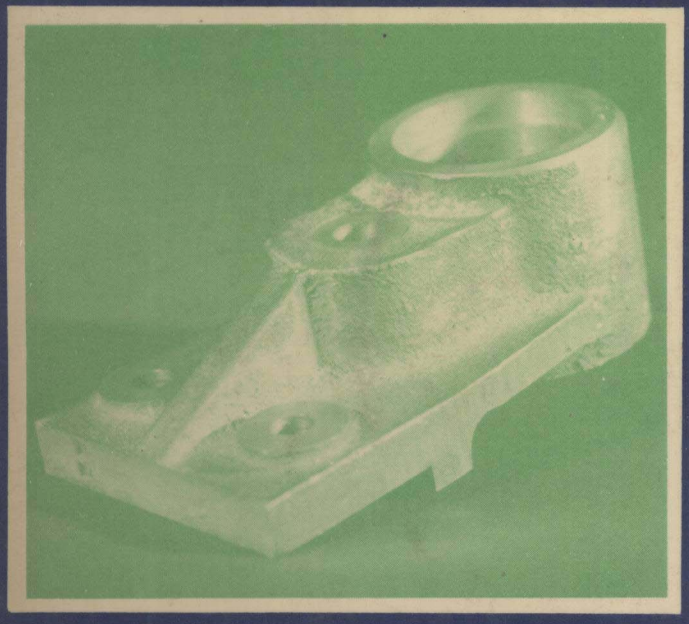
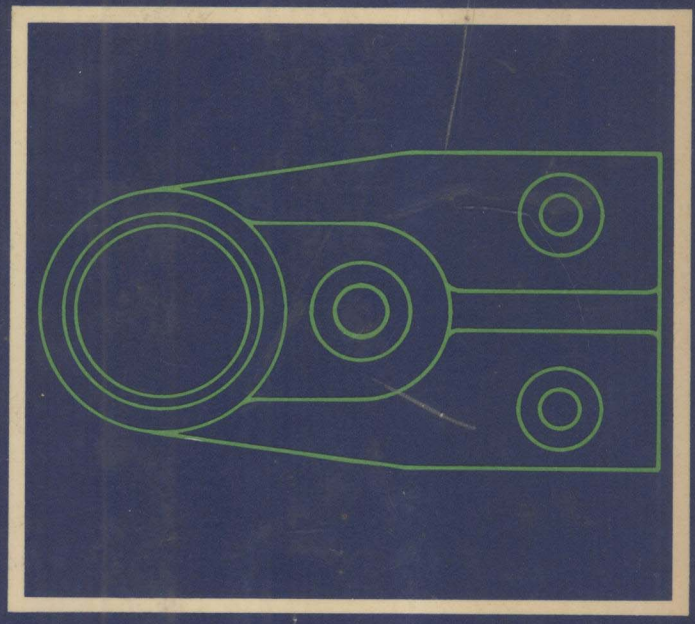
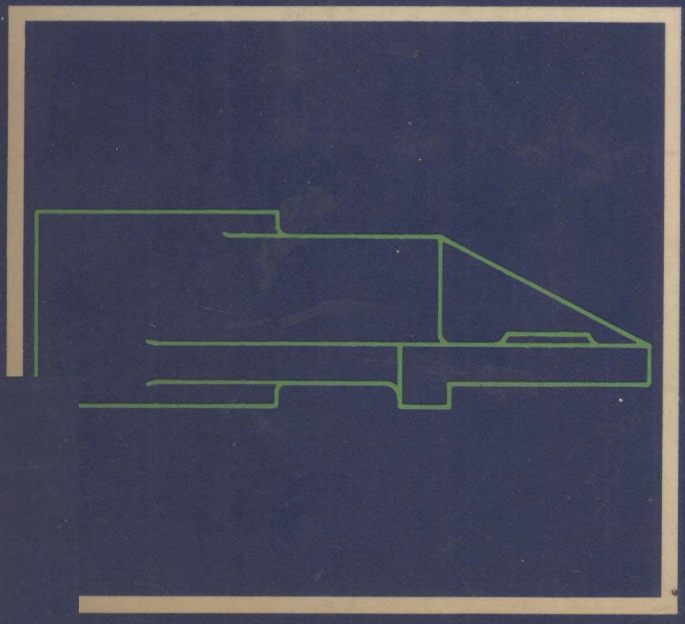
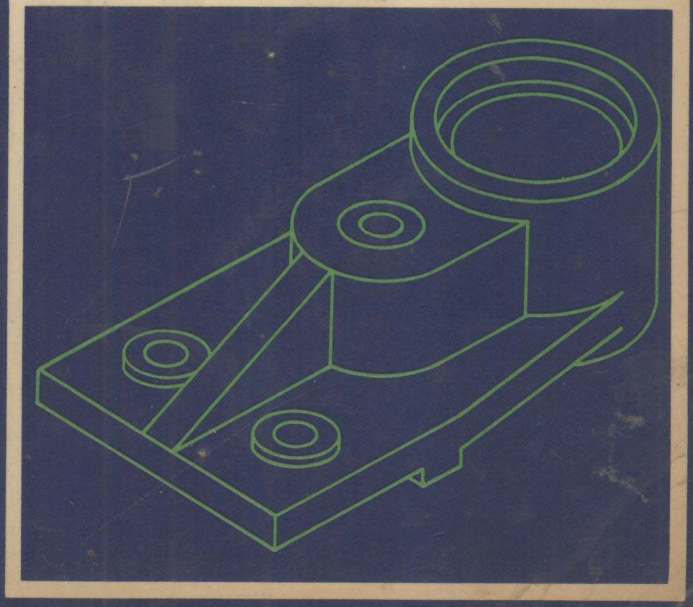
BASIC ENGINEERING DRAWING

R S Rhodes & L B Cook









BASIC ENGINEERING DRAWING

R S RHODES

M Weld I
Lecturer responsible for Engineering Drawing
Stafford College of Further Education

L B COOK

BA, AMIED, Cert.Ed.
Lecturer in Engineering Drawing
Stafford College of Further Education

Pitman Publishing

First published 1975

SIR ISAAC PITMAN AND SONS LTD.
Pitman House, Parker Street, Kingsway, London, WC2B 5PB
P.O. Box 46038, Banda Street, Nairobi, Kenya

SIR ISAAC PITMAN (AUST.) PTY. LTD.
Pitman House, 158 Bouverie Street, Carlton, Victoria 3053, Australia

PITMAN PUBLISHING CORPORATION
6 East 43rd Street, New York, N.Y.10017, U.S.A.

SIR ISAAC PITMAN (CANADA) LTD.
495 Wellington Street West, Toronto 135, Canada

THE COPP CLARK PUBLISHING COMPANY
517 Wellington Street West, Toronto 135, Canada

ISBN 0 273 31887 X

MW

Camera copy prepared by Morgan-Westley
Printed in Great Britain by Unwin Brothers Limited
The Gresham Press, Old Woking, Surrey
A member of the Staples Printing Group.

G5 - (T529/76)

Preface

This book contains what we consider to be the "basics" of Engineering Drawing. Orthographic Projection, Conventions, Sectioning, Pictorial Representation and Dimensioning have been covered in detail as we feel that a thorough understanding of these topics forms a sound foundation upon which to build. All technical information, examples, exercises and solutions have been compiled in accordance with the latest "metric" drawing office standards - B.S. 308:1972.

The book has not been written for any specific course but can be profitably used both by students being introduced to Engineering Drawing and also by those who have acquired a little knowledge of the subject and wish to consolidate and increase their understanding by working through carefully graded exercises. It should prove useful for Craft, Technician, O.N.C., C.S.E. and G.C.E. students. The book is seen primarily as a student self-educator though no doubt many teachers will find it useful as a reference source and/or exercise "bank".

Topics have been presented in a similar manner wherever possible. Generally the opening page introduces the topic, the next imparts the basic facts - visually rather than verbally wherever possible. An illustrative example is provided to aid understanding and this is followed by a series of carefully graded exercises.

We are well aware of the dangers of presenting exercises which are known to contain errors. They have been included because in our experience they are the common misconceptions among students of engineering drawing. In all cases the correct method and answers are given, sometimes immediately following the example, or in the solutions at the end of the book.

It must be emphasized that this book not only transmits information it is also a work-book. Do not be afraid of drawing and writing on the pages! If maximum benefit is to be derived from the book then the old maxim, "I do and I understand" must be the students' guide.

We wish to thank the British Standards Institution for allowing us to use extracts from B.S. 308:1972.

R.S.R. & L.B.C.

Contents

SOLUTIONS

Orthographic Projection

Communication

There are many different ways of communicating ideas, information, instructions, requests, etc. They can be transmitted by signs or gestures, by word of mouth, in writing, or graphically. In an industrial context the graphical method is commonly used, communication being achieved by means of engineering drawings.

If oral and written communication only were used when dealing with technical matters, misunderstandings could arise, particularly in relation to shape and size. The lack of a universal spoken language makes communication and understanding even more difficult because of the necessity to translate both words and meaning from one language to another.

However, the universally accepted methods used in graphical communication through engineering drawings eliminate many of these difficulties and make it possible for drawings prepared by a British designer to be correctly interpreted or "read" by, for example, his German, French or Dutch counterpart.

Equally important, the components shown on the drawings could be made by suitably skilled craftsmen of any nationality provided they can "read" an engineering drawing.

Conventionally prepared engineering drawings provide the main means of communication between the "ideas" men (the designers and draughtsmen) and the craftsmen (machinists, fitters, assemblers, etc.). For the communication to be effective, everyone concerned must interpret the drawings in the same way. Only then will the finished product be exactly as the designer envisaged it.

To ensure uniformity of interpretation the British Standards Institution have prepared a booklet entitled BS 308:1972, *Engineering Drawing Practice*. Now in three parts, this publication recommends the methods which should be adopted for the preparation of drawings used in the engineering industry.

The standards and conventions in most common use and hence those required for a basic understanding of Engineering Drawing are illustrated and explained in this book.

Orthographic Projection

In the engineering industry communication between the drawing office and the workshop is achieved mainly by means of engineering drawings. The principal method used to prepare these drawings is known as Orthographic Projection.

Basically, Orthographic Projection is the representation of a three-dimensional component on a flat surface (the drawing sheet) in two-dimensional form. At least two orthographic views, therefore, are required to indicate fully the shape and size of a component. If the component is a complicated one then usually more than two views are shown to aid understanding.

In this country two methods of Orthographic Projection are used. One is known as First Angle Orthographic Projection (often referred to as English Projection), the other as Third Angle Orthographic Projection (American Projection). Both methods of representation are illustrated and explained in this section.

Orthographic Projection: First Angle

The pictorial drawing opposite indicates the shape of the component with a single view.

An orthographic drawing indicates the shape of a component by using a number of views each looking at a different face of the component.

At least two views are necessary to fully represent the component. Usually, however, three views are shown in order to clarify internal and external detail:

(1) A Front View

(2) A Plan View

(3) A Side View

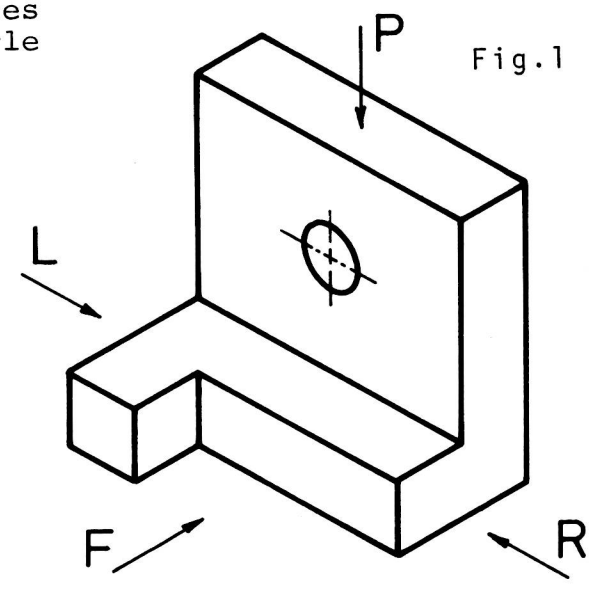
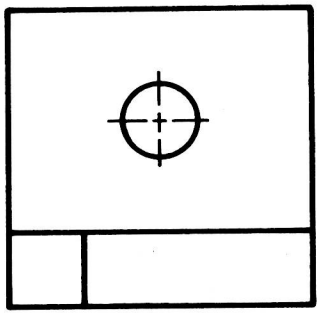


Fig.1

Fig.2



Front View (F)

(1) The front view, or front elevation, represents what is seen when looking at the front of the component in the direction of arrow F.

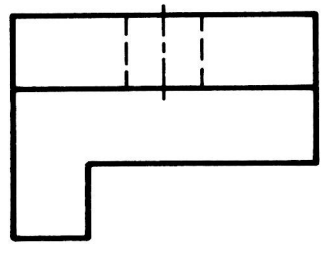


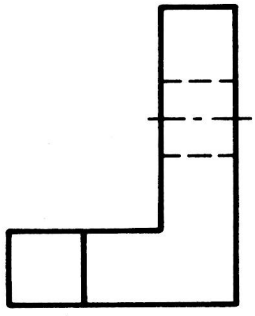
Fig.3

Plan View (P)

(2) The plan view represents what is seen when looking at the top of the component in the direction of arrow P at 90° to arrow F.

(3) A side view, or side elevation, represents what is seen when looking at the side of the component in the direction of either arrow R or arrow L. These arrows are at 90° to both arrow F and arrow P.

View looking in direction of arrow R.



Right-Hand Side View (R)

Fig.4

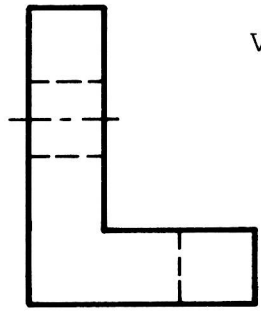


Fig.5

View looking in direction of arrow L.

Left-Hand Side View (L)

The separate views of the component are combined to form a complete orthographic drawing as shown below.

The front and side views are drawn in line with each other so that the side view may be "projected" from the front view and vice versa.

The plan view is drawn in line with and below the front view. In other words, the plan is projected from the front view.

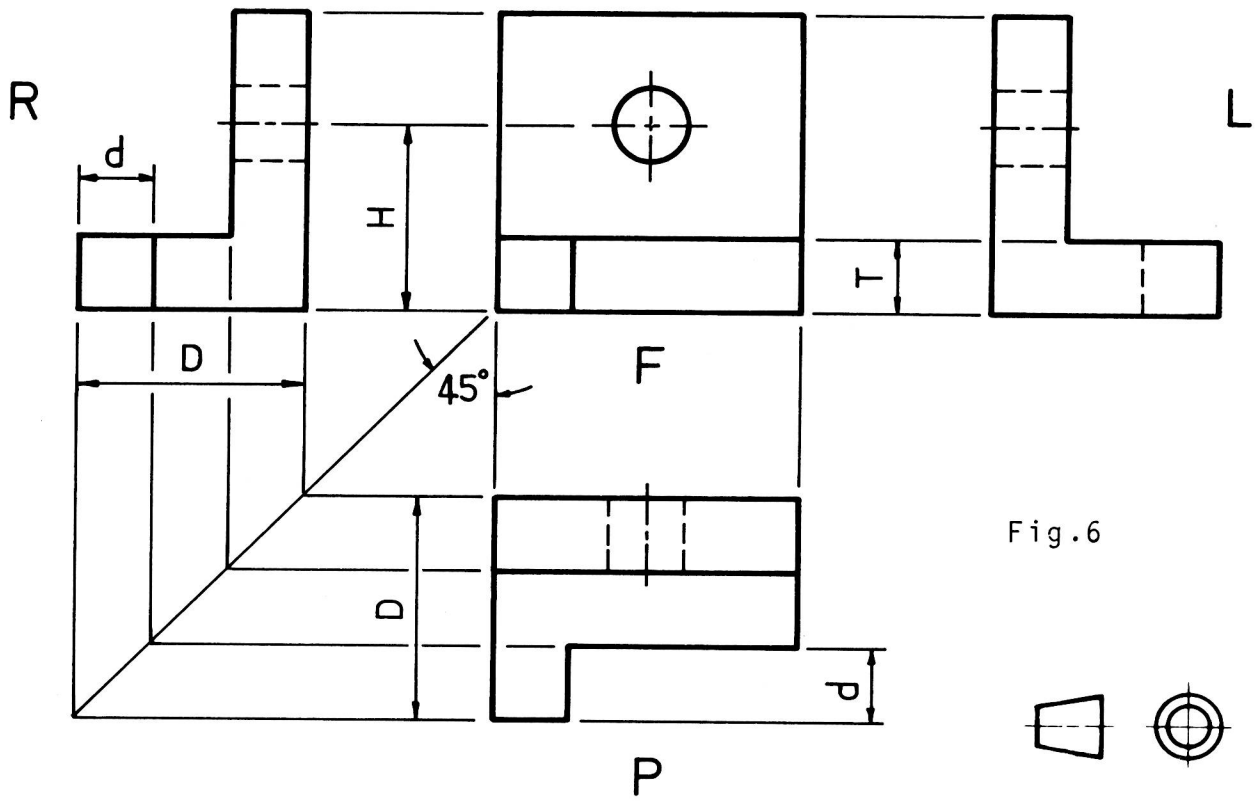


Fig.6

Points to note when making a drawing using First Angle Orthographic Projection:

(1) Corresponding heights in the front view and side view are the same.
For example, the height of the hole from the base, H, is the same in both front and side views.
The thickness of the base, T, is the same in both front and side views.

(2) Widths in the side view correspond to depths in the plan.
For example, the total width, D, in the side view is the same as the total depth, D, in the plan.
The width, d, is the same in both plan and side views.

Projection of widths from side view to plan is made easier by using the 45° swing line as shown.

(3) The plan view is usually projected BELOW the front view.
It can be above but this would be called an "inverted" plan.

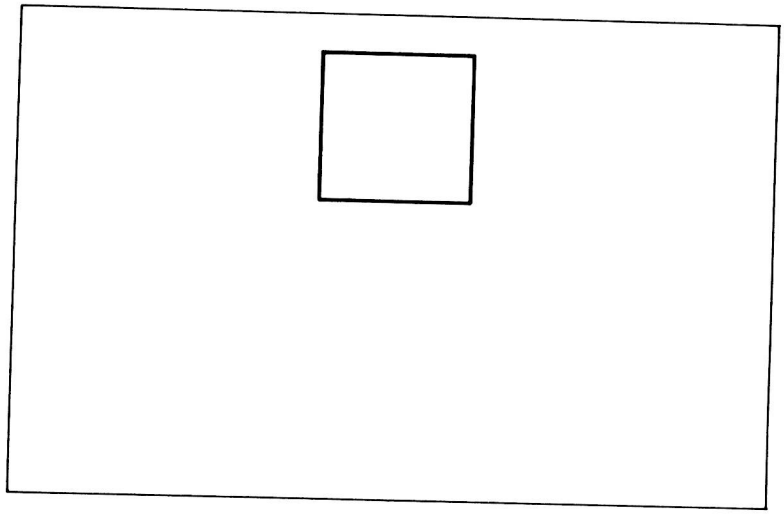
(4) The R.H. side view is shown on the L.H. side of the front view.
The L.H. side view is shown on the R.H. side of the front view.

Note: Drawings should be read (or interpreted) by viewing from the R.H. side or bottom R.H. corner of the drawing.

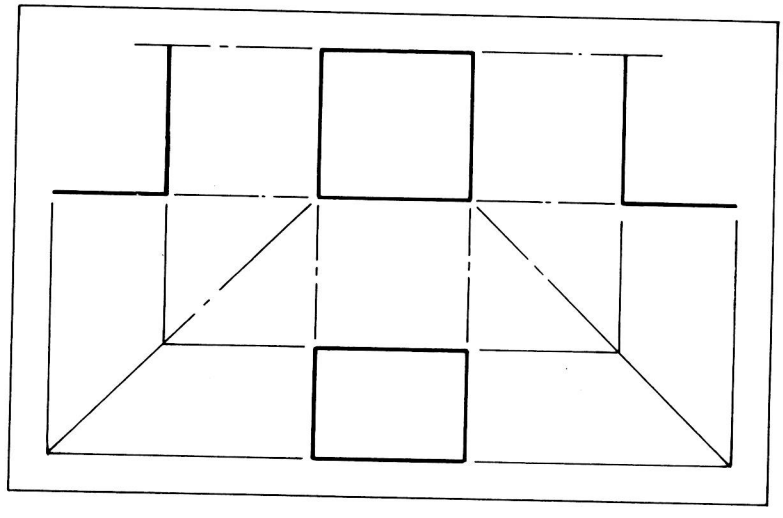
The orthographic drawing of the bracket, Fig.6, was constructed step by step as follows:

STEP 1. The face to be used as the front view of the component was chosen, in this case, looking in the direction of arrow F (Fig.1). The selection of the front view is purely arbitrary.

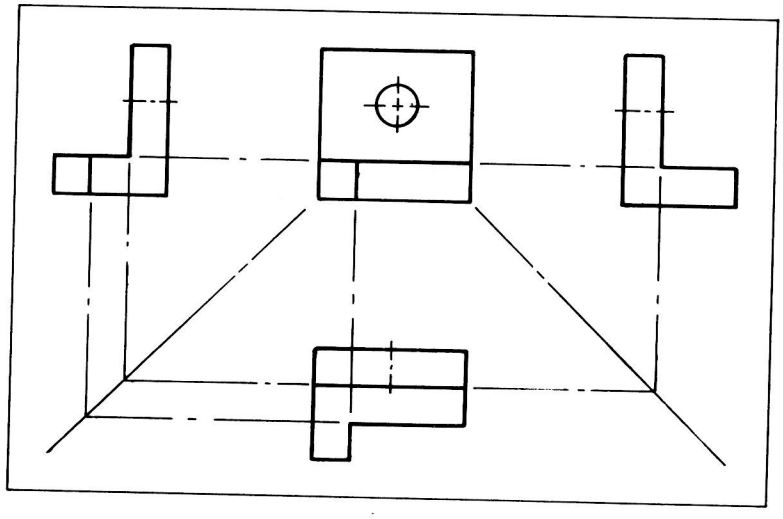
STEP 2. The outline of the front view was drawn FAINTLY in the position shown opposite leaving room on the drawing sheet for a plan view and also both end views to be added.



STEP 3. The outlines of the plan view and side views were projected FAINTLY from the front view and positioned as shown opposite.



STEP 4. All remaining external details were added and centre lines inserted as shown opposite.



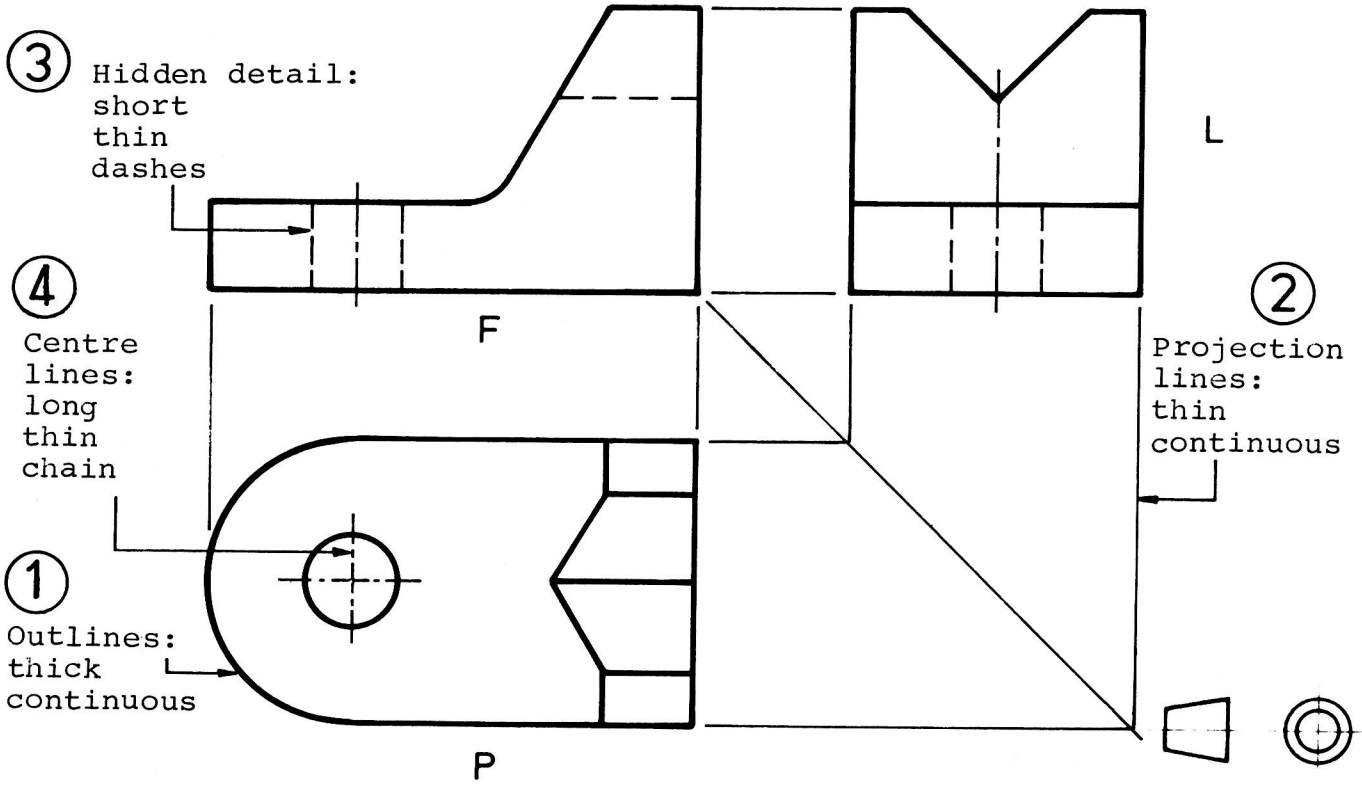
STEP 5. All hidden detail, i.e. for hole and recess, was added and the outline "heavied-in" to complete the drawing as shown in Fig.6.

Lines

For general engineering drawings, the following types of lines should be used.

1	———	Visible outlines
2	———	Dimension lines Projection lines Hatching or sectioning Leader lines for notes
3	– – – – – –	Hidden detail
4	——·——·——	Centre lines Pitch circles
5	—·—·—	Cutting or viewing planes
6	~~~	Short break lines Irregular boundary lines

Typical applications of some of the recommended types of lines have been shown in previous figures and are further illustrated below.

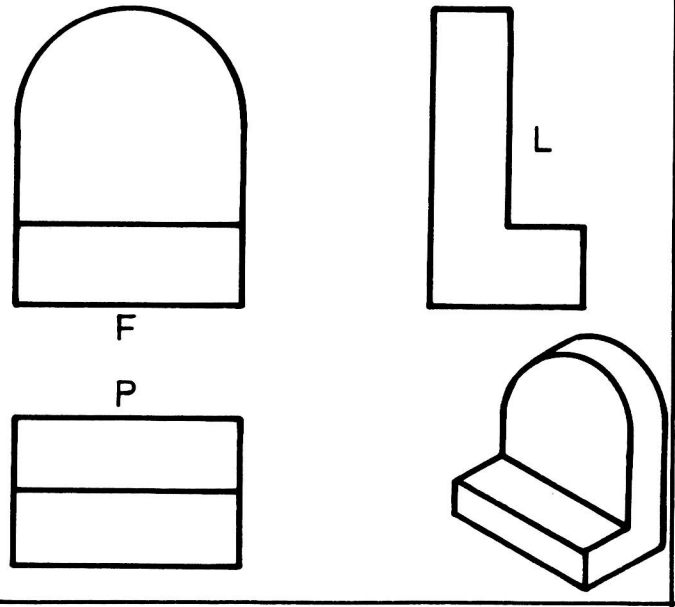


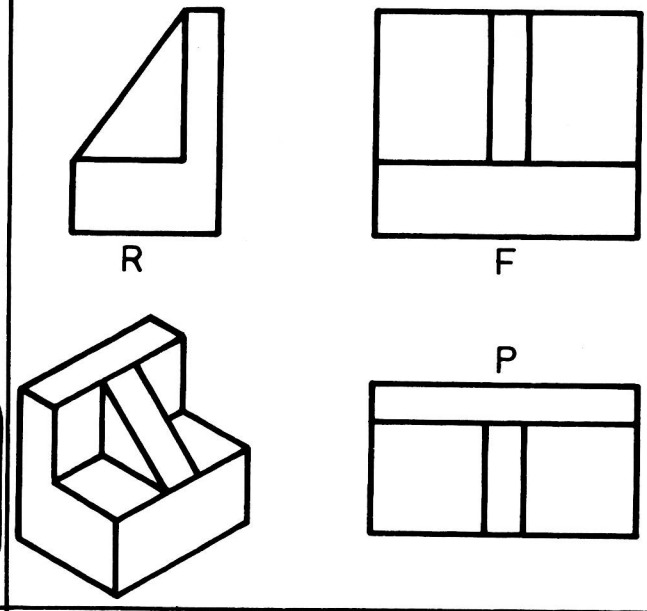
HIDDEN DETAIL

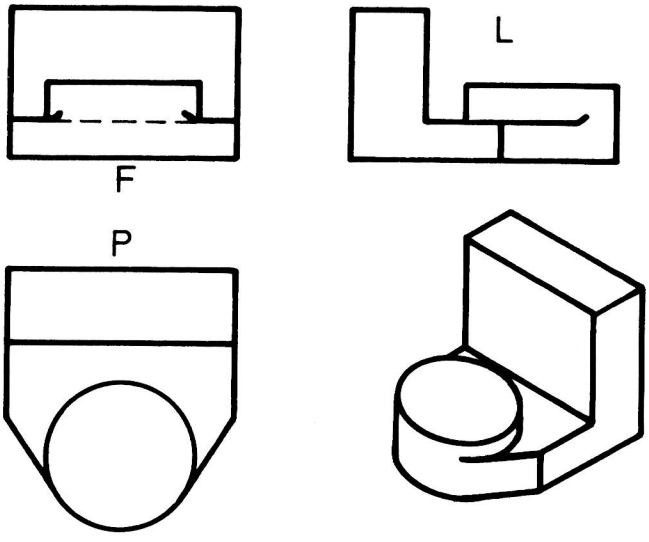
The line numbered 3 above is used to represent hidden detail, i.e. edges, holes, surfaces, etc., which are known to exist but cannot be seen when viewed from outside the component.

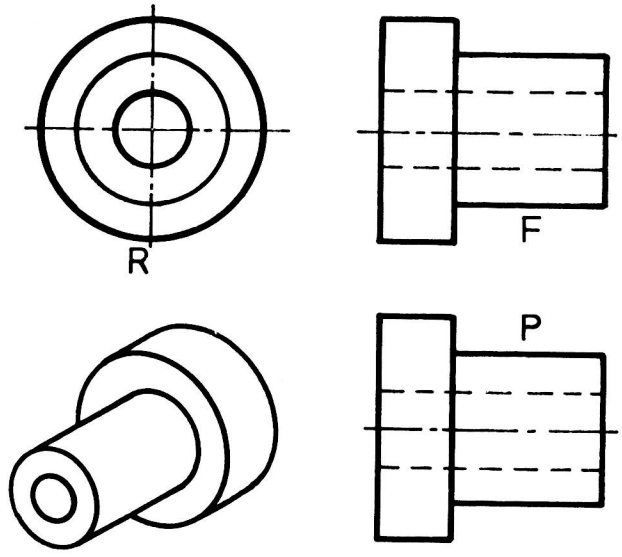
Note: A hidden detail line is a broken line *not* a dotted line

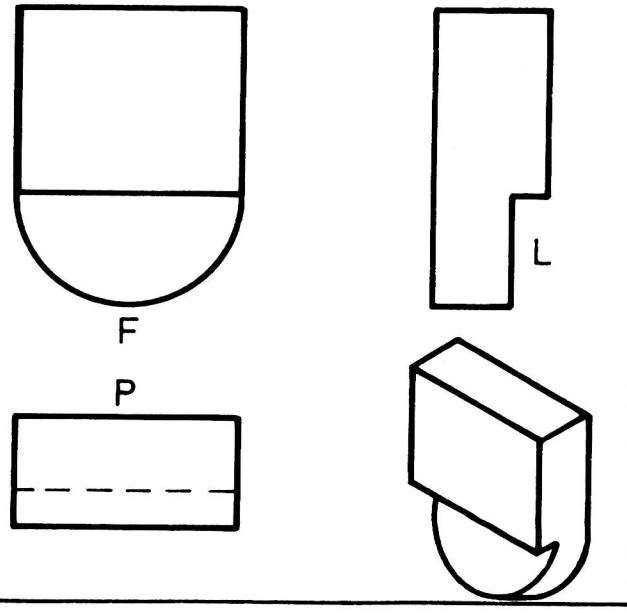
The following drawings are further examples of components drawn correctly in First Angle Orthographic Projection. Study each drawing carefully until you understand how each view is obtained.

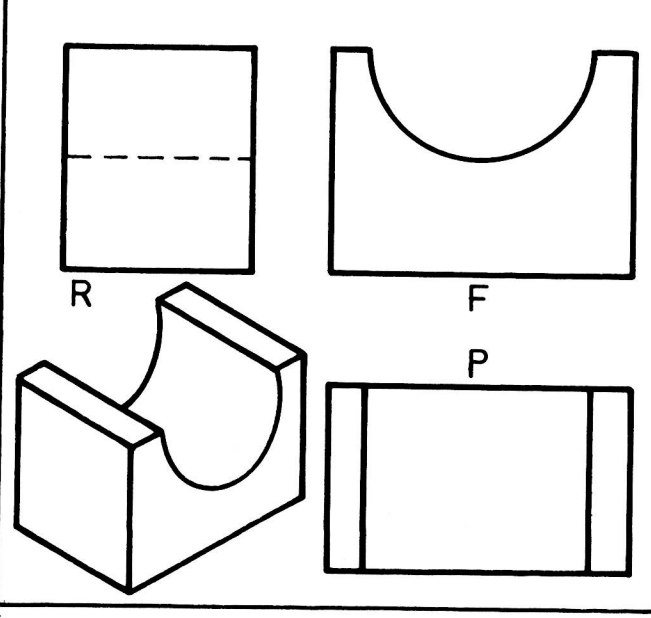






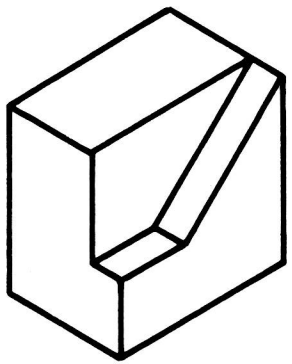




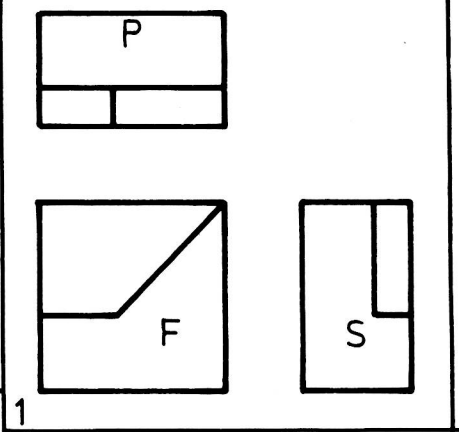


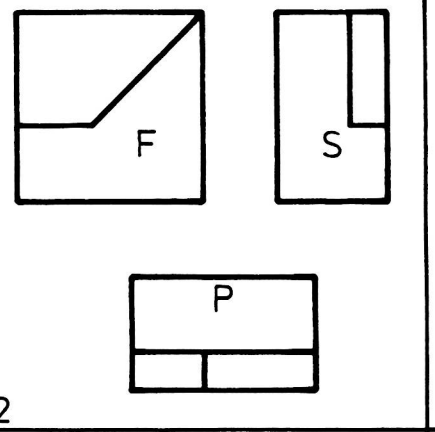
Drawings 1 to 9, shown in First Angle Orthographic Projection, represent the component below.

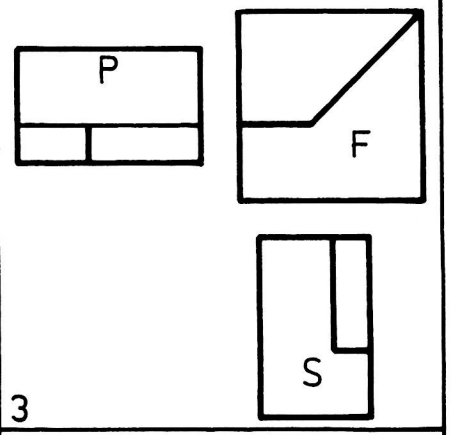
Examine each drawing carefully and explain briefly, either in the table below or on a separate sheet of paper, why each representation is INCORRECT.

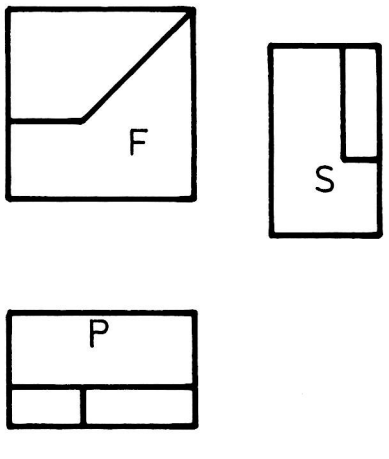


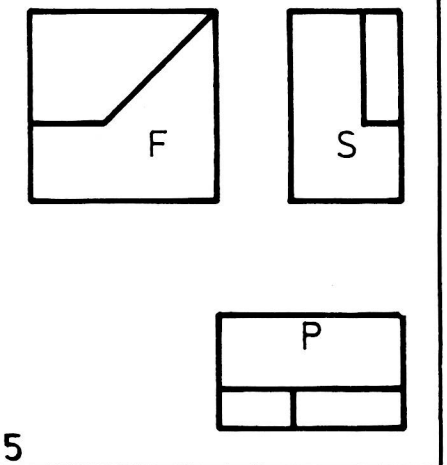
Drg.	Reason for incorrect representation
1	
2	
3	
4	
5	
6	
7	
8	
9	

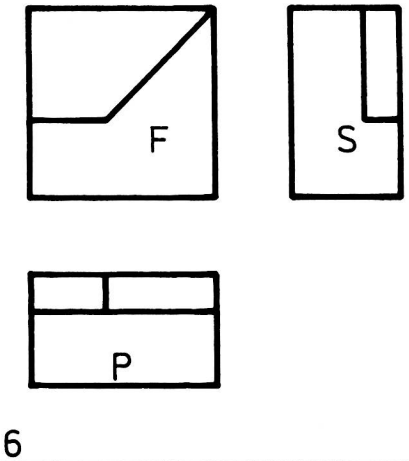


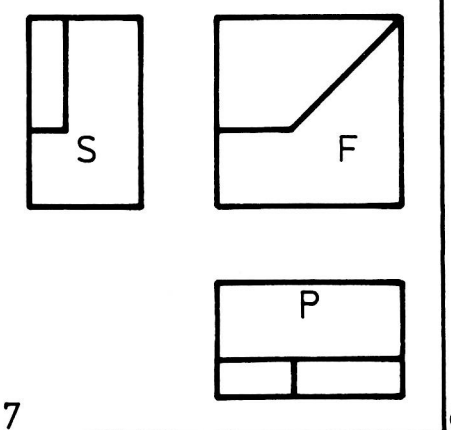


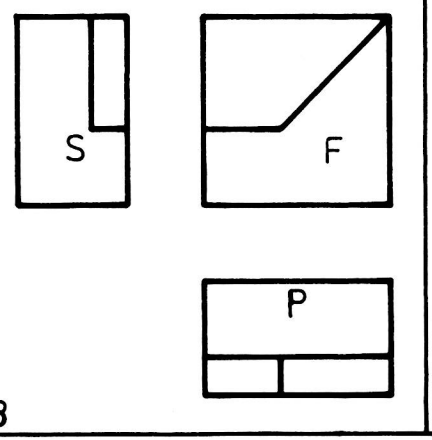


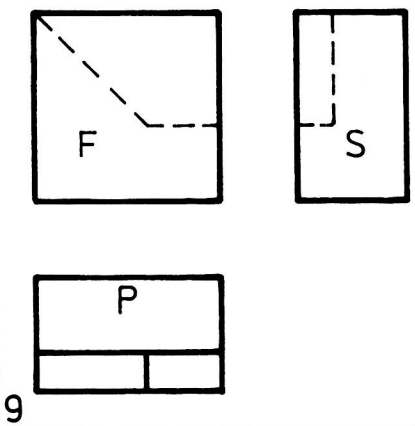












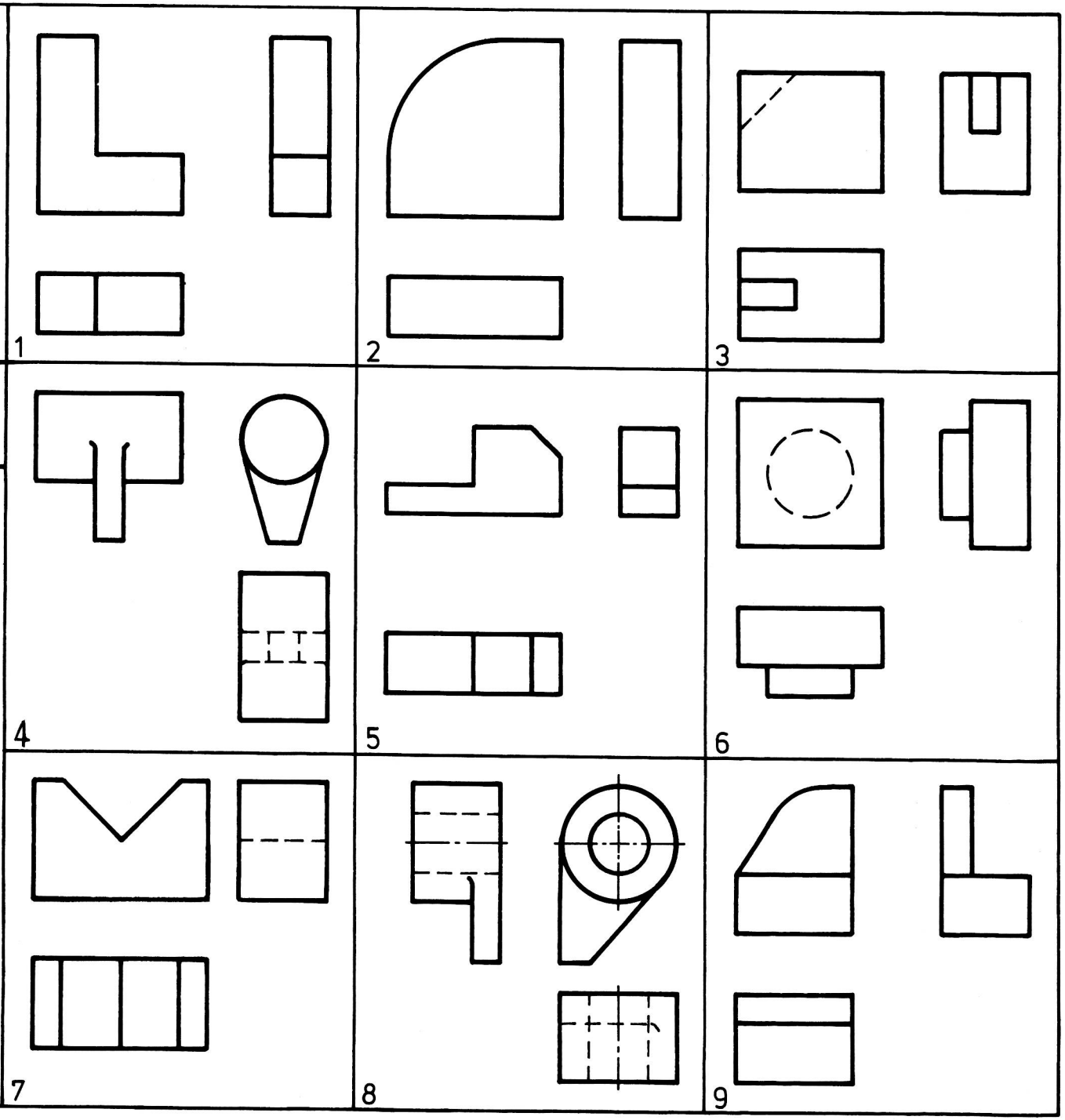
The drawings opposite are shown in First Angle Orthographic Projection.

Some show all three views drawn correctly, others show one of the views drawn incorrectly.

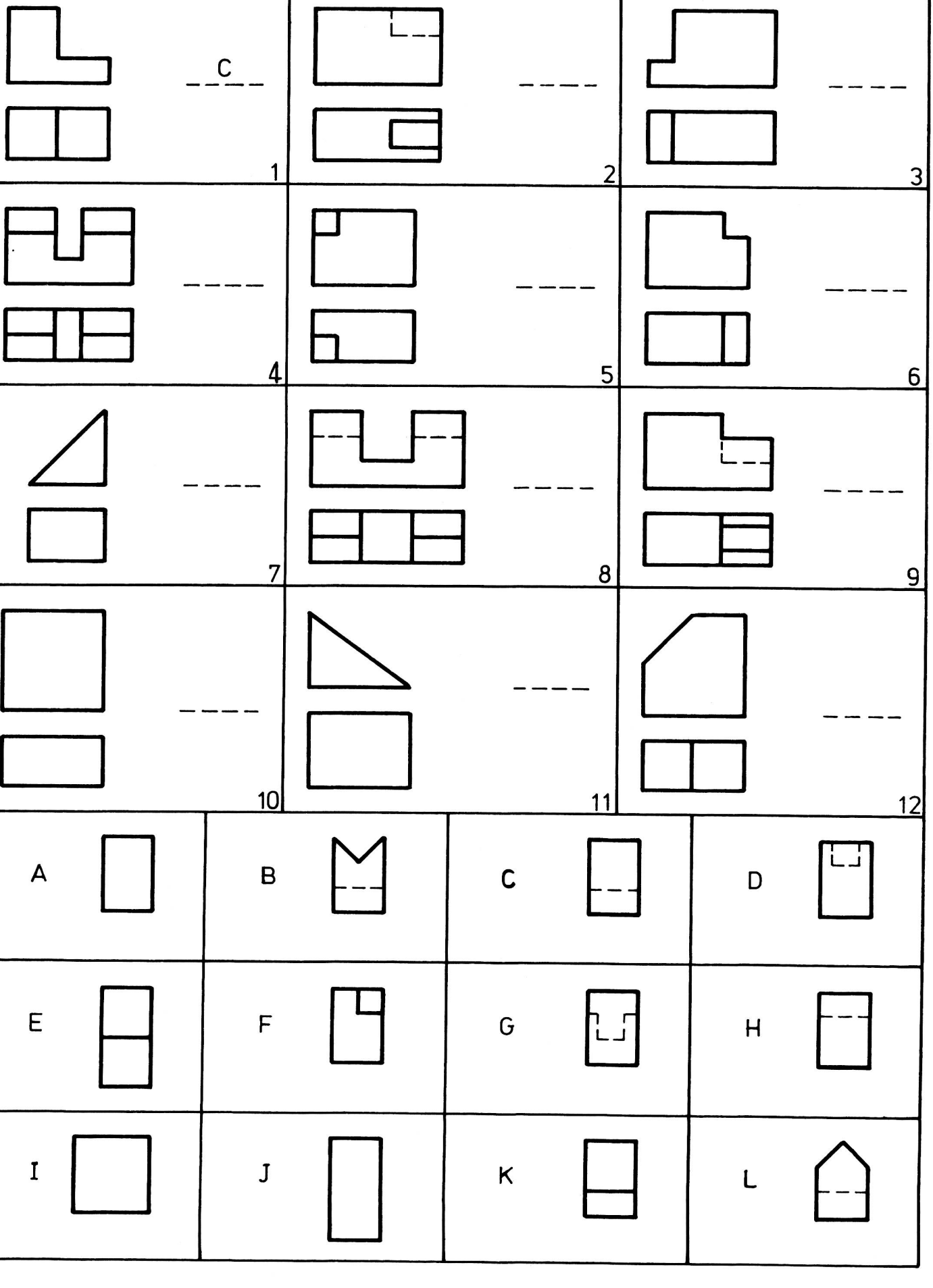
State in the table below the numbers of the drawings which are incorrectly drawn.

In the space provided sketch freehand the correct view in each case.

Number of drg. shown incorrectly	Sketch of correct view

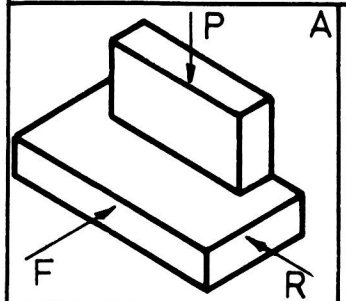


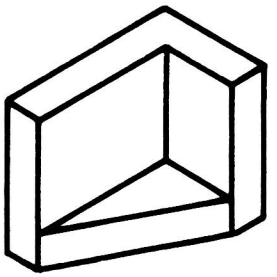
Select, from the views A to L below, the missing view from each of the drawings 1 to 12. Insert the letter in the space provided.
Example: the missing view from drawing number 1 is C.

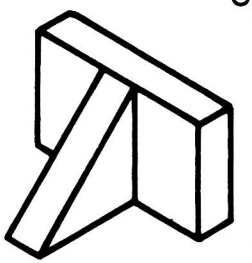


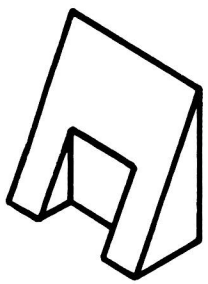
From drawings 1 to 18 opposite select the view which is requested in the table below. Place the number of this view in the appropriate position in the table.

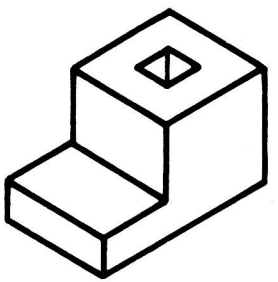
For example, for component A, the front view, looking on F, is number 10, so 10 is placed in the answer block as shown.

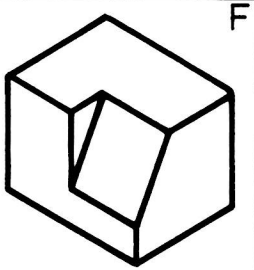












Drawing	A	B	C	D	E	F
Front view in direction of F	10					
Plan view in direction of P						
Side view in direction of R