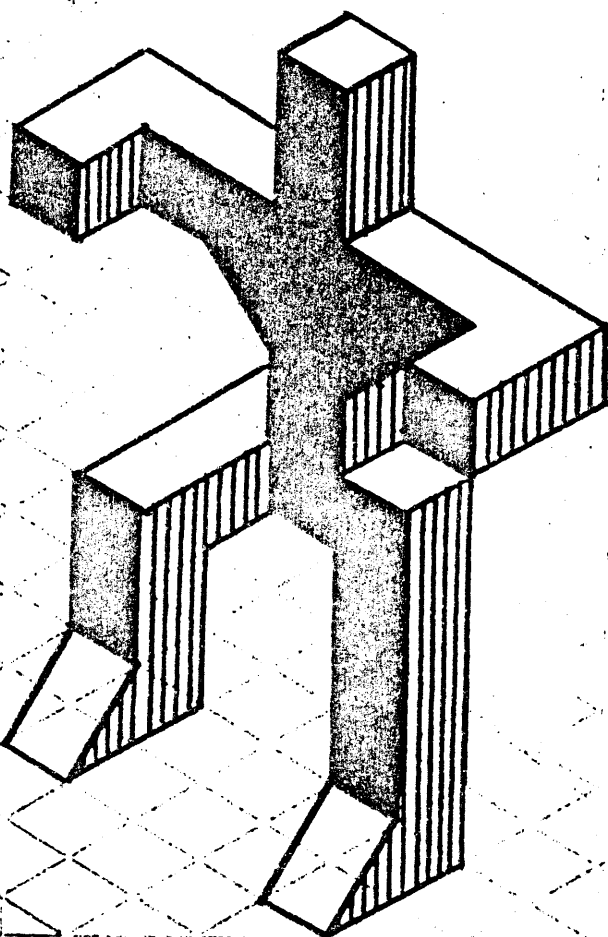




1. Enlarge the dimensions of this model fish by a factor of 2. What is the increase in volume of the model?



2. Draw this model aeroplane with its volume increased by a factor of 8.

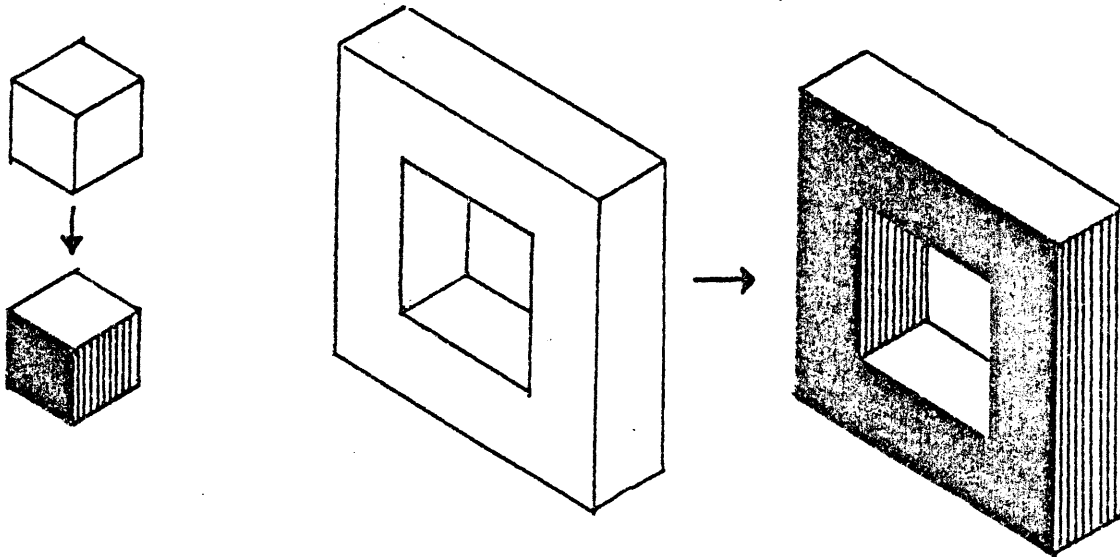


3. Draw this model robot with the area of each side increased by a factor of 4.

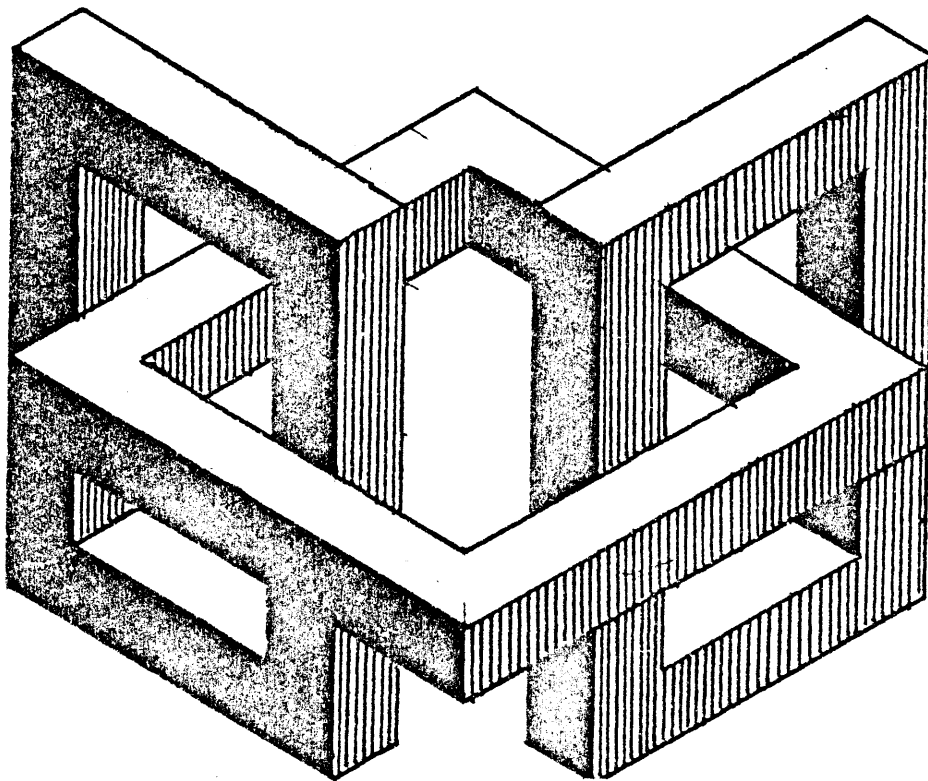
4. What is the increase in length compared to the increase in surface area?

5. What is the increase in length compared to the increase in volume?

### 3 - D ISOMETRIC DRAWING

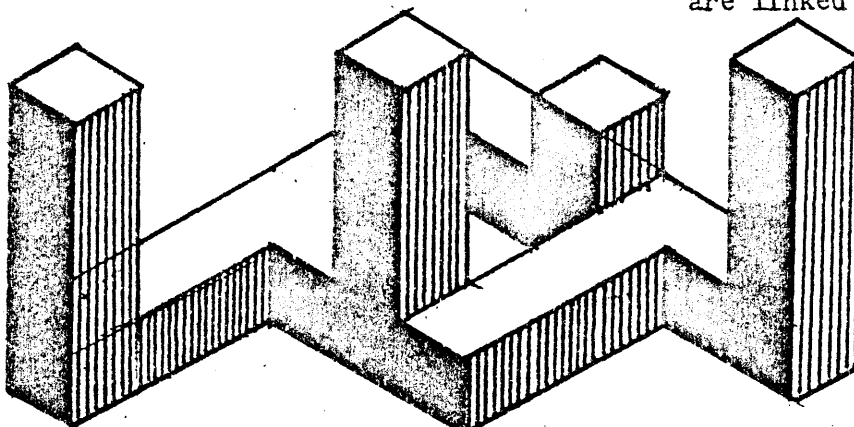


Isometric paper or dot paper can be used for drawing objects in 3 dimensions. Shown on this page are some basic 3 dimensional shapes.



Chain links in 3 - D.

Here a series of blocks in 3 - D form are linked together.



Could they represent a series of tower blocks?