ESE 2020
Prelims Paper - I

IES MASTER
PUBLICATION

GENERAL PRINCIPLES OF
Design, Drawing & Safety

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General Principles of
Design, Drawing & Safety

IES MASTER PUBLICATION

Office : F-126, (Lower Basement), Katwaria Sarai, New Delhi-110016 • **Phone :** 011-26522064
Mobile : 8130909220, 9711853908 • **E-mail:** info.publications@iesmaster.org, info@iesmaster.org
Web : iesmasterpublications.com, iesmaster.org

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E-mail : info.publications@iesmaster.org

Web : iesmasterpublications.com

First Edition : 2016

Second Edition : 2017

Third Edition : 2018

Fourth Edition : 2019

Typeset at : IES Master Publication, New Delhi-110016

PREFACE

Giving life to an engineer's dream for the betterment of society involves **Design, Drawing** and **Safety**. With the increasing complexities of economy, as well as the ensuing disruption in IT, besides the stringent safety rules, this inter-disciplinary subject has become quite challenging to comprehend from exam point of view.

Looking at the nature of Engineering Services Examination (ESE), and the level of questions being asked, the conventional approach of preparing through theory and examples is not enough to serve the purpose. The revised and updated edition of **General Principles of Design, Drawing and Safety** attempts to provide logical reasoning through mathematical analysis, gives a clear insight into the concepts, and paints a complete picture in front of you. In line with this, the book has been written in a simple and clear manner.

The book is divided into three major parts (i) Engineering Drawing (ii) Engineering Design and (iii) Engineering Safety. The first part discusses the basic principle of drawing associated with drafting of various points, object, sketches etc. Next, an overview of basic principles of design, types of design, associated governing tools and product development. Finally, basic knowledge need for engineering safety is presented. In addition to the above, UPSC sample papers and questions asked in ESE 2017-2019 are discussed after the completion of relevant topics. For students to determine their level of preparation, self-practice questions have been provided at the end of this book. Students may generally not require any additional study, and may be reasonably confident that all the probable questions and topics are covered in this book.

In their endeavour to give students the best, IES Master has brought about this book in an easy-to-grasp language that gives in a complete clarity of thought. As a result, what students get is their collective wisdom that breaks free the constraints of engineering students in appreciating the basics of Design, Drawing and Safety.

As you flip over the pages of this book, you would come across a slew of diagrams, flow charts, mind maps and tables. This book is a delight for every ESE aspirant as it communicates, connects, and builds upon the exam preparedness right up to the standards of the UPSC.

All care has been taken to make the understanding of this subject more clear and interesting. The credit goes to the entire IES Master team for their continuous support in bringing out this book. All comments and suggestions for further improvement of the book are welcome and will be appreciated.

Bipin Thakur
IES Master Publication
New Delhi

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CHAPTER 1

Introduction to Engineering Drawing

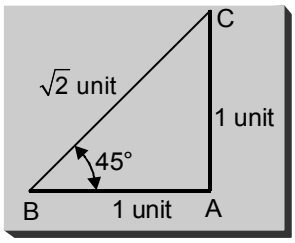
1.1 INTRODUCTION

INSIDE

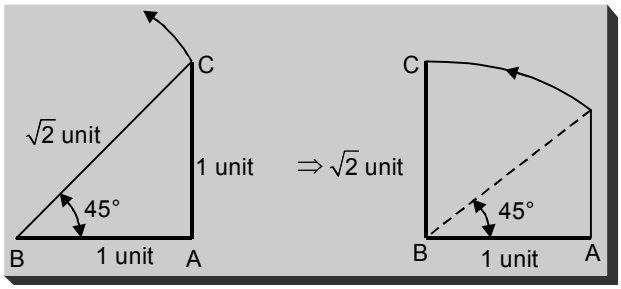
Engineering drawing is a technique of creating graphical representation that contains all necessary information such as dimensions, specifications and notes using which an abstract concept can be transformed into real world object. To realize such concept, basic tools of construction of drawing has to be clearly understood as to what standard has to be followed. There is an international standard on code of practice for drawing which is followed and adopted by Bureau of Indian Standard (BIS). In this chapter, we shall be dealing with drawing instruments and accessories (i.e. drafting tools) which is necessary for engineering drawing.

1.2 DRAWING SHEETS : [IS 10711 : 2001]

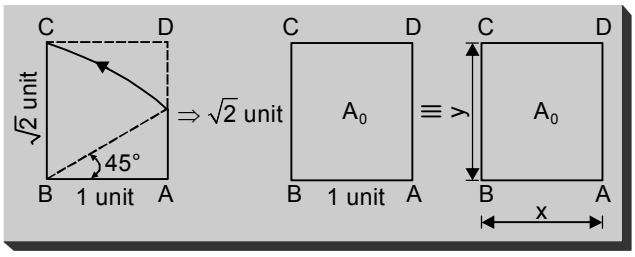
Consider an isosceles triangle ABC of unit length as shown below.



Now rotate BC anticlockwise so that BC becomes perpendicular to AB as shown below.



Now taking AB as one side and BC as another side complete a rectangle ABCD as shown below.



There are two basic principles involved in arriving at the sizes of A_0 sheet

(i) $x : y = 1 : \sqrt{2}$, where, x, y ∈ side

(ii) Surface area (xy) of A_0 sheet is unity i.e., xy = 1

$$\because \quad x:y = \frac{1}{\sqrt{2}}$$

$$\therefore \quad \frac{x}{y} = \frac{1}{\sqrt{2}}$$

$$\Rightarrow \quad y = x\sqrt{2} \quad \text{... (i)}$$

Also, $xy = 1 \Rightarrow x \cdot x\sqrt{2} = 1$ from (i)

$$\Rightarrow x^2 = \frac{1}{\sqrt{2}} \Rightarrow x = \frac{1}{\sqrt{\sqrt{2}}} = \frac{1}{1.189}$$

$$\Rightarrow \quad x = 0.841 \text{ m}$$

$$\therefore \quad y = 0.841\sqrt{2} = 1.189 \text{ m}$$

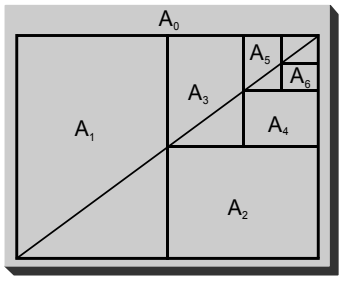
Hence, value of x and y is given as

x = 0.841 m (or) 841 mm

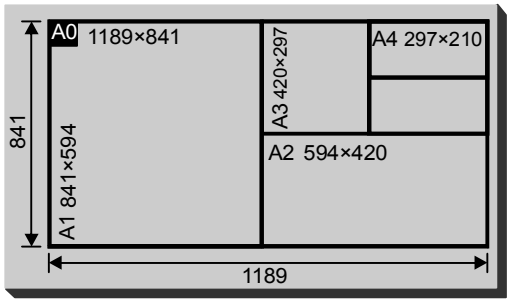
y = 1.189 m (or) 1189 mm

Successive smaller sizes are obtained by halving previous size sheets, with the above constant width to length ratio i.e., ($x : y = 1 : \sqrt{2}$)

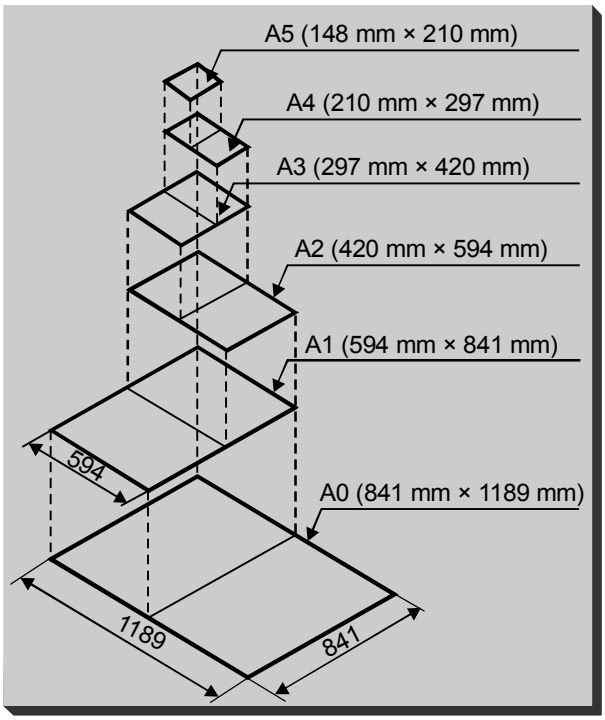
Example :



2-D view



3-D view



Note: The ISO 'A' series of sheet is based on a constant width to length ratio of $1 : \sqrt{2}$.

Application

The relationship of $1 : \sqrt{2}$ is particularly important for reduction onto microfilm, or reduction and enlargement on photocopiers. All metric equipment including microfilm cameras, microfilm printers, photocopiers and even drawing pen sizes are designed around this ratio.

Note: (1) A2 size drawing sheet is preferred for class use.
(2) Recommended size and its designation of ISO 'A' series of sheet is given below.

Table 1.1: Recommended size of drawing sheets

Drawing Sheet (IS 10711 : 2001)	
Designation	**Size (mm) Length × Width**
A0	1189 × 841
A1	841 × 594
A2	594 × 420
A3	420 × 297
A4	297 × 210

1.3 DRAWING BOARD : [IS 1444 : 1989]

It is generally made from soft wood such as white pine, fir, oak, red cedar etc.

- To prevent warping, the board should be made of narrow strips of wood joined together accurately.

QUESTIONS

Choose the most appropriate answer out of the given alternatives :

1. A drafter helps in drawing

(a) parallel and perpendicular lines

(b) concentric circles

(c) smooth curves

(d) all the above

2. In the engineering system of paper sizes, which of the following is "A2" size?

(a) 841 mm × 1189 mm

(b) 594 mm × 841 mm

(c) 420 mm × 594 mm

(d) 210 mm x 297 mm

3. Which of the following pencil leads is hardest?

(a) HB (b) H

(c) B (d) F

4. Which of the following purposes is **not** served by dividers?

(a) Divide lines or curves into a number of equal parts

(b) Transfer measurement from one part of the drawing to another part

(c) Make full size, reduced size or enlarged size drawing

(d) Step-off a series of equal distances on the drawing

5. To draw smooth curves of any nature, the draughting instrument used is

(a) mini-drafter (b) French curve

(c) templates (d) eraser shield

6. Parallel lines can be drawn with the help of

(a) mini-drafter

(b) T-square

(c) pair of set squares

(d) all of these

7. A typical layout of a drawing sheet **does not** contain

(a) centering mark

(b) orientation mark

(c) trimming marks

(d) identification mark

8. Grid references on a drawing sheet provide the following information:

(a) Location of details, additions, modifications, revisions, etc. of drawing

(b) To facilitate the positioning of the drawing when reproduced

(c) To facilitate brief record and initials of the person responsible

(d) To facilitate trimming

9. "A" series of paper has length-to-width ratio of approximately

(a) 3:2 (b) $\sqrt{3}:1$

(c) $\sqrt{2}:1$ (d) 5:3

10. The number of orientation marks generally contained by a drawing sheet is

(a) one (b) two

(c) three (d) four

11. Extension arms are used with engineering compasses to

(a) draw circles of larger diameter

(b) increase the gripping arm

(c) adjust distance between the legs

(d) increase accuracy

12. Which of the following statements are correct?

I. The length of A2 size drawing sheet is equal to the width of A1 size drawing sheet.

II. For technical drawing, harder grades of pencils are preferred.

(a) only I (b) Only II

(c) Both (d) None

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