Drawing Presentation-isometric, oblique and orthogonal

This part of the resource package is provided to assist you to understand and recognise some of the methods used to present objects. The exercises are suitable for completion by sketching or more formal drawing using instruments. While line work is not seen as an essential skill needed to complete this resource package, some effort should be made to use suitable lines to complete the work (that is, construction lines, outlines, centre lines.).

Information is provided covering both formal drawing and sketching. If you are asked to complete this work by your teacher, discuss and agree on the method to be used.

Drawing or sketching should help you understand and recognise common pictorial presentation of drawings. Either method may be useful in your later career.

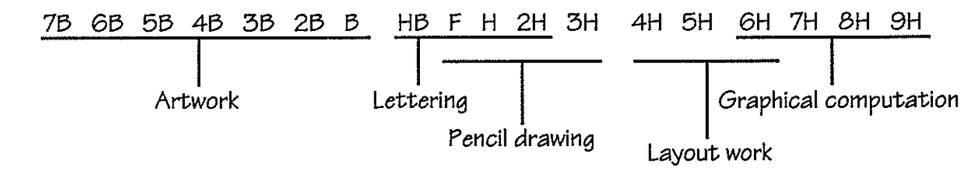
If you have completed MEC075, "Produce and Interpret Engineering Sketches" you may prefer to complete this section using formal drawing methods to increase your skills.

Instruments you may need if you are completing the exercises using formal drawing.

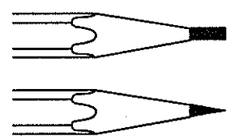
- Compass - 130mm spring bow type
- Set square - 45° (300mm approximately)
- Set square - 60° - 30° (300mm approximately)
- Scale rule - metric with ratio 1:1, 1:2, 1:5, and 1:10 (optional)
- Eraser - soft pencil type
- Erasing shield
- Roll of adhesive tape
- Pencils - drawing type H, 2H
- Pencil sharper
- Sandpaper pad
- Tee square and drawing surface for work outside the classroom.

Equipment required if completing the exercises by sketching

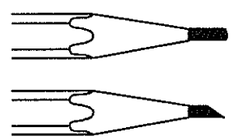
- Pencil - HB or H and 2H
- Rule
- Eraser - soft pencil type
- Pencil sharpener
- Sandpaper pad



Drawing pencil grades



Wedge shaped (line drawings)



Bevel shaped (use of compass leads)

Conical point shape (lettering, line drawing and sketching)

The correct way to sharpen leads

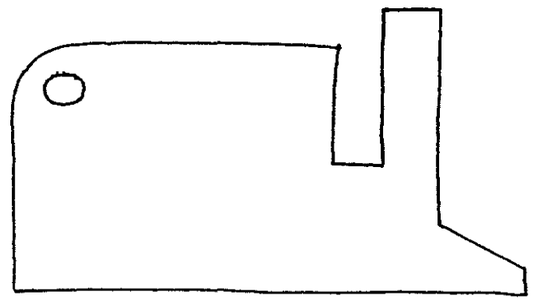
Freehand sketching

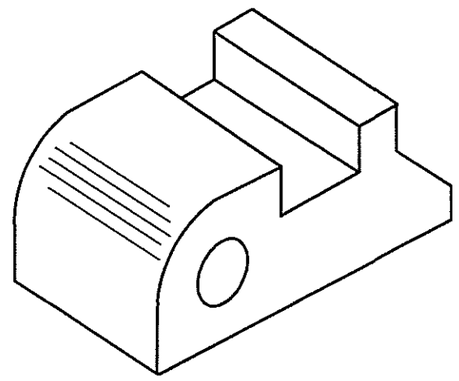
Freehand sketching is drawing by hand without using a ruler or other guiding instruments. For drawing things such as machines and mechanical structures, conventional standards for mechanical drawings are usually followed.

What do we use freehand sketching for?

A wide variety of purposes. Here are the more important ones.

- To provide a means of learning about drawing presentation methods.
- To give information from the field or factory to the drawing office. This happens where equipment needs repairing or changing.
- Ease of communication between the designer, draftsperson, and the tradesperson
- To make sketches of the layout and views needed for mechanical drawings
- As a base for discussion
- To give a picture which will help to interpret a complex orthogonal drawing





It is advisable to try and keep the sketch in proportion to the object. In the illustration you will notice the difference in proportion between the isometric sketch and the orthogonal (2D) sketch. In the flat sketch (2D), the hole is out of position. The block is too high and the slot is too narrow and deep. While the sketch should be in proportion, dimensions will provide the working information.

An advantage of sketching is that you only need a pencil, paper and an eraser. The drawing paper is not secured to the drawing board during sketching, so that the paper can be rotated to allow the ease of line work and blending of lines.

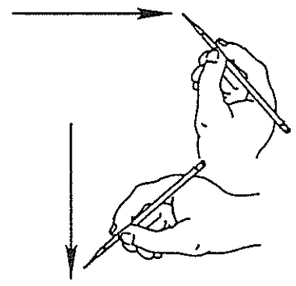
Freehand sketching - lines

Method of sketching

Left-handers - reverse the instructions on these pages where you need to.

Hold your pencil lightly (don't grab it tightly), and hold it about fifty or sixty millimetres from the point.

DO NOT USE A STRAIGHT EDGE



Horizontal lines

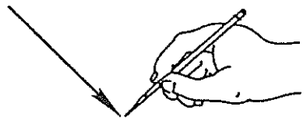
When You are drawing horizontal lines, your hand slides along the left to right. Measure the distance between the to established points with your eyes. Short joining lines may provide an acceptable finish especially for longer lines.

Vertical lines

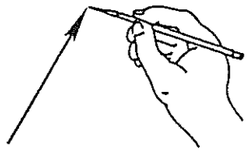
Use a wrist movement from top to bottom when you draw a vertical line.

Sloping lines

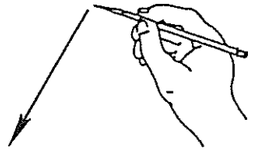
When you are drawing a line from upper left to lower right, make the movement with your wrist, holding your hands above the line.



Draw lines from lower left to upper right by sliding your whole hand



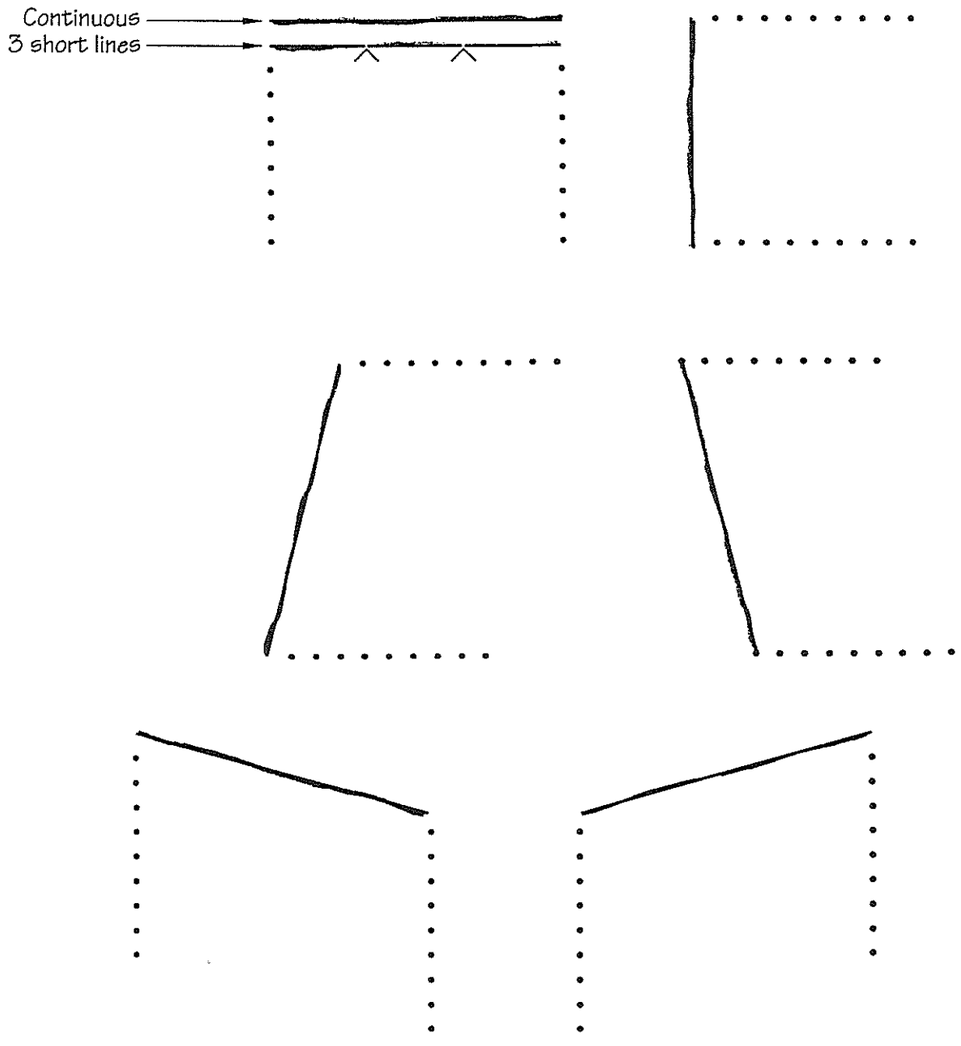
When drawing lines from upper right to lower left, use your wrist. Your hand will always be below the line.



Exercise 5-1 (sketching)

Instructions - practice freehand sketching on lines in the position provided.

Parallel lines

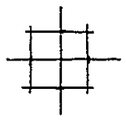


Freehand sketching - circles

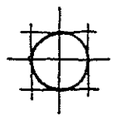
Small diameter circles - up to 10mm diameter

Step 1 Draw light horizontal and vertical centre lines. The point where they where they cross will be the centre.

Step 2 From the centre, where the lines cross, mark off the radii and draw a box.

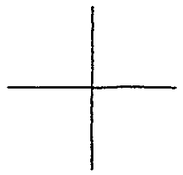


Step 3 Join the points with a smooth, even curve.

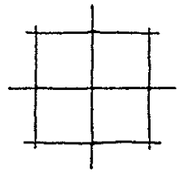


Medium diameter circles - from 10mm to 30mm diameter

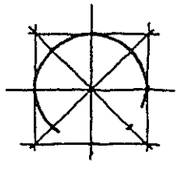
Step 1 The same as for small circles



Step 2 The same as for small circles

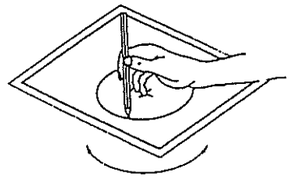


Step 3 Draw diagonals and mark off the radii. Join the points with a smooth even curve



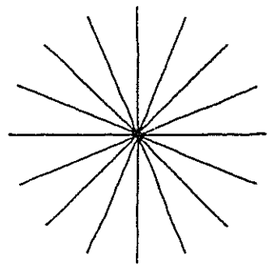
Large diameter circles (method 1)

Hold your pencil as shown in the picture below, and keep the tip of your little finger firmly on the paper as a centre. Then, holding your hand still, rotate the paper.

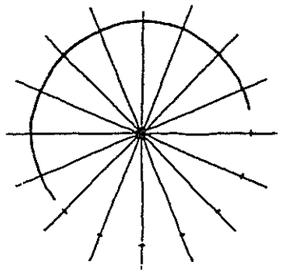


Large diameter circles (method 2)

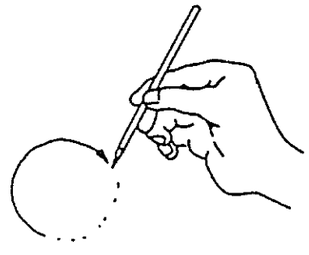
Step 1 Draw light horizontal, vertical and slanting lines as shown.

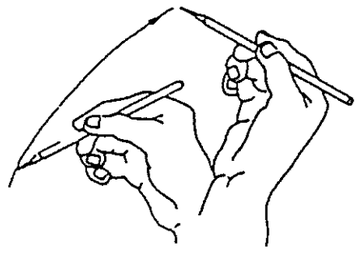


Step 2 Mark the estimated radius on all lines and join the points with a smooth even curve.



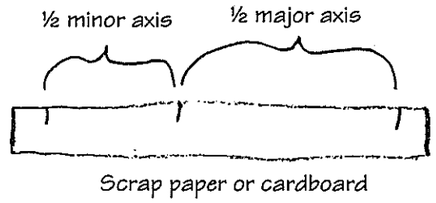
Circles and arcs
When drawing circles and arcs, move your wrist and fingers as shown.

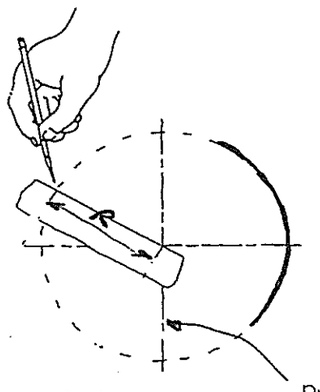


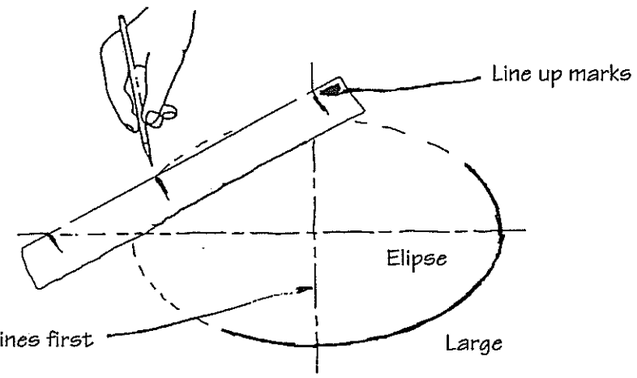


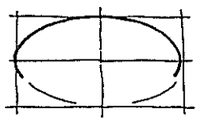
Practice these methods on scrap paper.

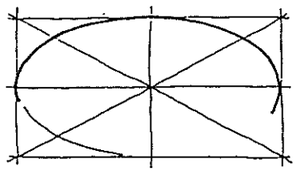
Ellipse

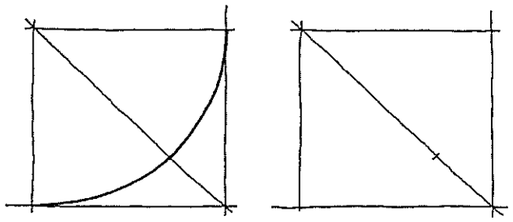


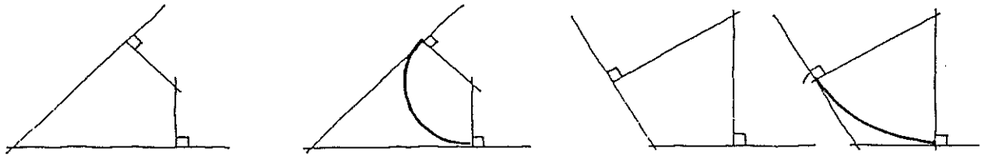

Circle



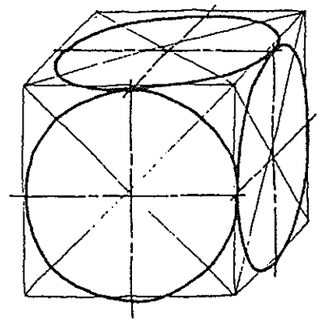

Small

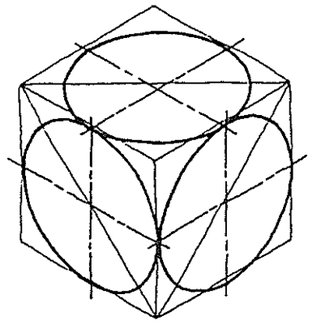

Medium

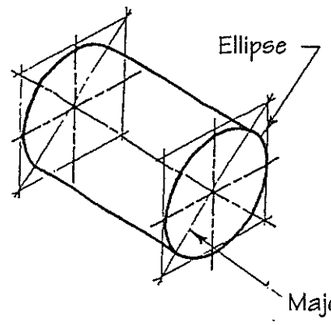

Radii

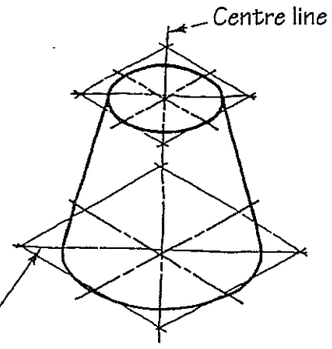


Practice these on scrap paper.

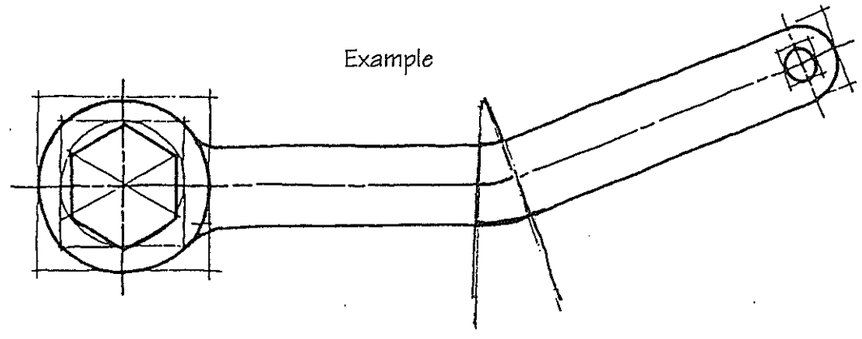

The three 'oblique circles'


The three 'isometric circles'



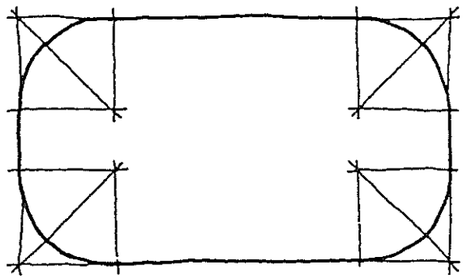


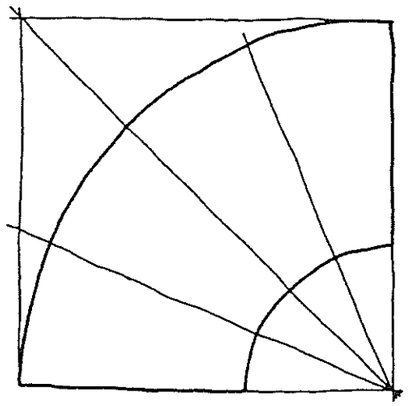
Example

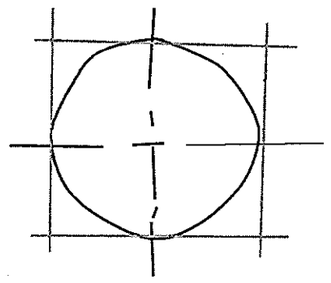


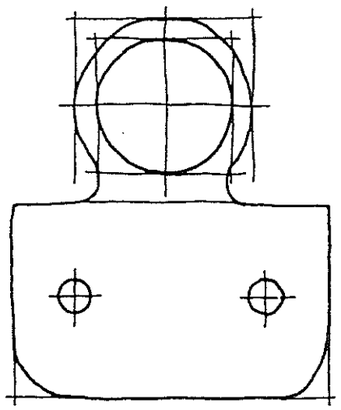
Exercise 5-2
Freehand sketching

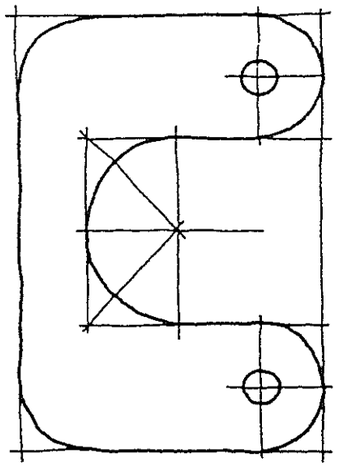
Squares, rectangles, arcs and circles
Copy the sketches to the same proportions, in the space beside each sketch. Use the freehand sketching techniques shown previously.











Setting up a drawing sheet and using drawing instruments

1. The tee square is used to draw horizontal lines

2. The stock of the tee square should be hard against the edge of the board.

3. Vertical lines are drawn with a set square on the tee square.

4. Set squares are used for drawing inclined lines at 15°, 30°, 45°, 60° and 75° angles.

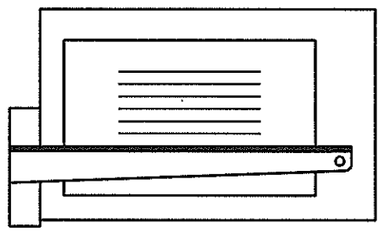
5. The tee square and set squares can be used to drawing parallel lines at right angles to the tee square.

   Always watch the point of the pencil when drawing a straight line. Try to keep your lines of even thickness for any particular type of line. If you are using a conical point pencil, rotate it while you draw to help keep an even line thickness.

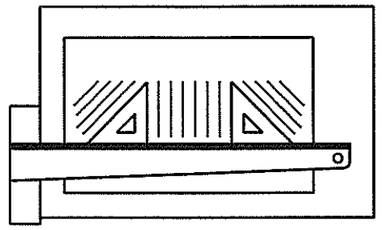
Lines should be firm and even

Not coarse and wooly

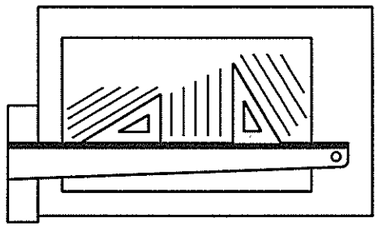
Nor double and broken



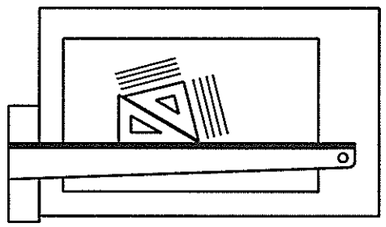
Horizontal



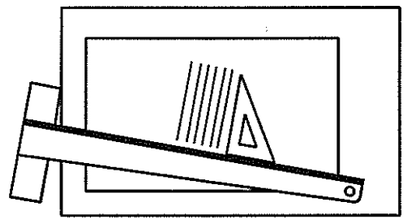
90° or vertical and 45°



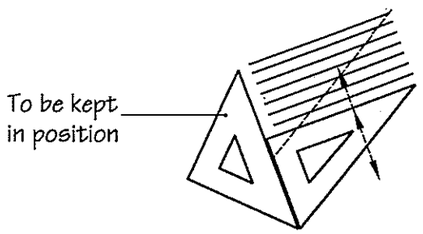
30°, 60° and vertical



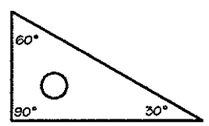
15° and 75°



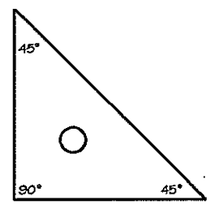
Parallel to a line at any angle



Drawing parallel lines using set squares



60° - 30°



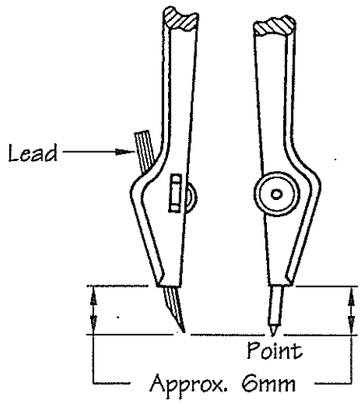
45°

Set square angles

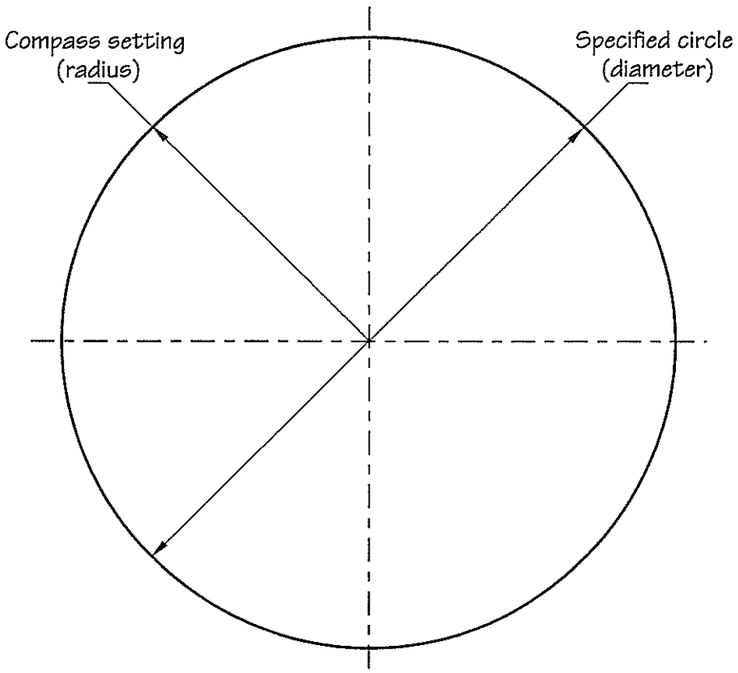
The use of a compass

The compass is used for drawing circles and arcs. An extension fitted to one leg enables circles of large diameter to be drawn. For best results a spring bow type is recommended. (Not a friction joint type)

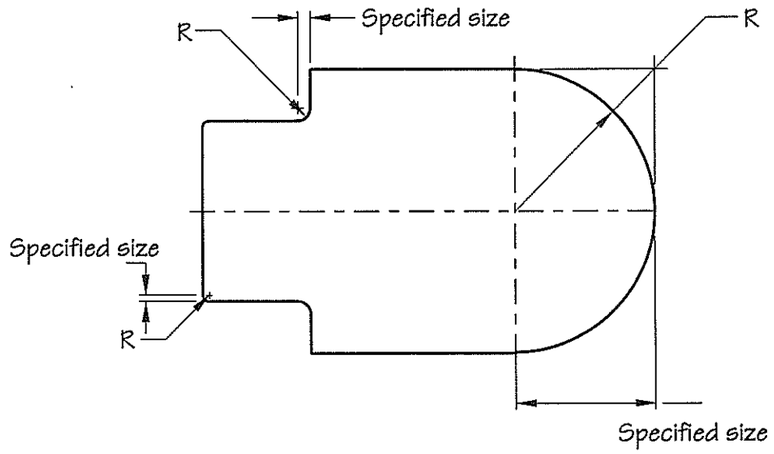
The lead is sharpened to a bevel point and must be of a grade suitable for producing lines of the same quality as ruled pencil lines. As it is difficult to pres hard using the compass, a soft grade of lead is recommended for outline work.



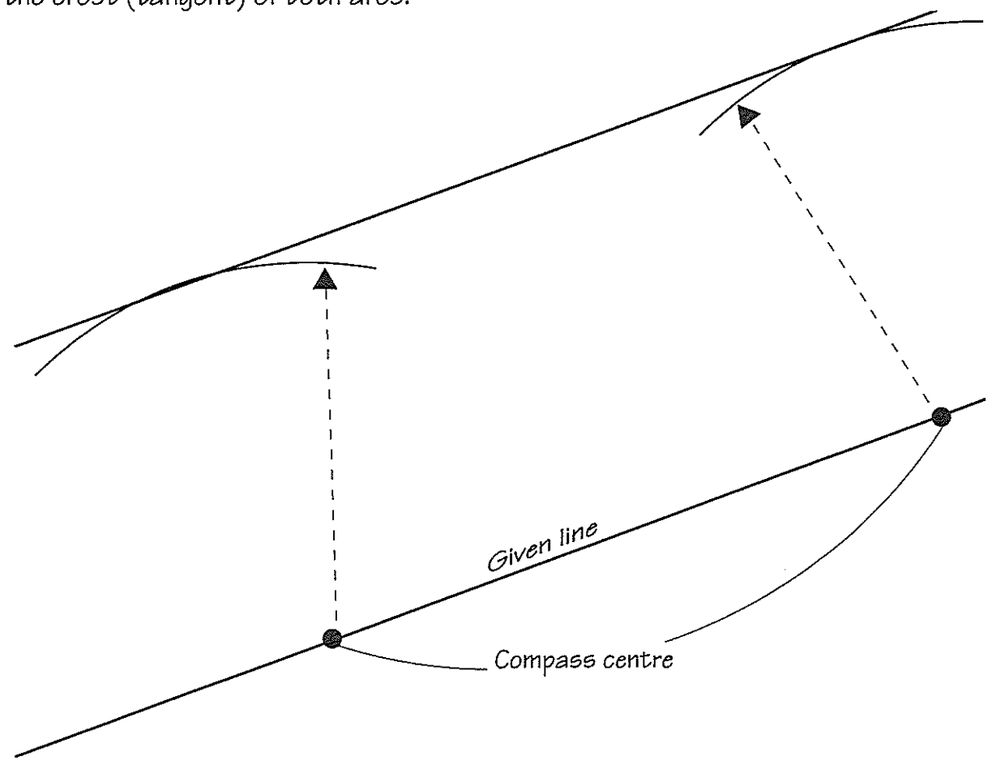
To draw a circle of specified diameter, the compass is set from a rule to a radius which corresponds to half the diameter.



To draw an arc of specific radius, the compass is set from a rule to the size specified then transferred to the corner, fillet or application.



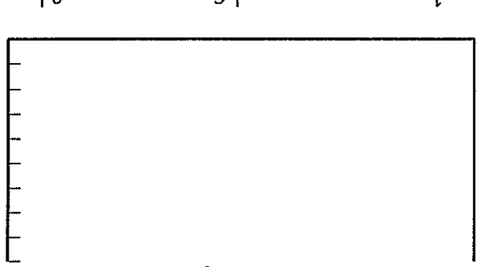
To draw lines parallel to any given line the compass must be set to the distance the lines should be apart. Close to the extremities of the line draw arcs. With a rule draw a line to touch the crest (tangent) of both arcs.



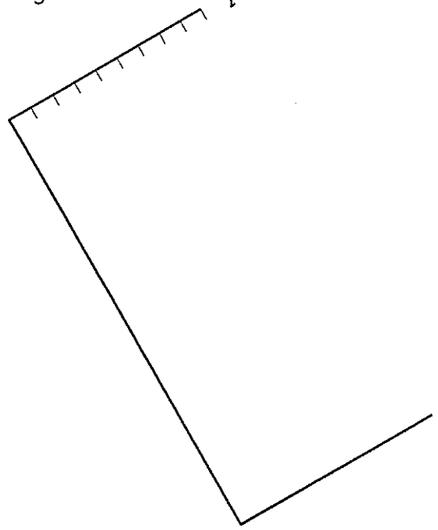
Exercise 5-3

Use of tee and set squares

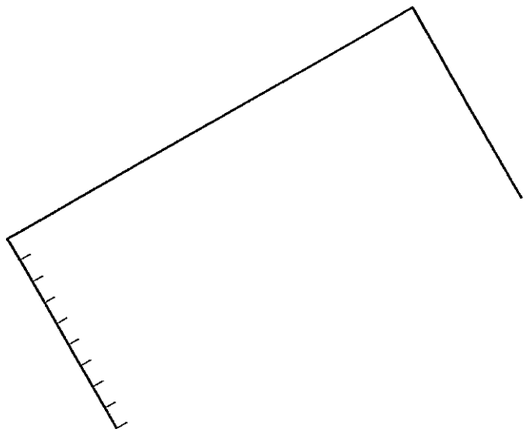
Copy the following parallel and oblique lines using tee and set squares



Outlines

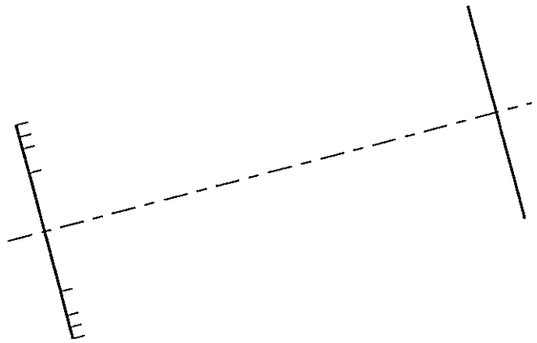


Outlines

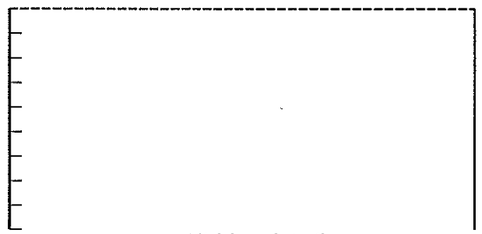


Hatching lines

Centrelines

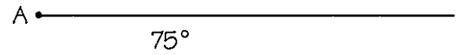


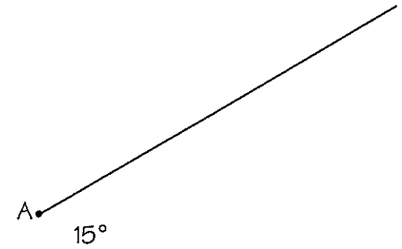
Construction lines

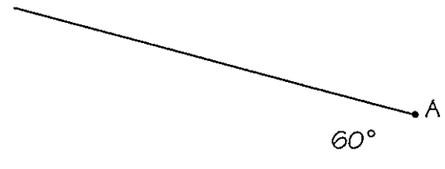


Hidden details

Using a tee square and set squares construct the following angles from Point A.







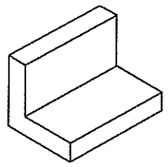
Isometric drawing (sketching or instruments)

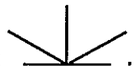
In isometric drawing three sides of the item are shown, all in dimensional proportion, but none is shown as a true shape with 90° corners.

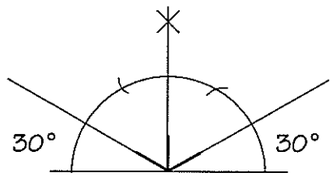
Isometric box

The best way to do an isometric drawing is to imagine a box which would exactly hold the item you want to draw. Draw the box, using light construction lines, to show the height, length and width of the item. Then draw the item inside the box.

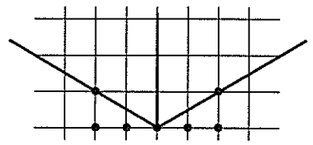
Example: an isometric sketch of an angle bracket.



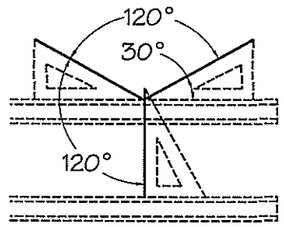
Step 1 Start with a  . The two lower angles are 30° to the horizontal.



Construction of angles

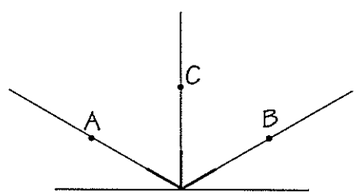


Graph paper layout of angles

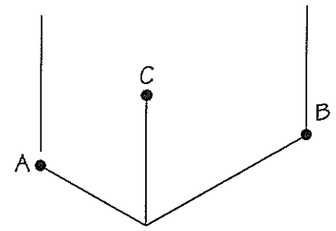


Isometric axis
Tee square / set square

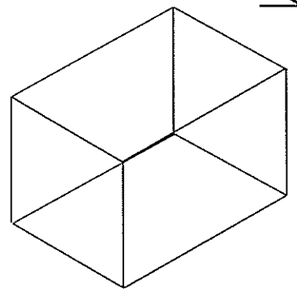
Step 2 Plot the overall length, width and height, in proportion, on the appropriate arms, to locate points A, B and C.



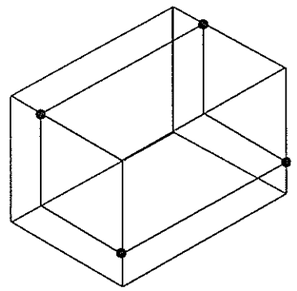
Step 3 Raise the vertical lines from points A and B.



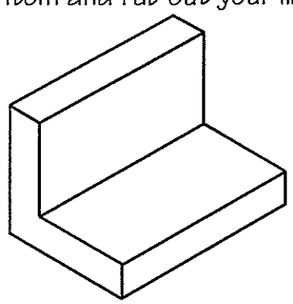
Step 4 Complete the box by projecting from points A, B and C. Make sure that each line is parallel to its corresponding line in the basic 



Step 5 Plot the specific dimensions of the item on the correct faces of the box, then draw a light outline of the item.



Step 6 Darken the outline of the item and rub out your light construction lines.

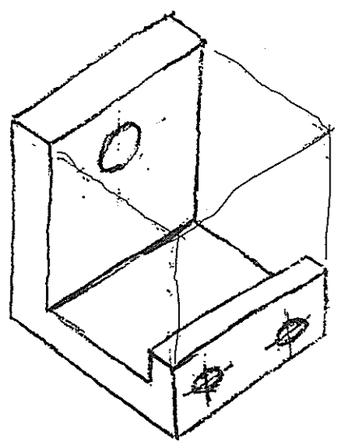


Exercise 5-4 (sketching or instruments)

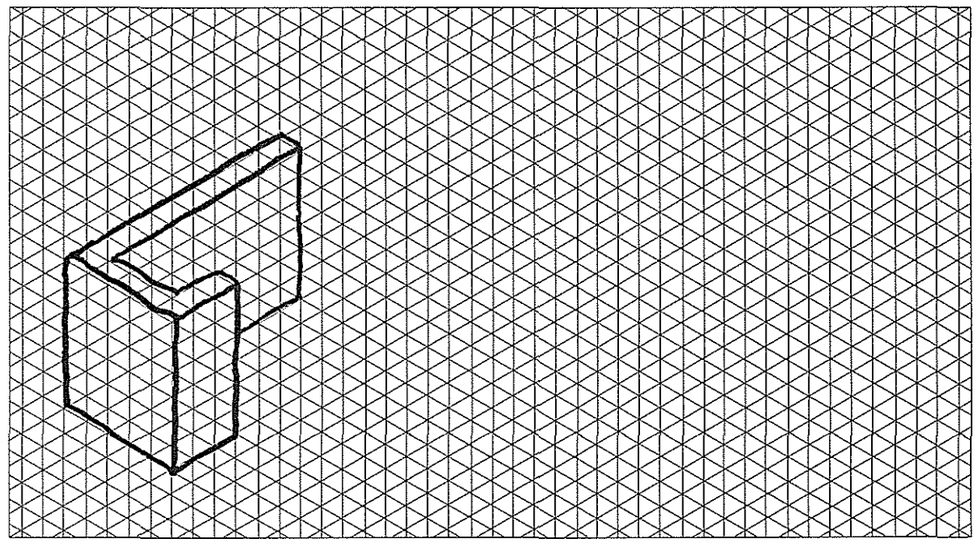
Example freehand isometric pictorial (sketching or formal drawing using instruments)

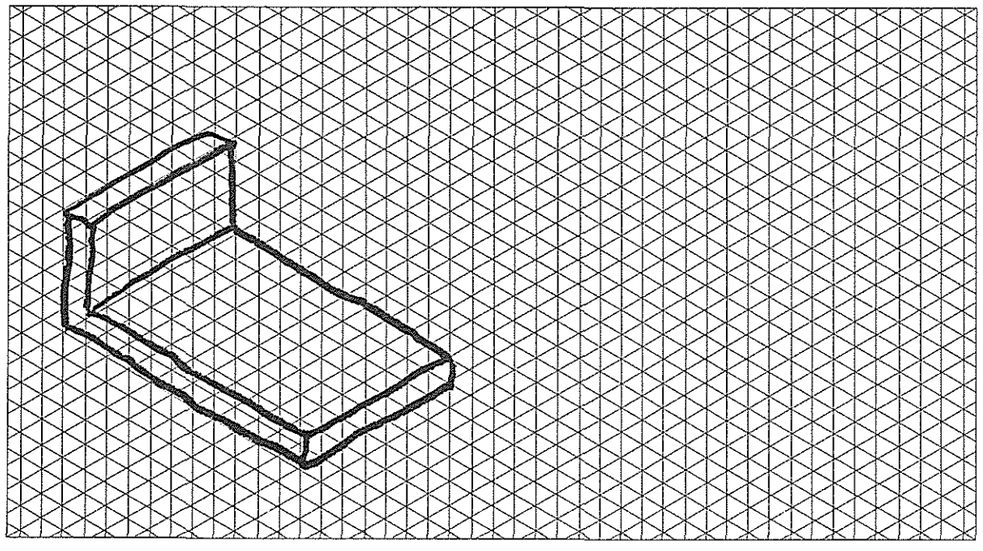
An isometric drawing of a bracket showing the proportions of length, height and width

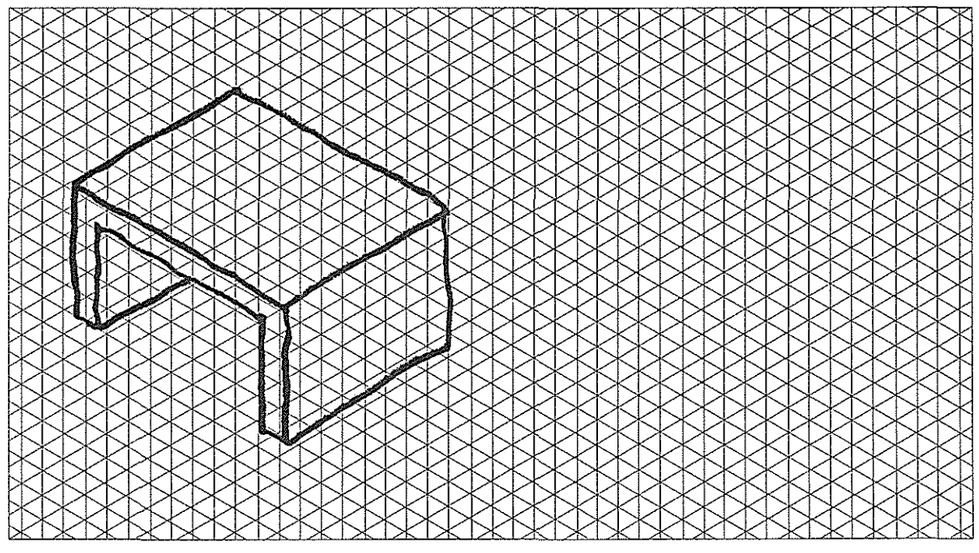
Step 1 Draw your box showing length, width and height.
Step 2 Sketch the outline of the bracket
Step 3 Darken the bracket outline
Step 4 Rub out your box



Study the example shown on the left before you try the sample exercises. When you have done that, study the samples and reproduce the items on the right of the grid in the same length, height and width.



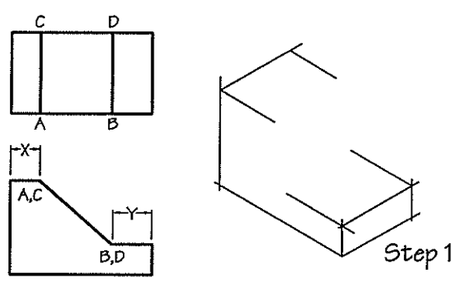


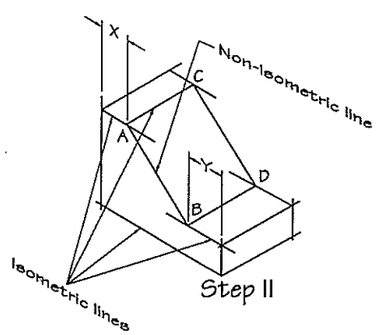


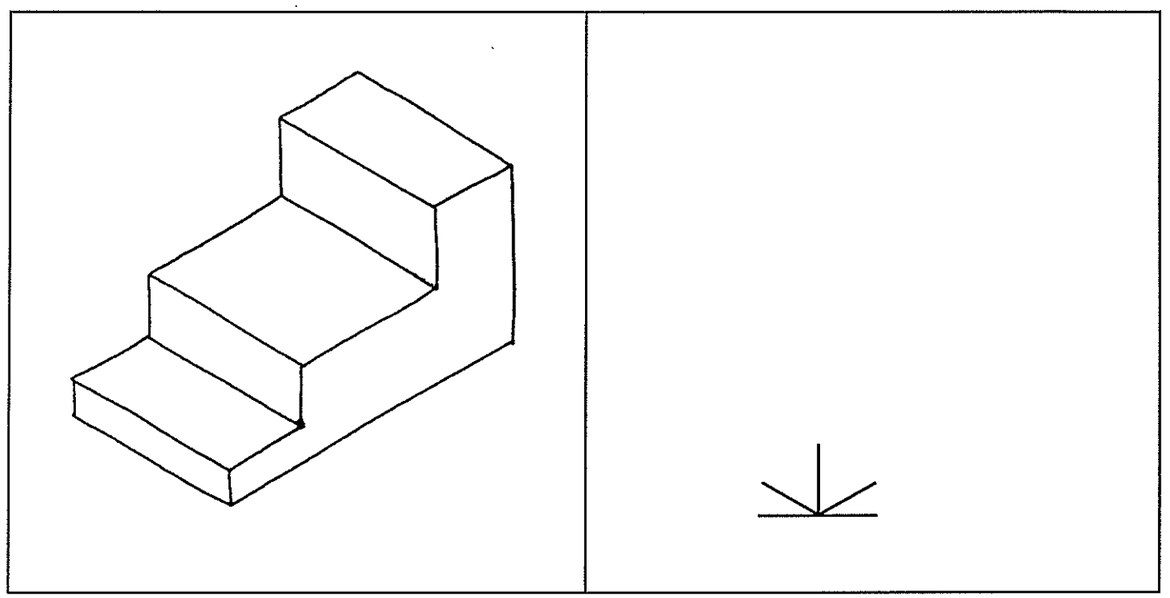
Exercise 5-5 (sketching or instruments)

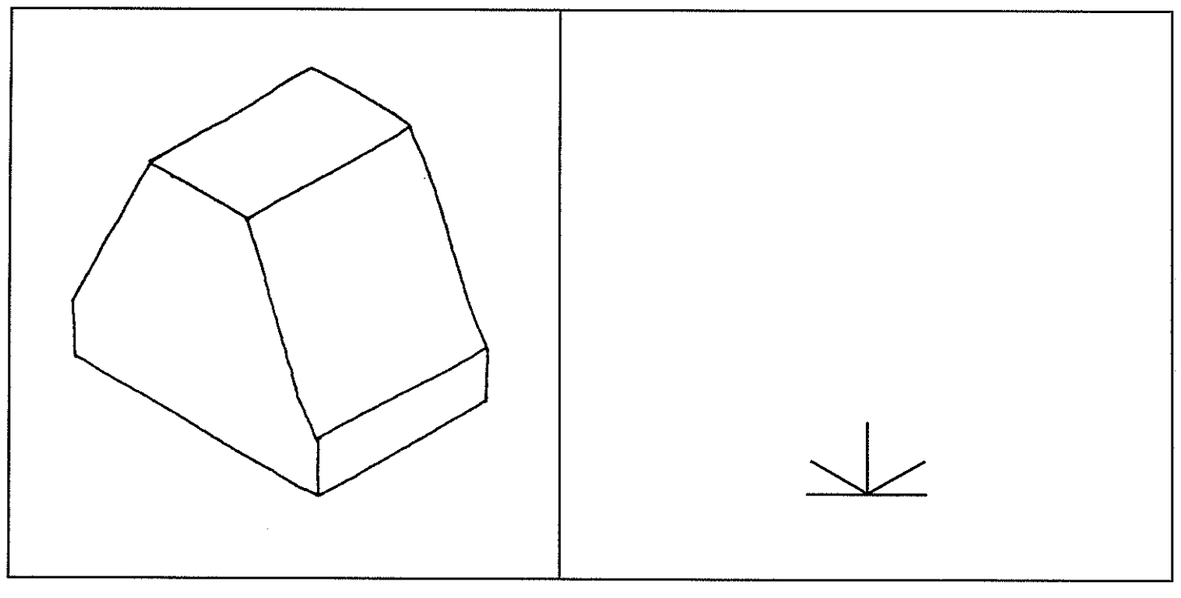
Isometric pictorial

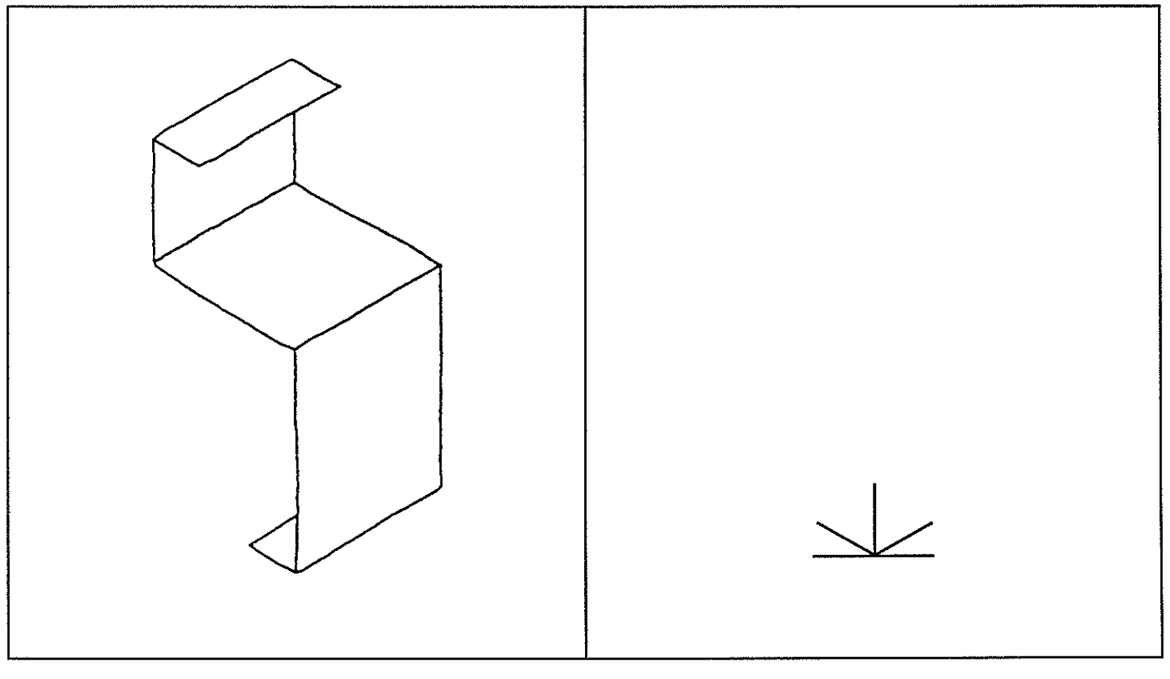
Draw freehand or with instruments, the isometric sketches of the brackets to the same length, width and height proportions in the spaces provided, where the start point has been shown.









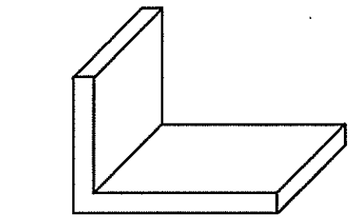


Oblique cabinet drawing (sketching or instruments)

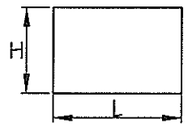
Using the oblique drawing method, it is easier to sketch objects with curved or irregular true shapes, such as cylinders, that are not easily drawn with the isometric method. This is because one face of the drawing will be a true shape of the object and therefore easier to draw, that is a circle. (This only applies for circles on the front faces)

Again you can draw the object inside a box with the same overall dimensions as the object. The length and height of the true shape are in proportion, with the width drawn in half proportion to keep the drawing in perspective.

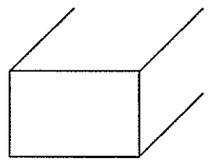
Example: An oblique drawing of an angular bracket.



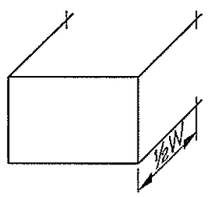
True shape of a section



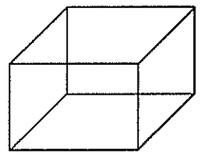
Step 1 Draw a rectangle to the overall length and height of one side of the object to be drawn. We generally choose a side in which the true shape of the object is seen.



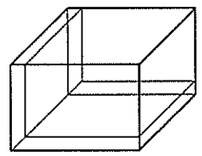
Step 2 From each corner of the rectangle project light lines at 45°. These lines can be either to the left or right depending on how the details will be shown most clearly.



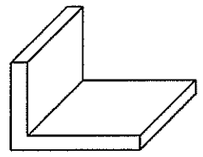
Step 3 On the 45° lines plot half the proportional width of the object.



Step 4 From the four points plotted, complete the box, making sure each line is parallel to its corresponding line in the original rectangle.

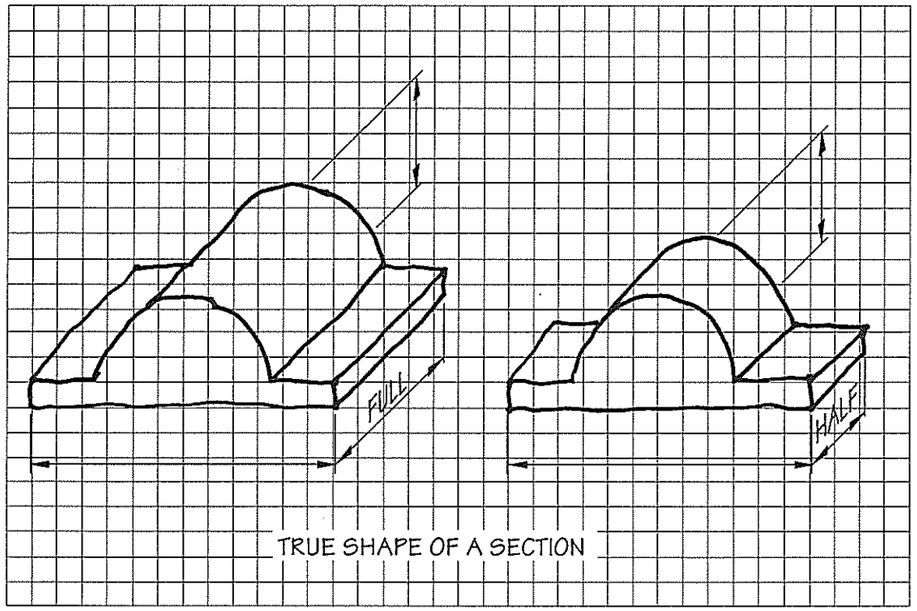


Step 5 Plot the true shape of the object on the correct faces of the box.



Step 6 Darken the outline of the object and remove the light construction lines.

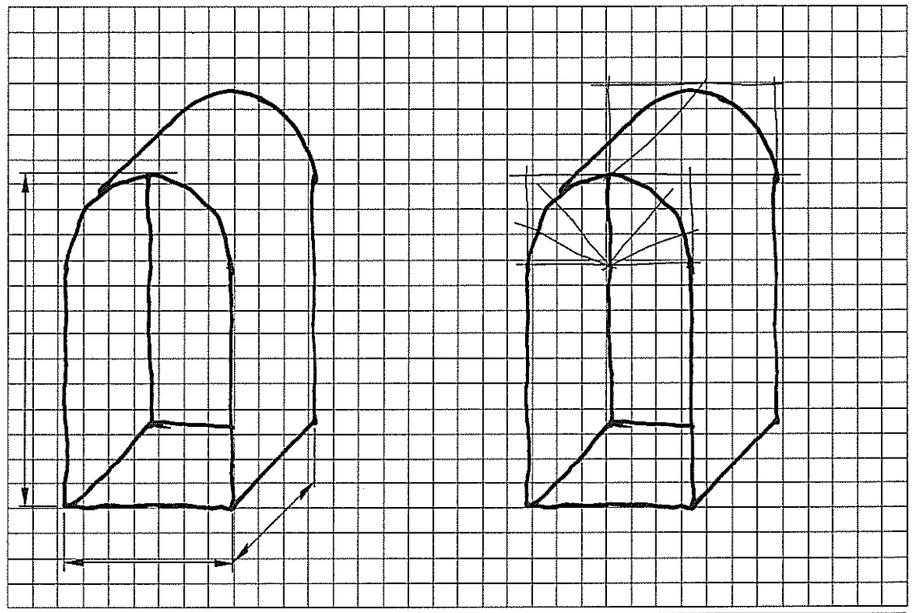
Oblique drawing (sketching or instruments)



The figures above are oblique drawings of a pipe saddle former. The width of the former in the right item is drawn half the true distance, so that you get as little distortion as possible, and so you get better proportion. This is called cabinet oblique drawing.

Remember: All curves are part of a circle.

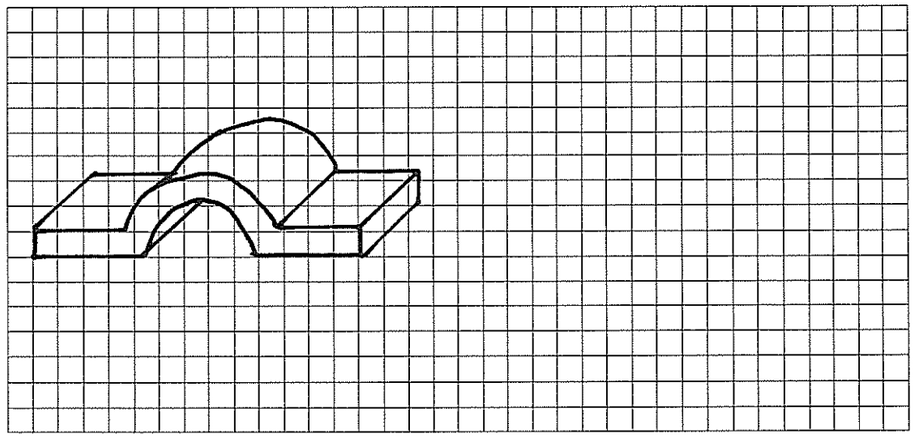
Study all the examples before you attempt exercise 5-6, duplicating the object in length, width and height proportions. (It may be sketched or drawn with instruments)



An oblique view of a guard indicating the proportions of length, height and width.

Construction lines assist in laying out circles in freehand

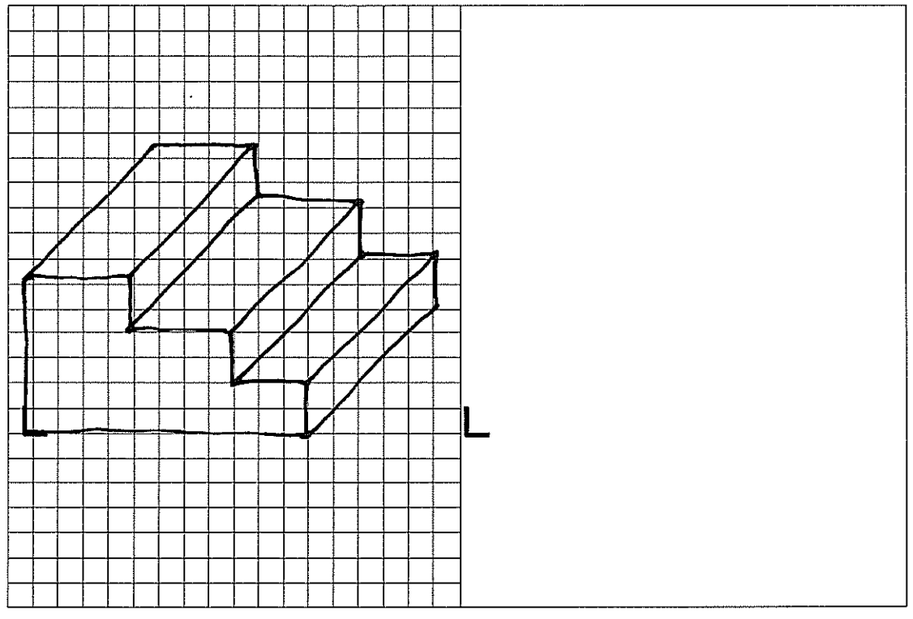
Exercise 5-6
(sketching or instruments)

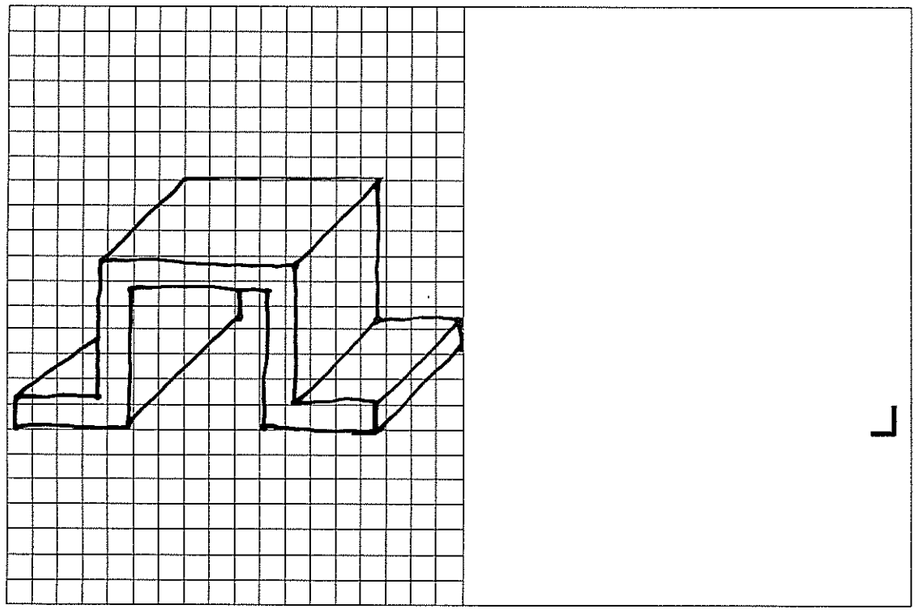


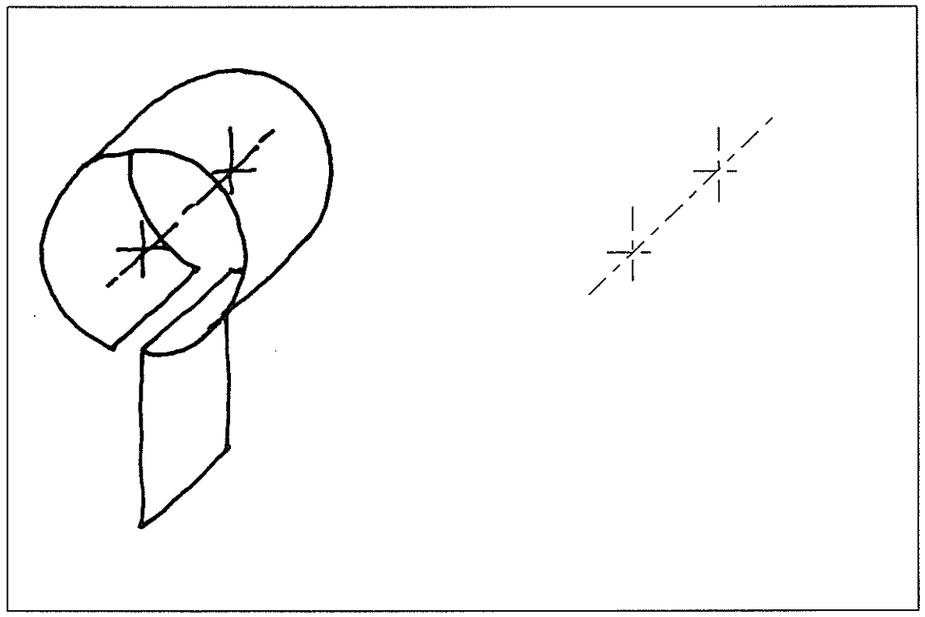
Exercise 5-7 (sketching or instruments)

Oblique drawing

Using the skills you have already learnt, sketch or draw oblique drawings of the brackets on this page to the same length, width and height proportions as shown.



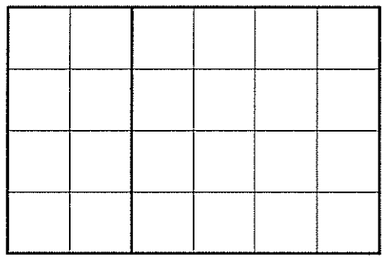


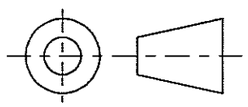


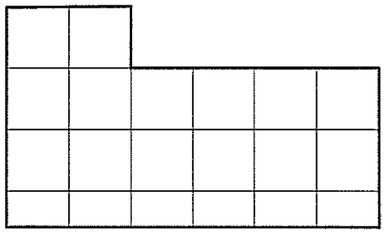
Exercise 5-8 (sketching or instruments)

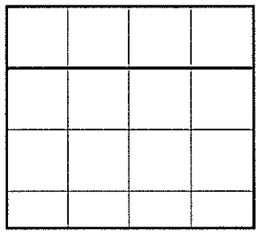
On the right hand side of this sheet, sketch or draw an isometric and oblique drawing of the object below. Draw to full scale.

If necessary ask your teacher to help you visualise the shape from the orthogonal views shown, referring to the relevant explanations in this section of the resource book.







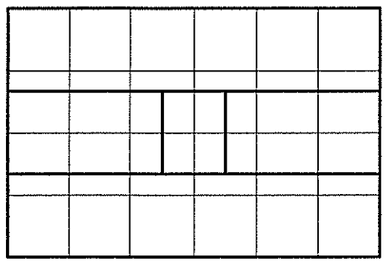


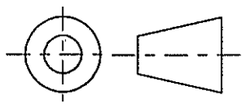
Machined block

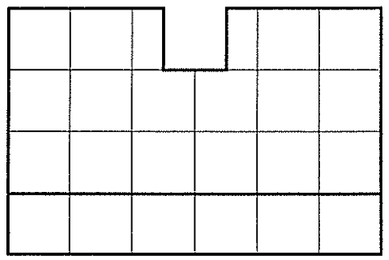
Exercise 5-9 (sketching or instruments)

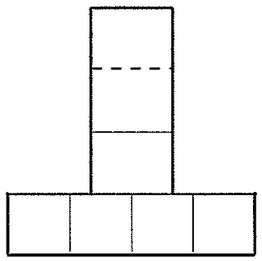
On the right hand side of this sheet, sketch or draw an isometric and oblique drawing of the object below. Draw to full scale.

If necessary ask your teacher to help you visualise the shape from the orthogonal views shown, referring to the relevant explanations in this section of the resource book.







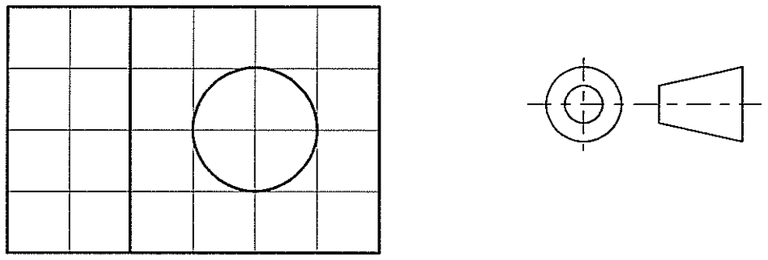


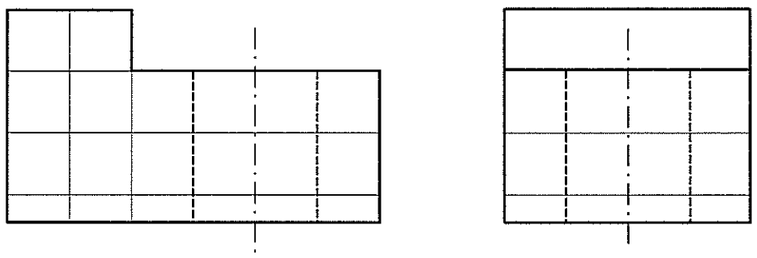
Cast block

Exercise 5-10 (sketching or instruments)

On the right hand side of this sheet, sketch or draw an isometric and oblique drawing of the object below. Draw to full scale.

If necessary ask your teacher to help you visualise the shape from the orthogonal views shown, referring to the relevant explanations in this section of the module.



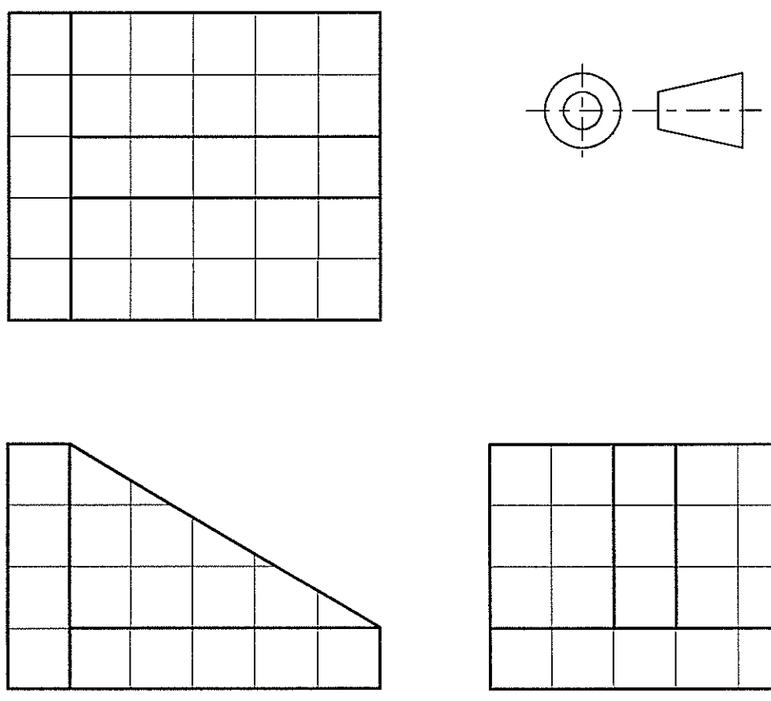


Machined block

Exercise 5-11 (sketching or instruments)

On the right hand side of this sheet, sketch or draw an isometric and oblique drawing of the object below. Draw to full scale.

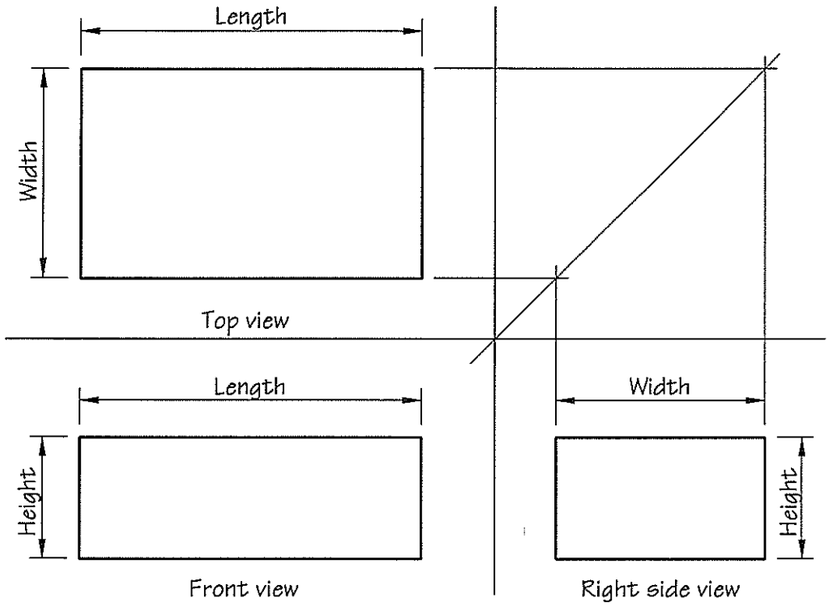
If necessary ask your teacher to help you visualise the shape from the orthogonal views shown, referring to the relevant explanations in this section of the resource book.

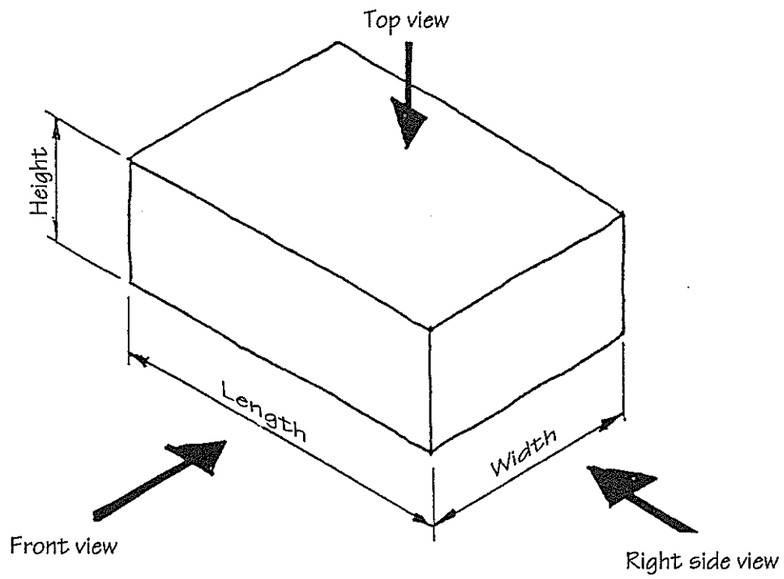


Fabricated block

Multi-view to pictorial sketch or drawing

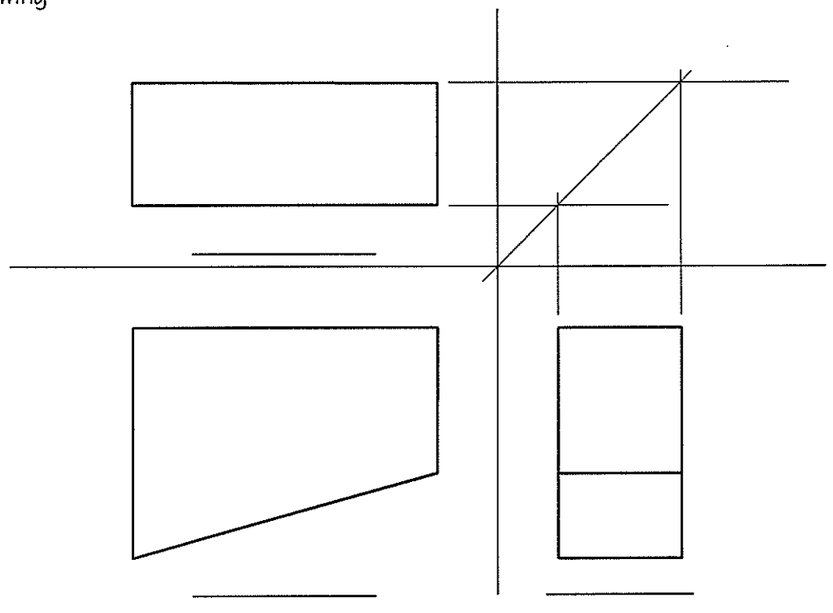
Note: use isometric techniques





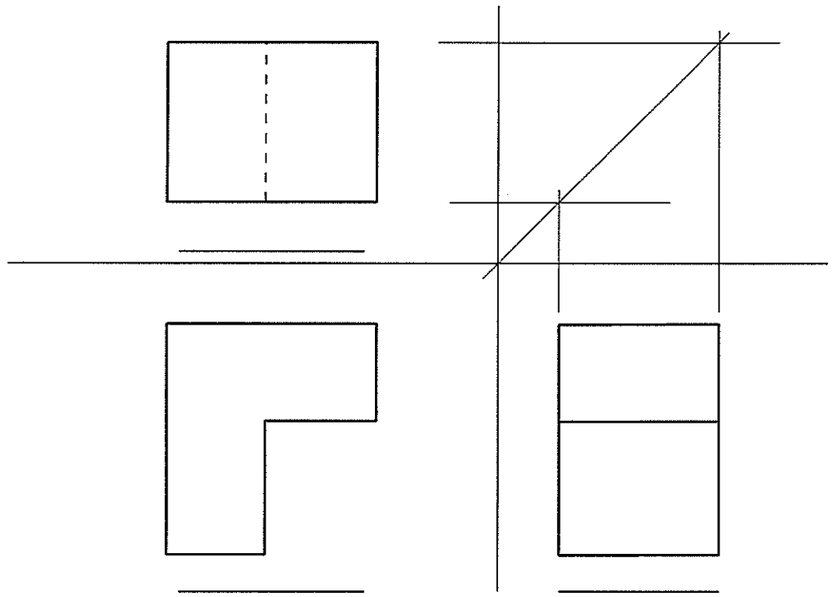
Exercise 5-12 (sketching or instruments)

- Name the views in the spaces provided
- Draw or sketch an isometric drawing of the article to similar proportions as the views
- Draw arrows and title them to show viewing directions, similar to the sample isometric drawing

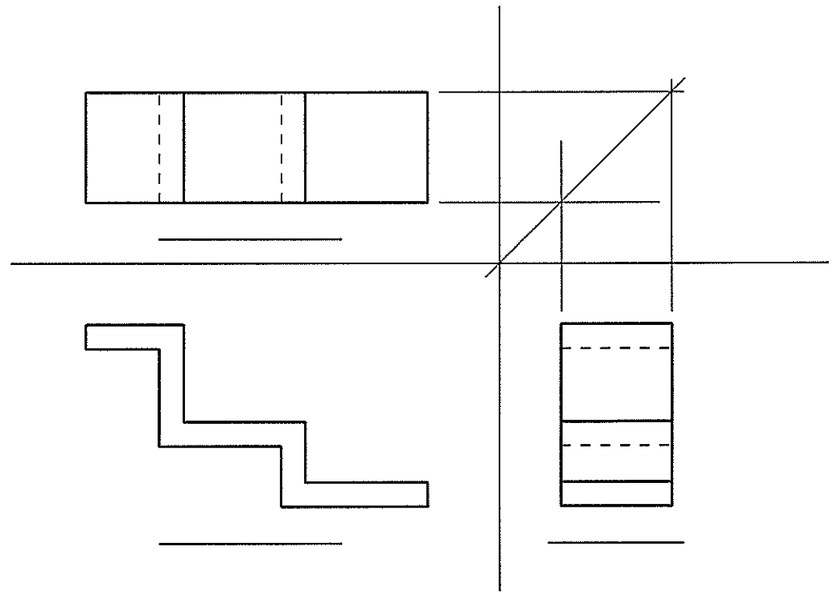


Exercise 5-13 (sketching or instruments)

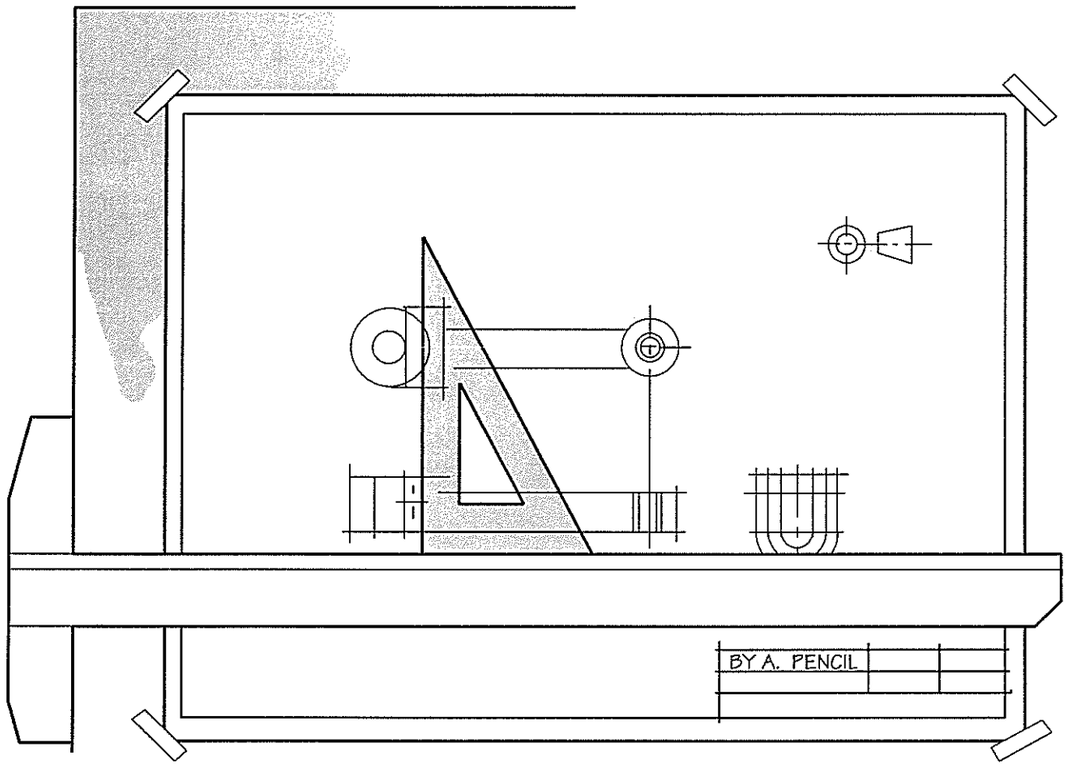
- Name the views in the spaces provided
- Draw or sketch an isometric drawing of the article to similar proportions as the views
- Draw arrows and title them to show viewing directions, similar to the sample isometric drawing



- Name the views in the spaces provided
- Draw or sketch a cabinet oblique drawing of the folded article to similar proportions as the views shown (use ½ the width for 45° line)
- Draw arrows and title them to show viewing directions



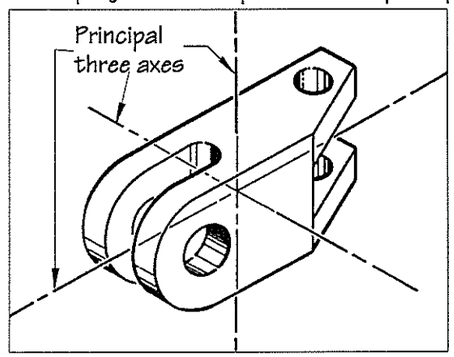
Orthogonal projection



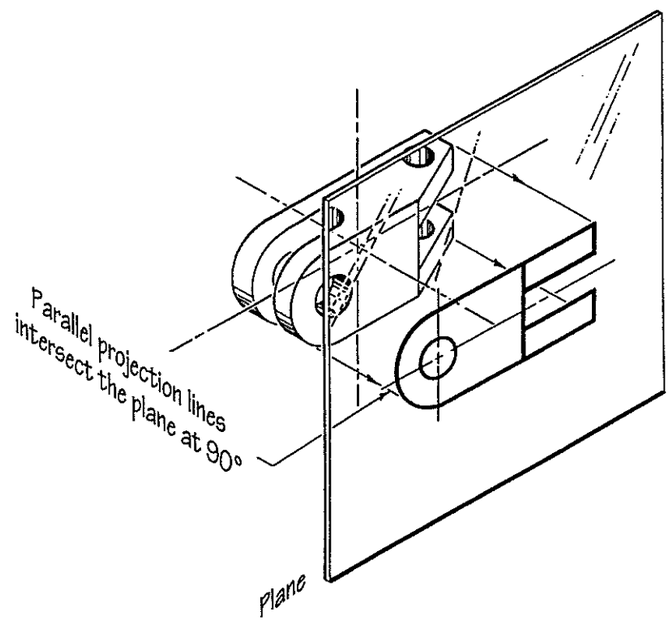
Three principal axes are shown here as part of a pictorial description. These are simply used to aid identification of the object's orientation or relation to other bodies such as planes.

Therefore, orthogonal projection occurs when:

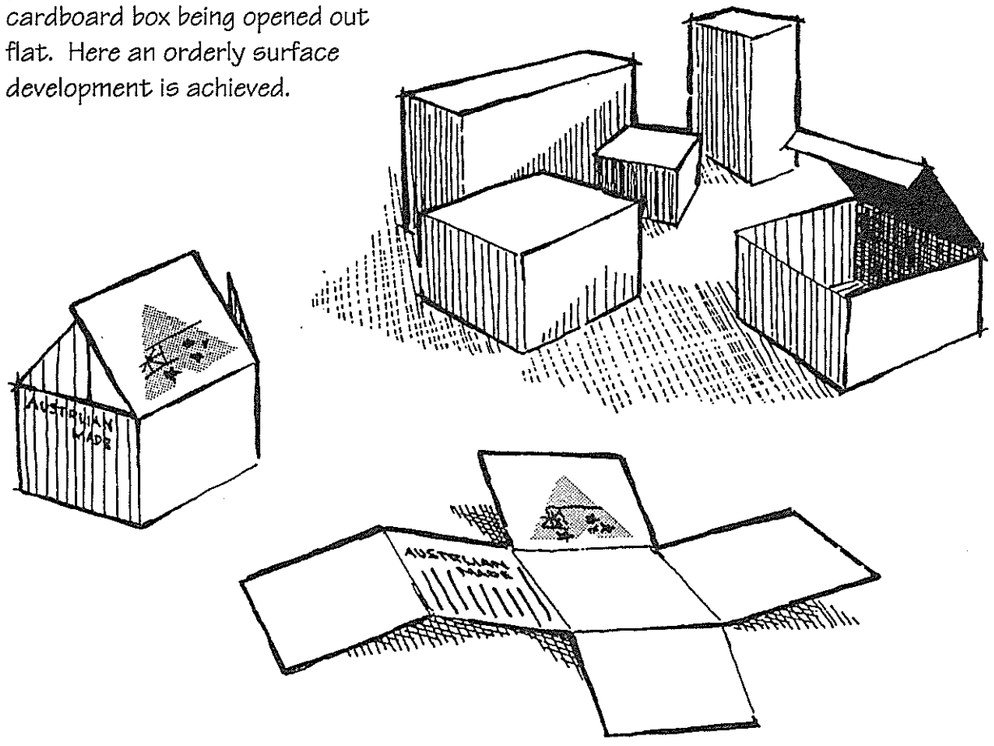
- A plane is positioned perpendicular (at 90°) to a principal axis,
- The lines of projection are parallel to each other,
- The lines of projection are parallel to a principal axis.



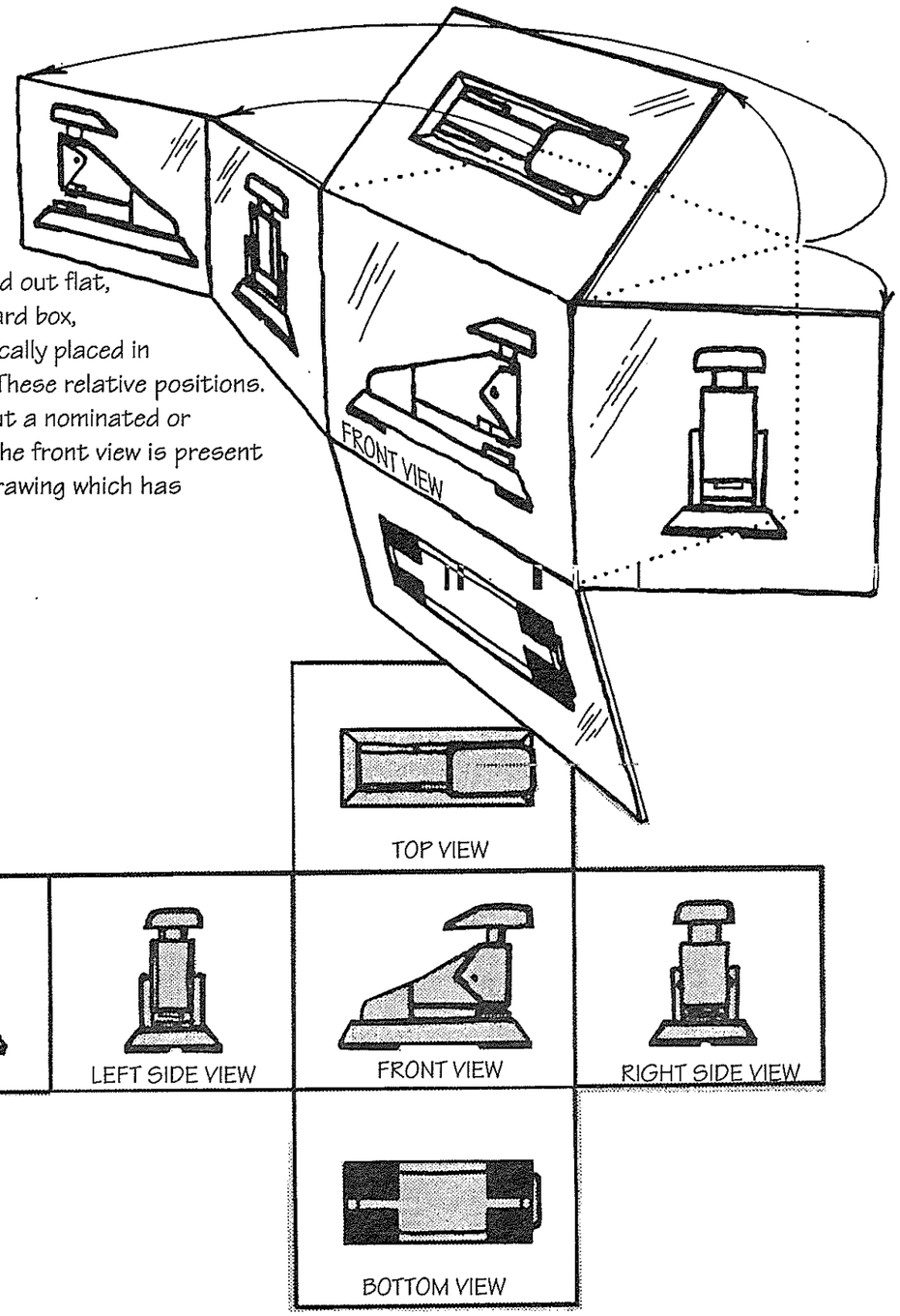
A plane (a surface on which the image is projected) is positioned perpendicular (at 90°) to one of these principal axes and parallel to the other two. An image of the object's surface is then transferred to the plane by parallel projection lines. The image produced is a true shape of what your eye sees.



A view of each surface may be required. In this case, their position will be similar to a cardboard box being opened out flat. Here an orderly surface development is achieved.

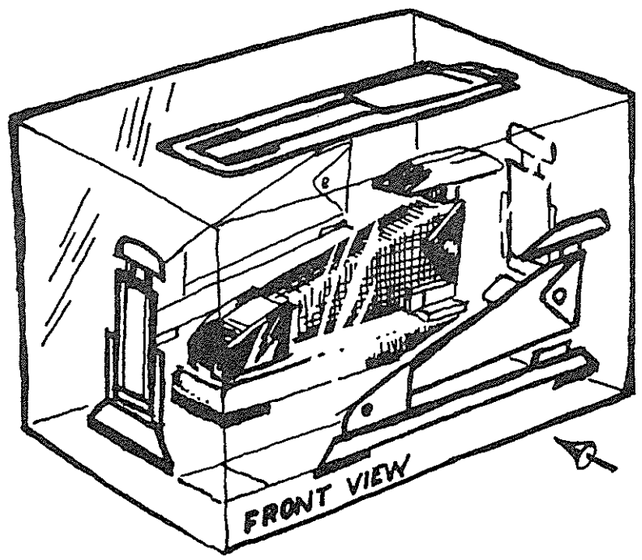


When the box is opened out flat, similar to our cardboard box, each view is automatically placed in its relative position. These relative positions. remain constant about a nominated or selected front view. The front view is present in every orthogonal drawing which has more than one view.



Layout of views in Third Angle Projection

An object can be arranged inside an imaginary transparent box so that its principal axes are perpendicular (at 90°) to each side or plane on the box. By orthogonal projection an image of each surface can be transferred to the six planes in turn.

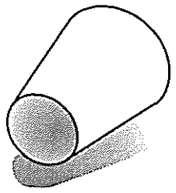


Angle of projection

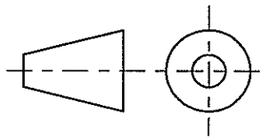
The two methods of orthogonal projection are THIRD ANGLE and FIRST ANGLE.

As orthogonal drawings can be produced in two angles of projection, identification of the drawing becomes necessary.

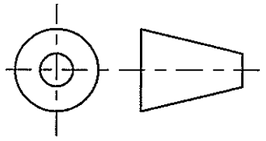
A symbol is used to identify the angle of projection based on a simple frustum of a cone.



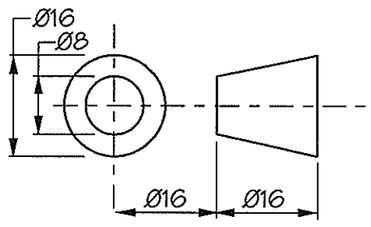
First angle projection symbol

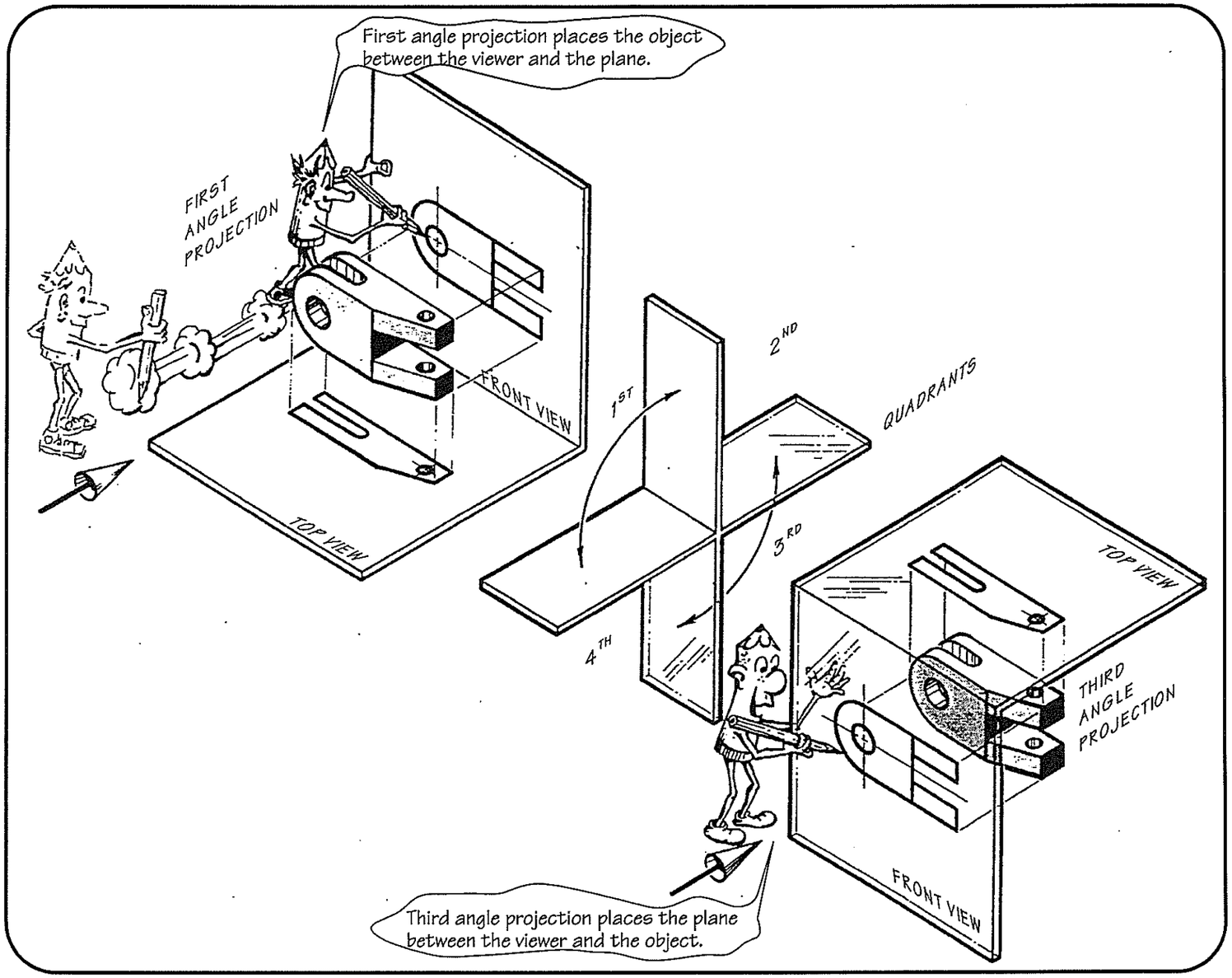


Third angle projection symbol



To obtain suitable proportions it is recommended the symbol be drawn to these dimensions. (This is not compulsory)

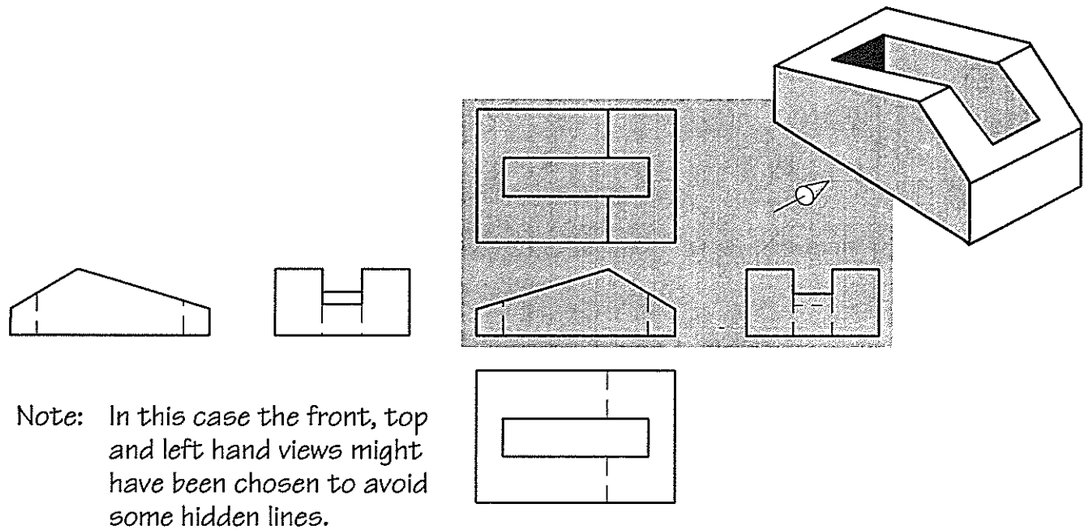




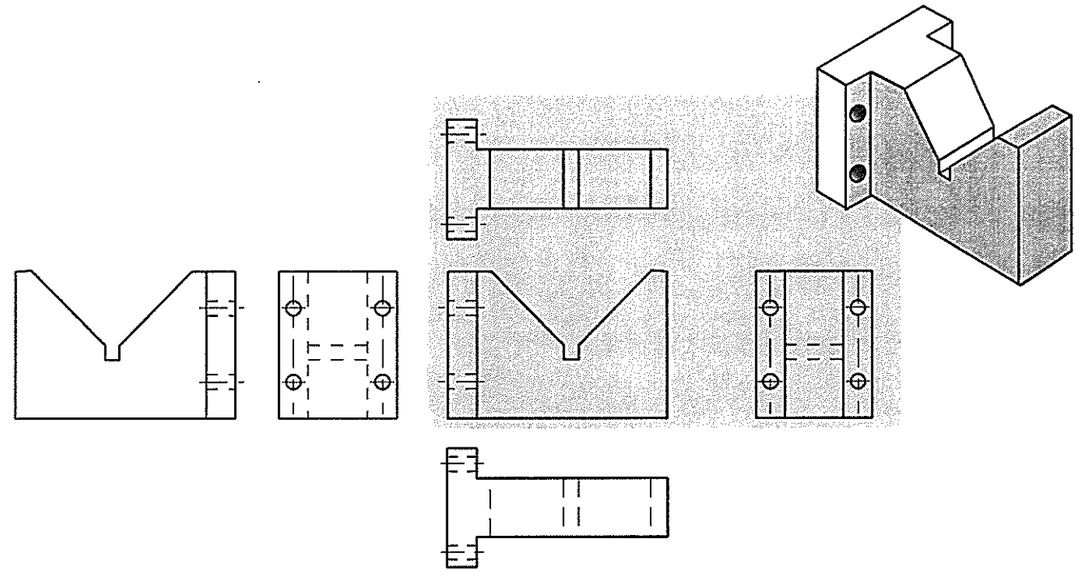
The Standards Association of Australia currently recommends the use of THIRD ANGLE PROJECTION in the production of multiview drawings. This projection offers a convenient layout of views. That is, view represents the near side of the object in the adjacent view.

Views to be drawn

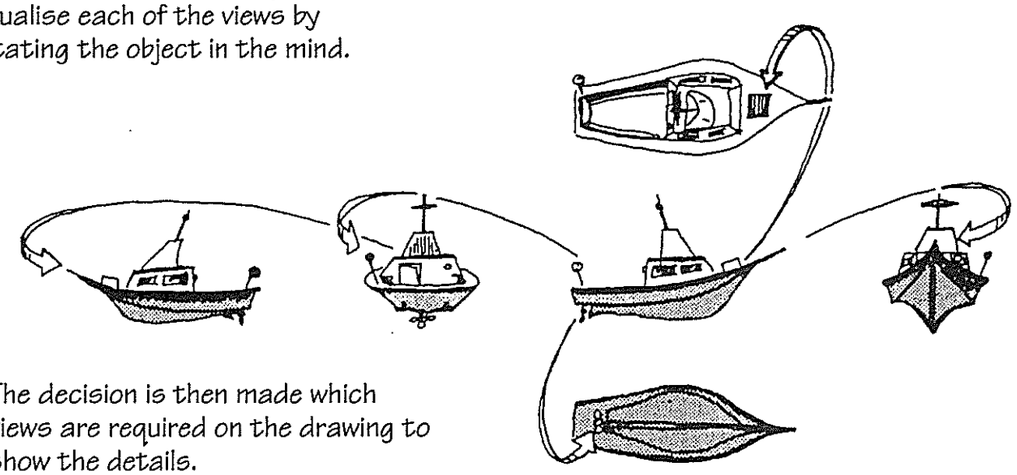
The most common views drawn are the FRONT VIEW, TOP VIEW and RIGHT SIDE VIEW. These are referred to as the three regular views. Choose any of the six possible views to show information that would otherwise be hidden.



Note: In this case the front, top and left hand views might have been chosen to avoid some hidden lines.



What is needed is to imagine or visualise each of the views by rotating the object in the mind.



The decision is then made which views are required on the drawing to show the details.

Note: Each view is given a special name.

Rule for third angle projection (reference to the drawing below).

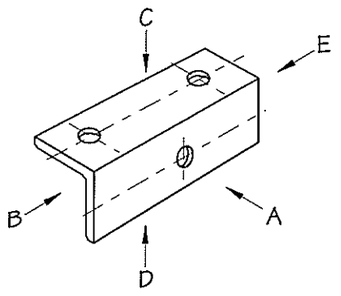
1 A view from the left of the front view is drawn on the left (left end view B).

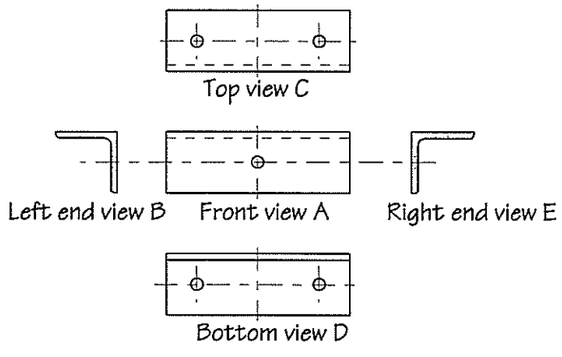
2 A view from the right of the front view is drawn on the right (right end view E).

3 A view from the top of the front view is drawn on the top (top view C).

4 A view from the underside of the front view is drawn on the underside (bottom view D).

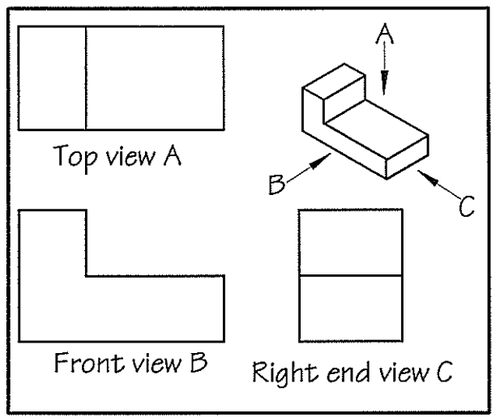
Note: Since this is a simple object, only three views are necessary to show its size and shape (views A, B, and C or A, E and C).

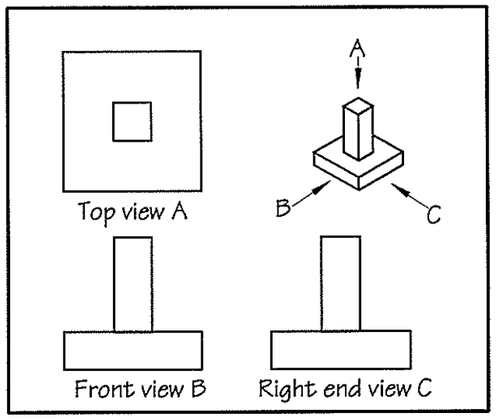


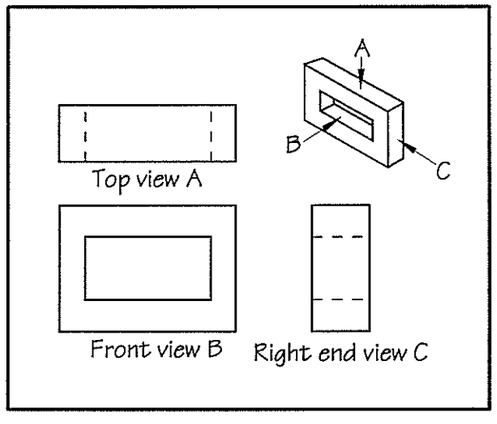


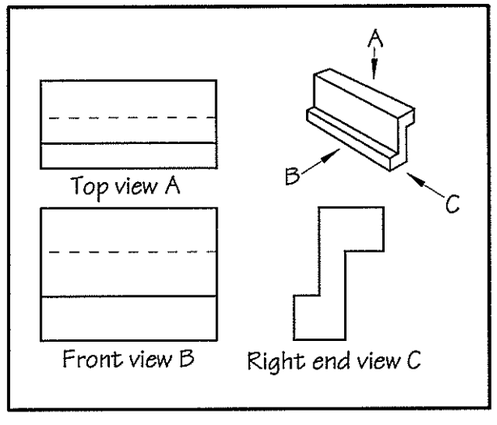
Practical examples

Drawn below are four (4) items showing the application of third angle projection. Without all the views shown, the correct interpretation of shape and size would not be possible.



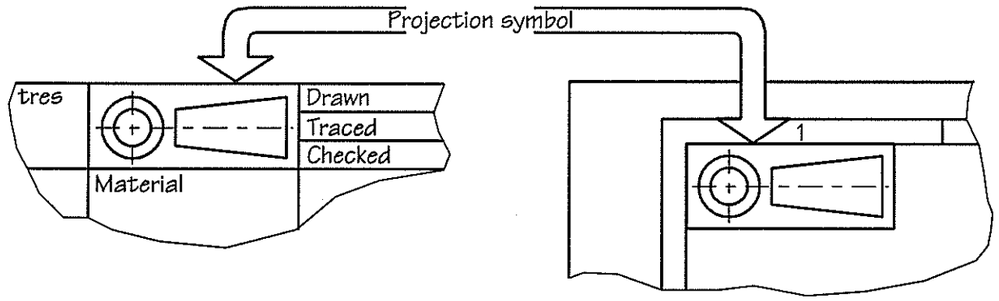




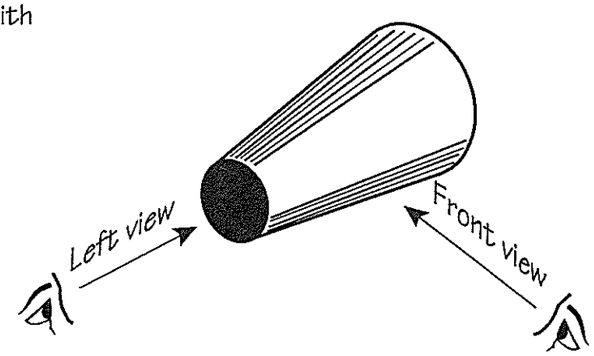


Projection symbol

All drawings that follow the AS 1100 standards must show which projection system they use, but instead of writing the whole name we use a symbol. It goes either in the title block at the top or bottom of the sheet with the other details, or inside the grid lines, wherever it can be seen easily.

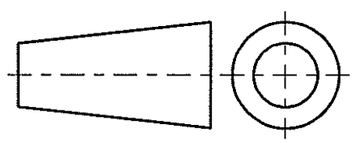


The project symbol is a third view orthogonal drawing of a solid cone with the point cut off.



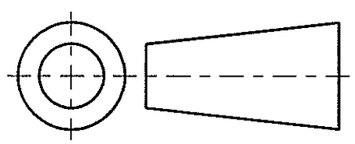
First angle projection symbol

Left view is drawn to the right of the front view



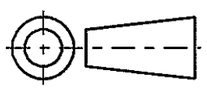
Third angle projection symbol

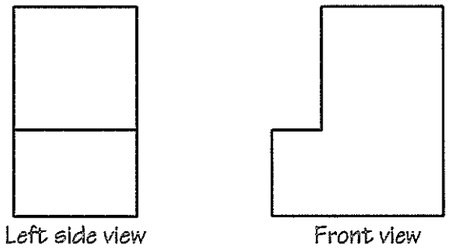
Left view is drawn to the left of the front view



Exercise 5-14

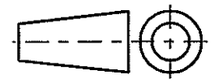
Example

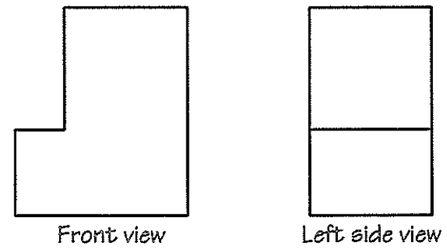




Third angle projection

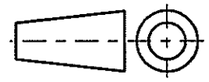
Example





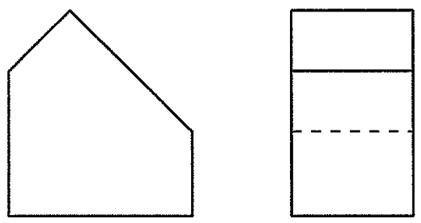
First angle projection

What projection system is used here?

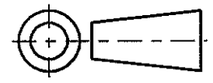


_____ angle projection

Label the side view left or right

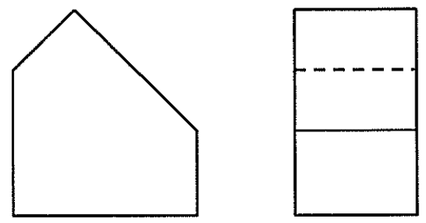


What projection system is used here?

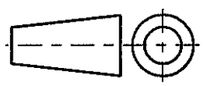


_____ angle projection

Label the side view left or right

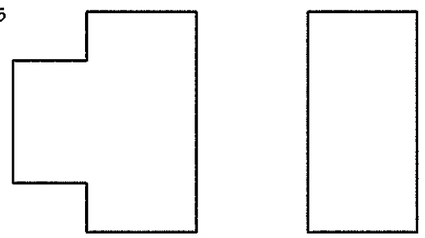


What projection system is used here?

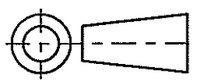


_____ angle projection

Draw the missing lines and label the views

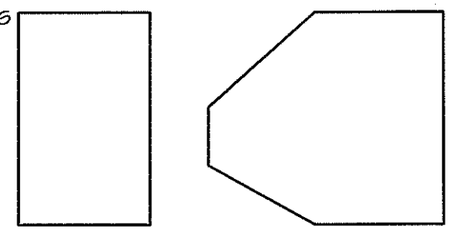


What projection system is used here?



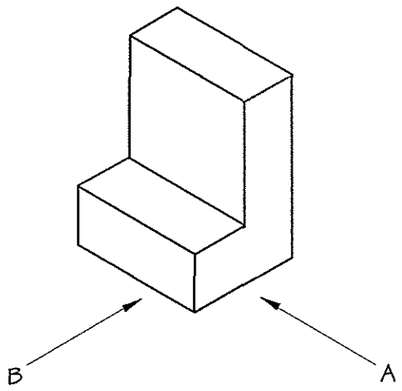
_____ angle projection

Draw the missing lines and label the views



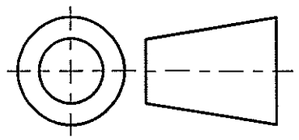
Exercise 5-15

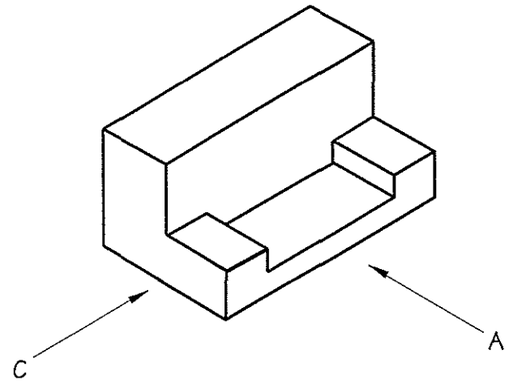
Select the correct views



1. Which view below is from direction

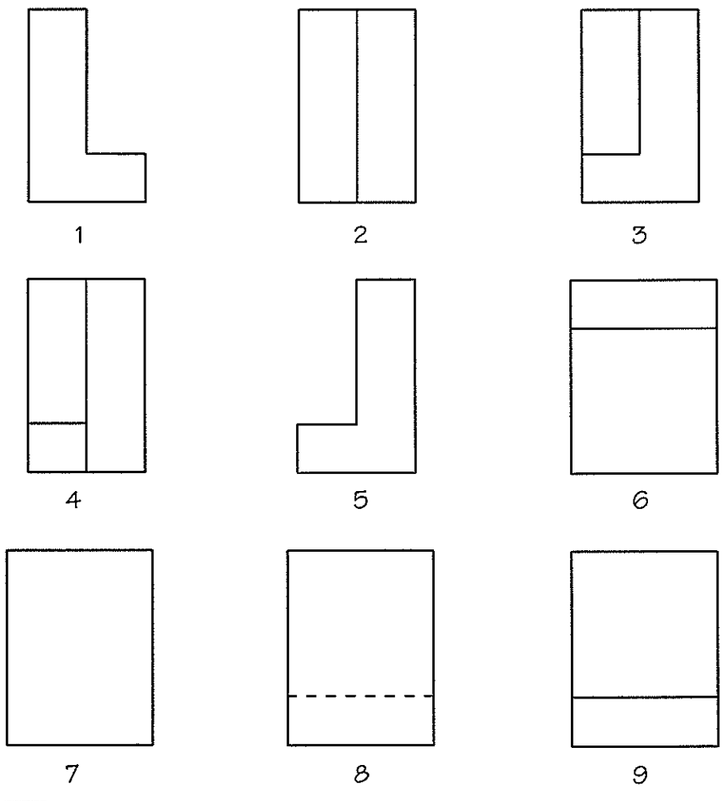
A	
B	

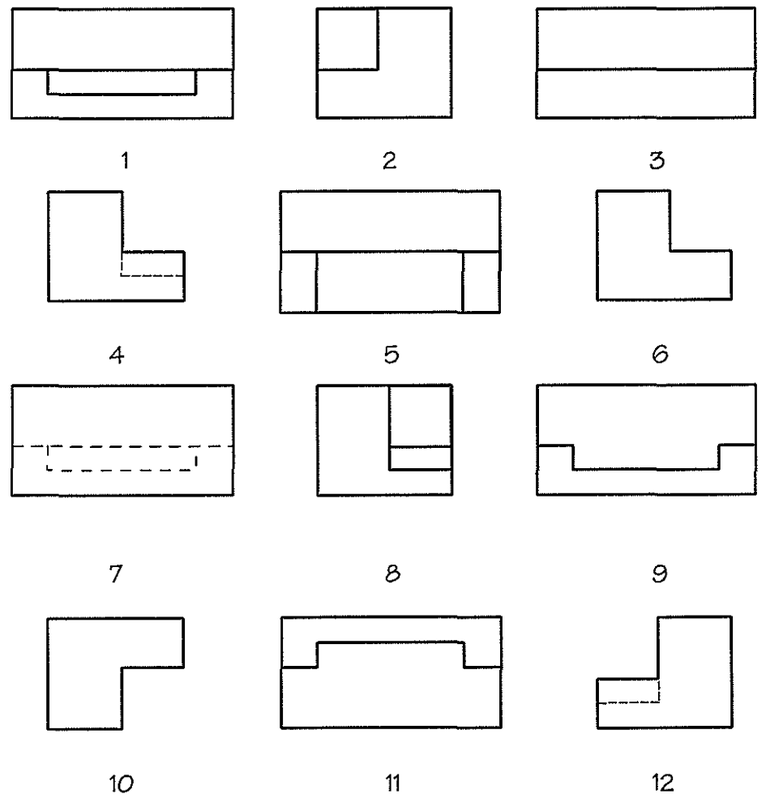


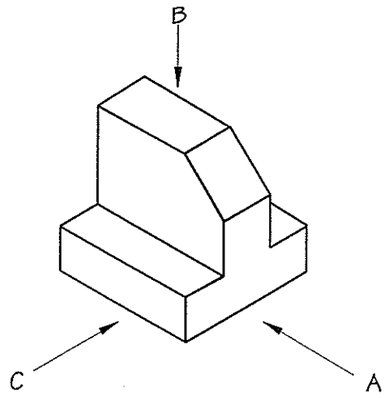


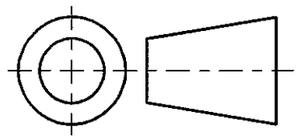
2. Which view below is from direction

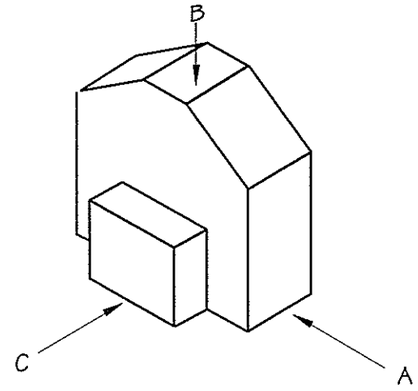
A	
C	





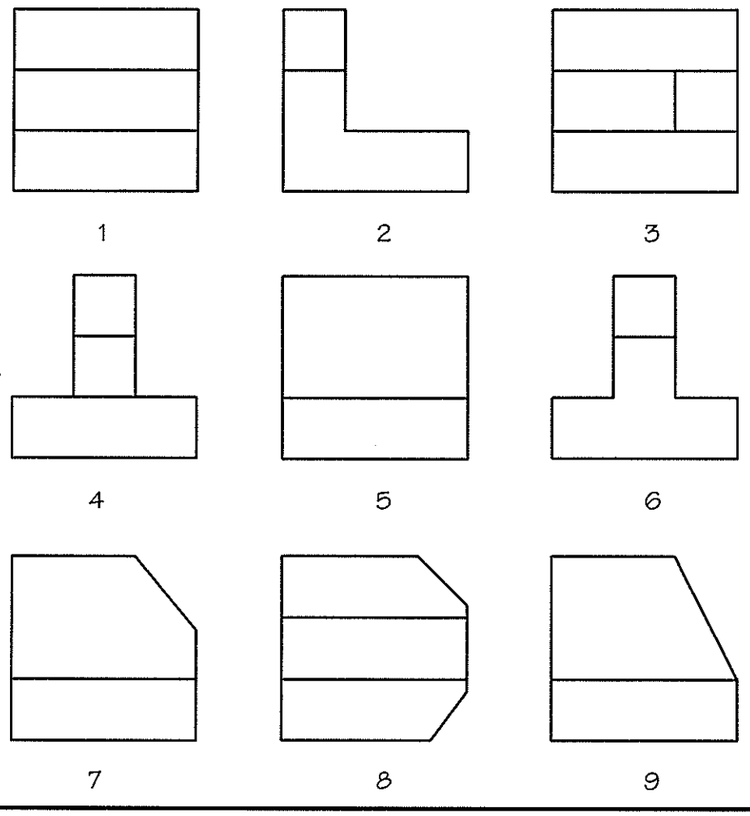






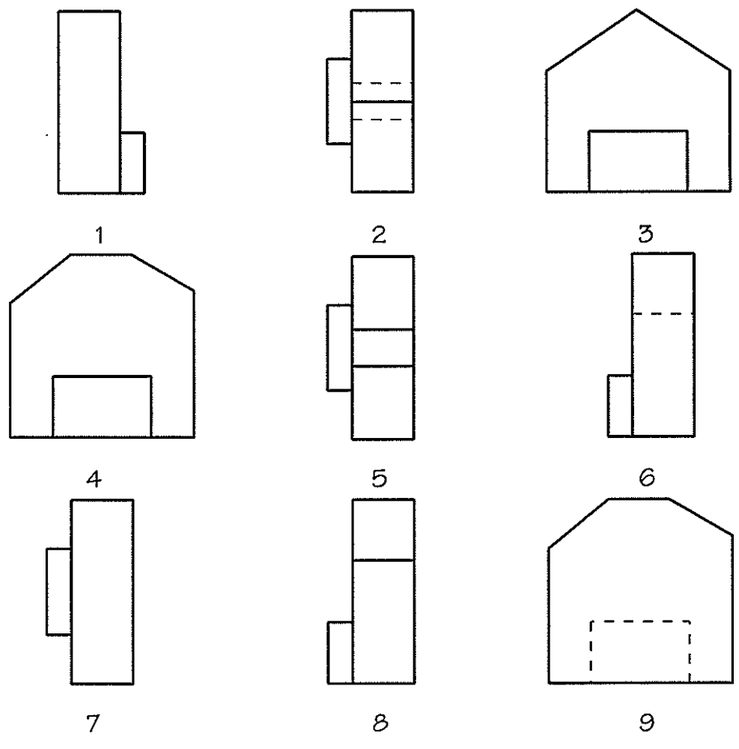
3. Which view below is from direction

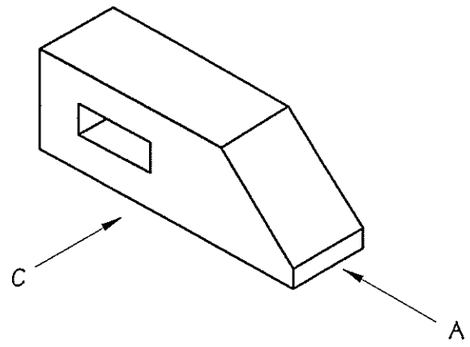
A	
B	
C	

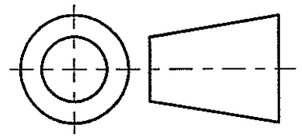


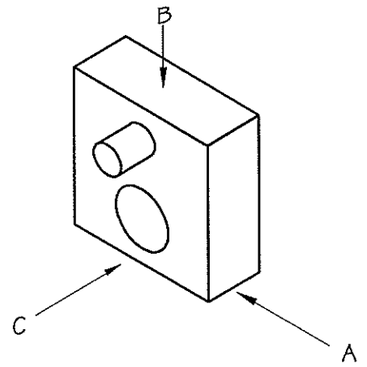
4. Which view below is from direction

A	
B	
C	







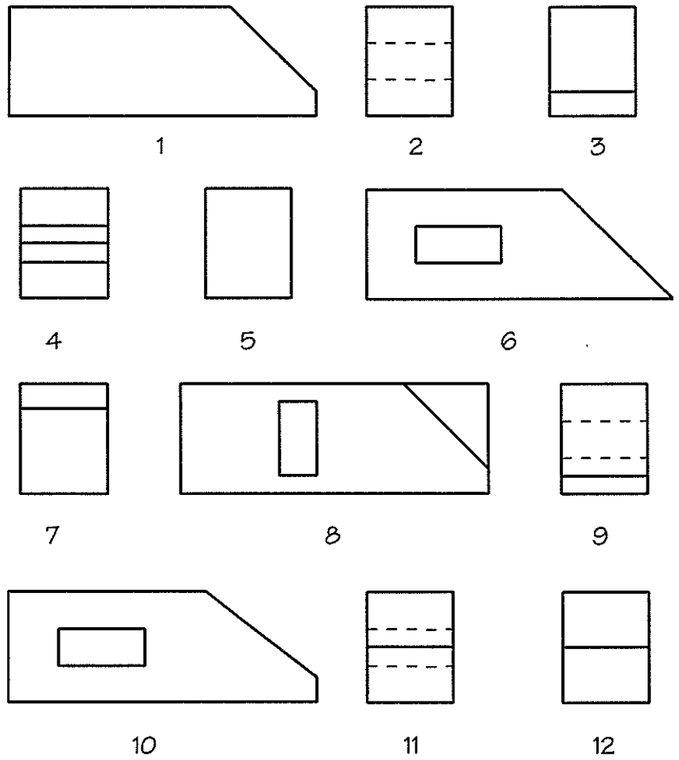


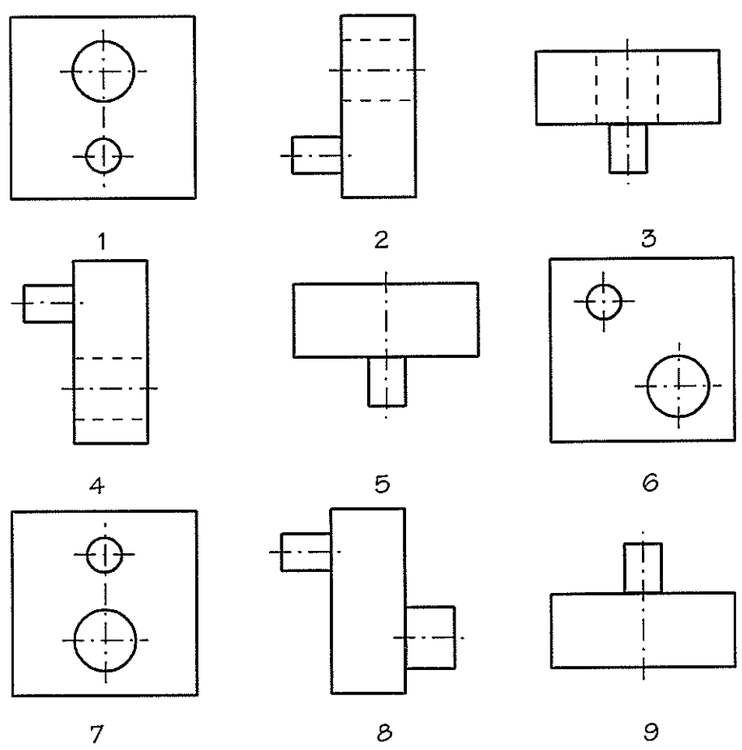
2. Which view below is from direction

A	
C	

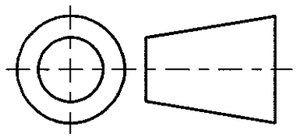
4. Which view below is from direction

A	
B	
C	



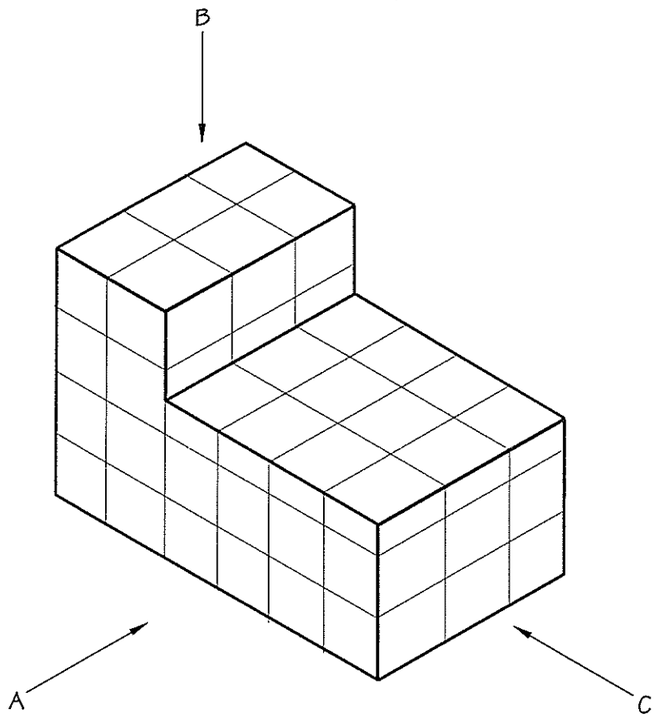


Exercise 5-16 (Sketching or instruments)



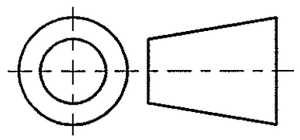
Orthogonal projection practice

IN the next three exercises, produce a third angle orthogonal sketch or drawing of the following component. There are to be three views; a front view looking in the direction of arrow A, a top view looking in the direction of arrow B and a right side view looking in the direction of arrow C.



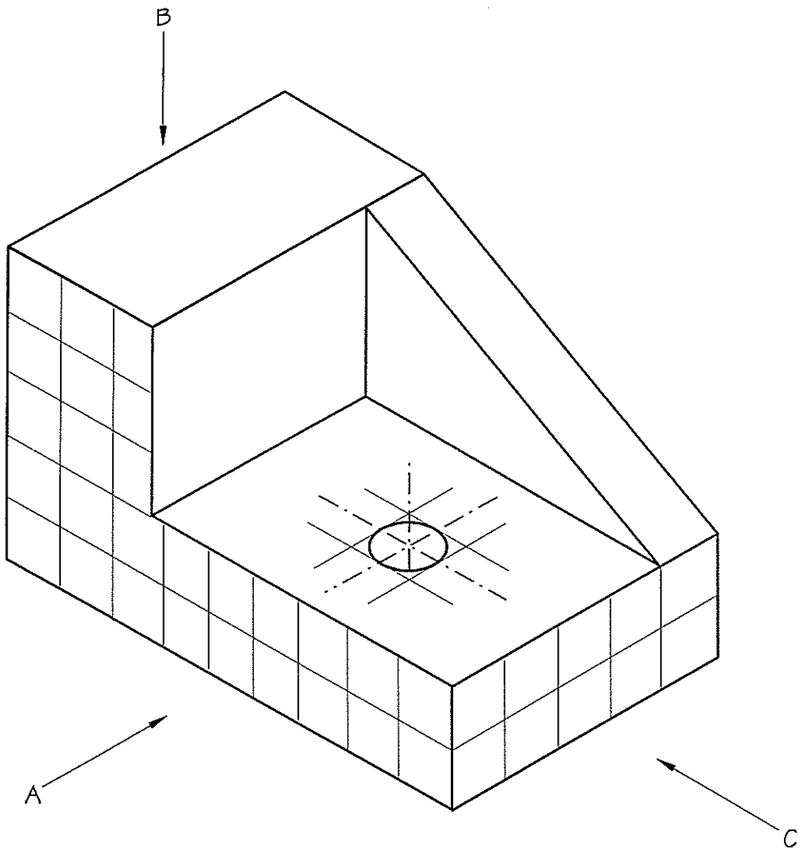
Machined block

Exercise 5-16 (Sketching or instruments)



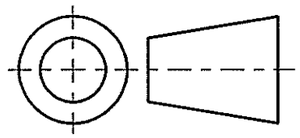
Orthogonal projection practice

Produce a third angle orthogonal sketch or drawing of the following component. There are to be three views; a front view looking in the direction of arrow A, a top view looking in the direction of arrow B and a right side view looking in the direction of arrow C.



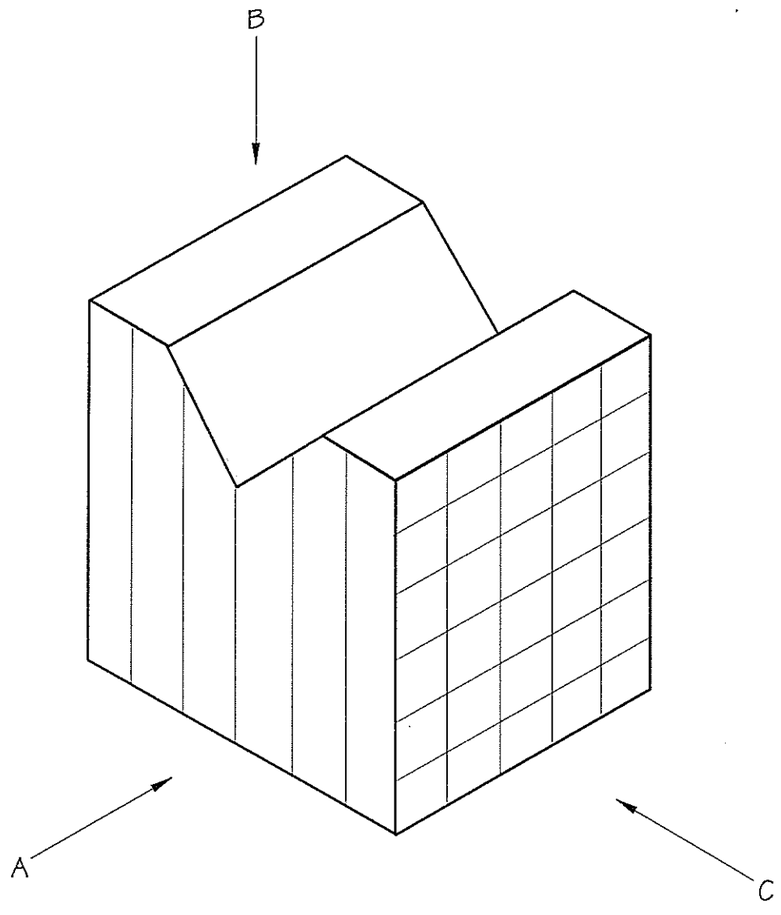
Cast block

Exercise 5-16 (Sketching or instruments)



Orthogonal projection practice

Produce a third angle orthogonal sketch or drawing of the following component. There are to be three views; a front view looking in the direction of arrow A, a top view looking in the direction of arrow B and a right side view looking in the direction of arrow C.



Machined block