

## Chapter 1: Introduction to Design



### Key Words

- design
- technology
- appreciation
- design function
- elements of design
- principles of design
- design features
- environmental awareness
- sustainable material use
- production
- after-use disposal
- societal and cultural influences

### You will need:

1. notebook, pencil, pens
2. engineering articles
3. colours
4. drawing instruments

After studying this chapter and practising its activities, you should be able to:

1. develop appreciation of function in the design world.
2. use basic elements and principles of design.
3. demonstrate awareness of environmental considerations related to sustainable material use, production methods and after-use disposal.

## Introduction

This chapter introduces you to the basic concepts of technology and design. The concepts include design features, elements, principles and materials required.

Studying this chapter will enable you to appreciate the usefulness of technology and design in your environment. This will give you knowledge why many structures in your environment are constructed in different shapes, designs and orientation.

This section will further guide you in analysing the environmental, cultural and social influences on technology and design.

### Activity 1: Familiarising with design terminologies and aspects

- 1.1 In smaller groups, brainstorm the meaning of the following terms: design, technology, design technology, design aspects/features, design elements and design principles, sustainability, environmental conservation.

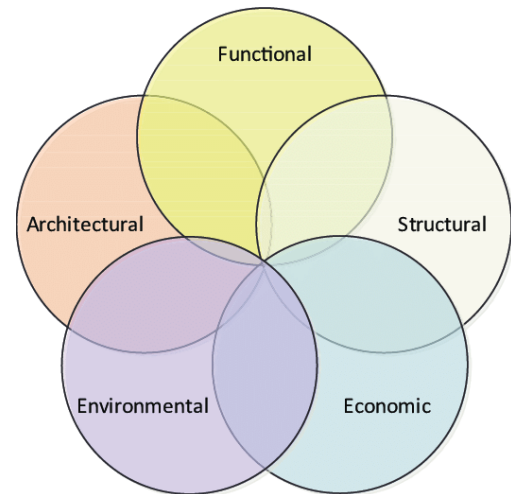
- 1.2 Identify the objects that require design in your environment.




- 1.3 Choose one of the identified object and create a chart to relate/explain the design features/aspects with their functions in the environment, example: a cup.

S/N	Feature	Function
	Handle	Accommodates the fingers to hold the cup
	Body	Contains the contents of the cup
	Base	Supports the cup to rest on a surface
	Mouth	Lets out contents of the cup

- 1.4 Collaborate with your classmates and discuss the design principles in your immediate environment, example: functional: the purpose to which the design is made, or the problem to be solved by the design.



- 1.5 Identify and state the role of the basic design elements, example: lines, shapes.

Design element	Role
Line —————	Defines the boundary of a design.
Shape (e.g. Triangle) 	Specifies the particular form of outline of a design.

- 1.6 In pairs, identify and describe the different materials used in design and state their sources, example: wood.

Material	Description	Source
Wood	A hard fibrous material from the main substance of the trunk or branches of a plant.	1. Trees 2. Shrubs

- 1.7 State the reasons for the different choices of materials in design, example: wood. The material is:

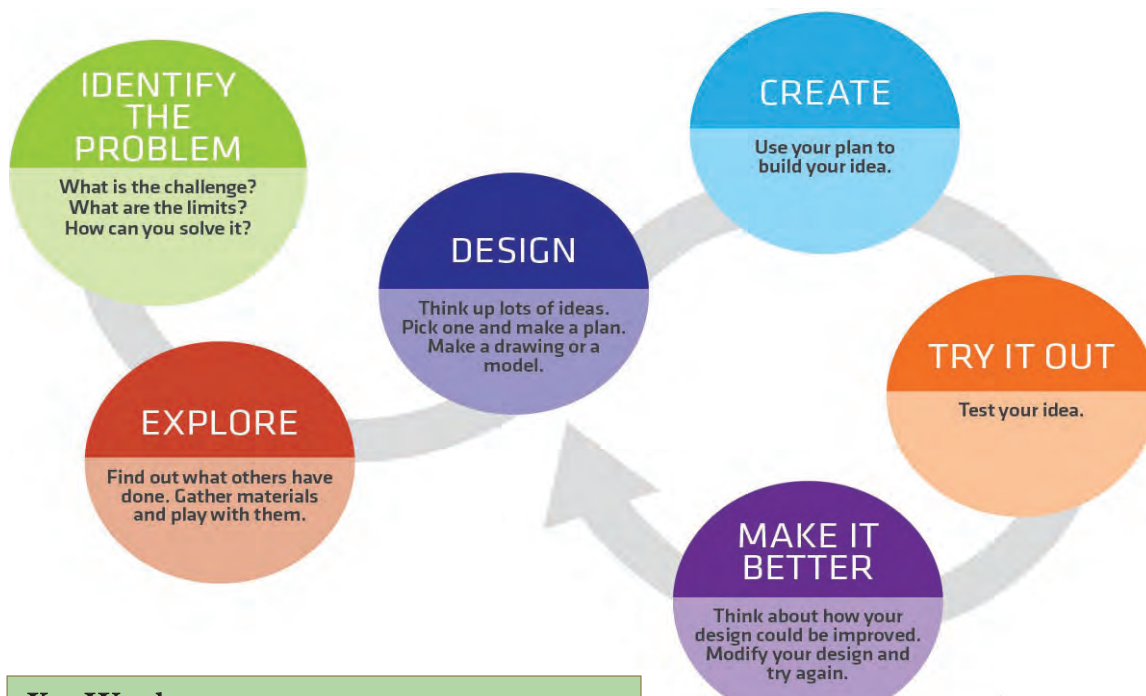
- |                              |                                     |
|------------------------------|-------------------------------------|
| i) readily available         | vi) rigid in structural application |
| ii) less costly              | vii) light in weight                |
| iii) ease to work            | viii) resistant to wear             |
| iv) warm to touch            | ix) good in texture                 |
| v) strong in structural form | x) bright in appearance             |

- 1.8 Explain the cultural/societal influences on design in relation to the different materials, example: wood. Some cultures like the Karamojong prefer wood for their stools as compared to other materials.



- 1.9 Suggest practices that promote continuous availability of the different design materials for example, wood materials.
- i) Continuous afforestation and reforestation
  - ii) Planting fast growing timber lot trees
  - iii) Recycling waste into reusable forms of wood
  - iv) Adopting modern cost effective methods of wood conversion
- 1.10 In groups, suggest the safe environmental practices of different design materials listed in (6) above: for example, wood.
- i) Promoting afforestation and reforestation
  - ii) Adopting clean energy cooking technologies
  - iii) Recycling all waste wood
  - iv) Substituting wood with other materials where possible
  - v) Combining or and reinforcing wood with other materials to limit its use.
  - vi) Adopting and promoting natural methods of wood preservation.
- 1.11 Write individual reports indicating the key points learnt in this chapter.

## Chapter 2: The Design Process



### Key Words

- design
- design process
- design need
- facility
- resource
- design brief
- design factor
- design idea
- design specifications
- sketch
- investigation
- model/mock-up
- suitability

### You will need:

1. notebook, pencil, pens
2. engineering articles
3. sample models
4. colours
5. drawing instruments
6. essential tools
7. materials from the environment

At the end of this chapter and after practising its activities, you should be able to:

1. identify the community needs to design a particular resource/facility (e.g. bus shelter, library, water station, market, recycling centre).
2. make appropriate design decisions.
3. use exploration/experimentation, reflection and revision when producing a variety of models or mock-ups.



## Introduction

This chapter introduces you to the basic design techniques required to generate ideas and actions necessary to satisfy identified community need(s). You will be able to use the essential tools and materials to design and produce the article(s) required to solve community challenges.

### Activity 2: Practising the design process

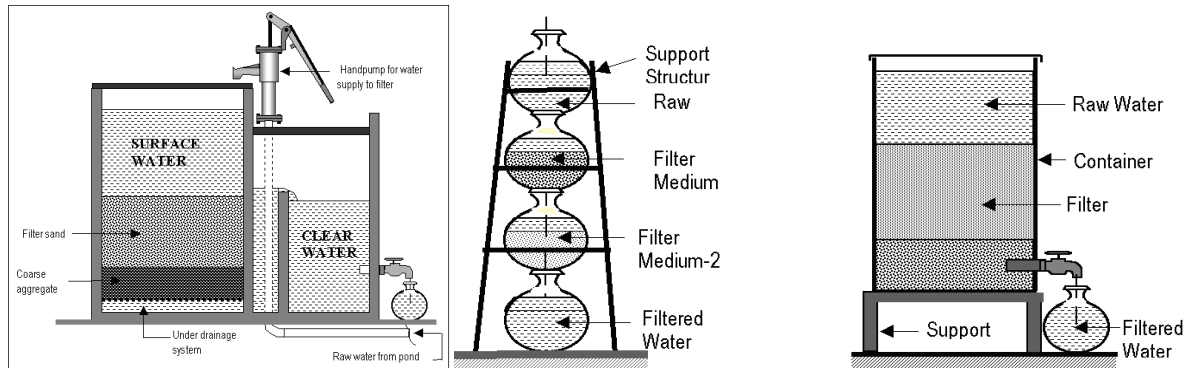
#### 2.1 In groups:

- identify the challenges in your community; for example, poor accommodation, lack of safe drinking water.
- select the most pressing challenge; for example, lack of safe drinking water.



- identify and illustrate with neat sketches the possible solutions required to solve the pressing challenge; for example, sand water purifying equipment/facility to provide the community with safe drinking water, or a shadoof.





- d. choose one solution from the ones identified in 2.1(c) above and explain the factors that affect the design of the solution you have chosen, putting into consideration the community needs.

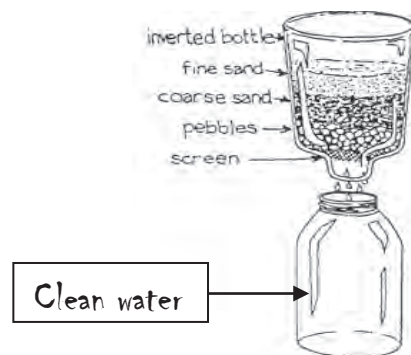
### Choosing the sand water purifying equipment/facility

Factors that influence the design are:

- Cost of construction
- Availability of materials
- Ease with which to make
- Maintenance costs
- Reliability technology
- Durability
- Size of community
- Filter

- e. Write individual report to state the components and materials required to make the equipment identified in 2.1(c), such as:
- Purifying container
  - Water collection container
  - Sands (fine and coarse)
  - Pebbles
  - Loam and clay soil
  - Water pump

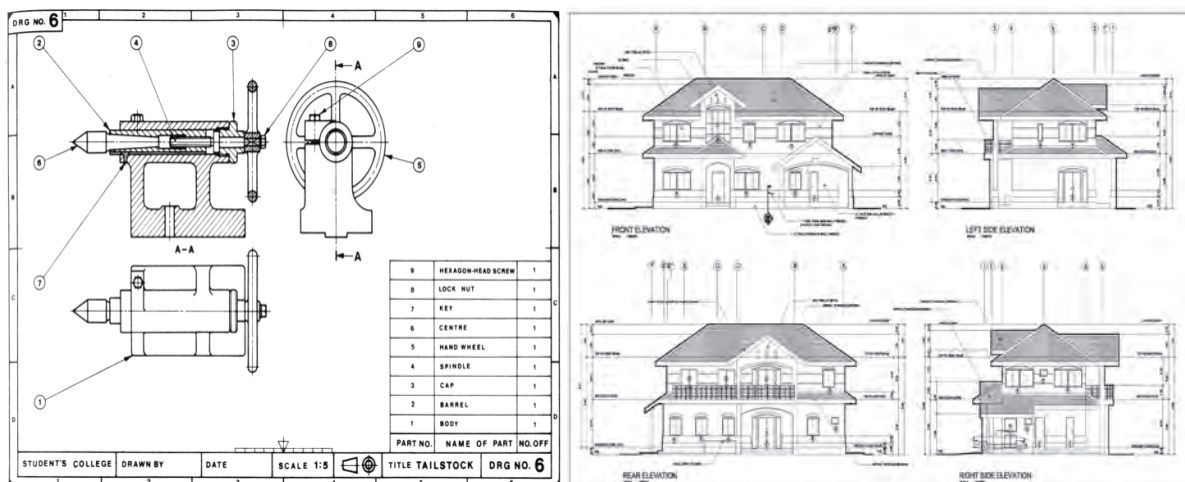
- f. Individually, make a prototype (model) of the technology and write a report evaluating the model against design specifications.



- g. Individually, identify any improvements that can be added to the model for proper functioning, such as:
- Larger purification container
  - Large clean water collection container
  - Clean water outlet
  - Row water supply pump
- h. Individually, use the model to test ideas in the design brief; for example, obtain clean water from the model test.



## Chapter 3: Introduction to Drawing



### Key Words

- drawing
- engineering drawing
- engineering design
- drawing equipment
- drawing techniques
- lines
- primary angles
- secondary angles
- paper layout

### You will need:

1. notebook, drawing pencils (HB, 2H), pens
2. drawing equipment
3. drawing set
4. engineering articles

After practising activities in this chapter, you should be able to:

1. use basic drawing equipment and properly lay out drawing paper.
2. use lines to construct primary and secondary angles.

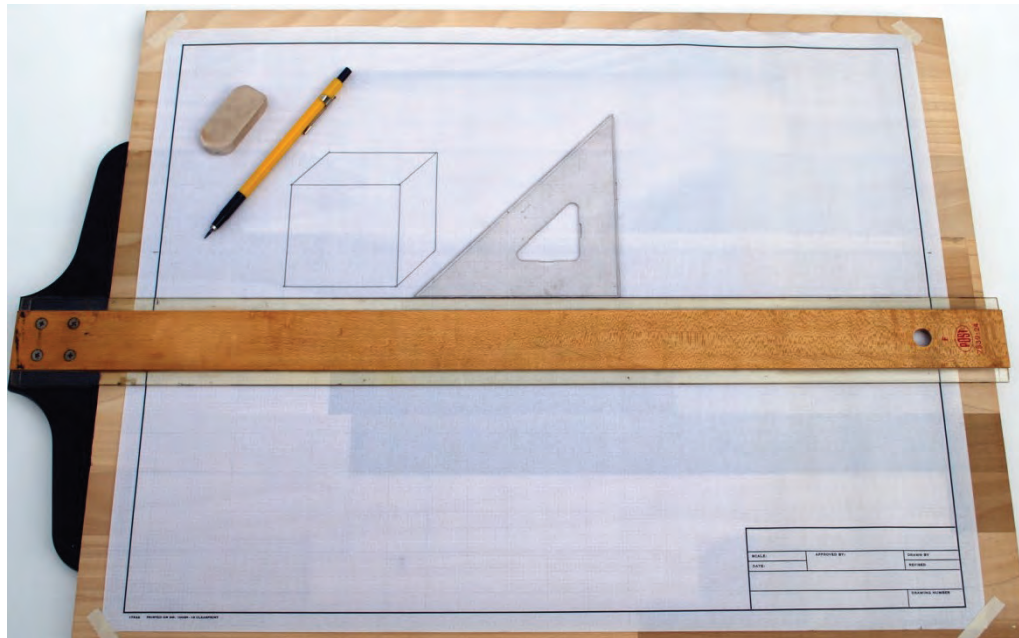
### Introduction

This chapter introduces you to the basic drawing equipment and techniques for engineering design. After studying this chapter, you will be able to use the essential equipment and materials to layout drawing paper and graphically produce different engineering article(s).

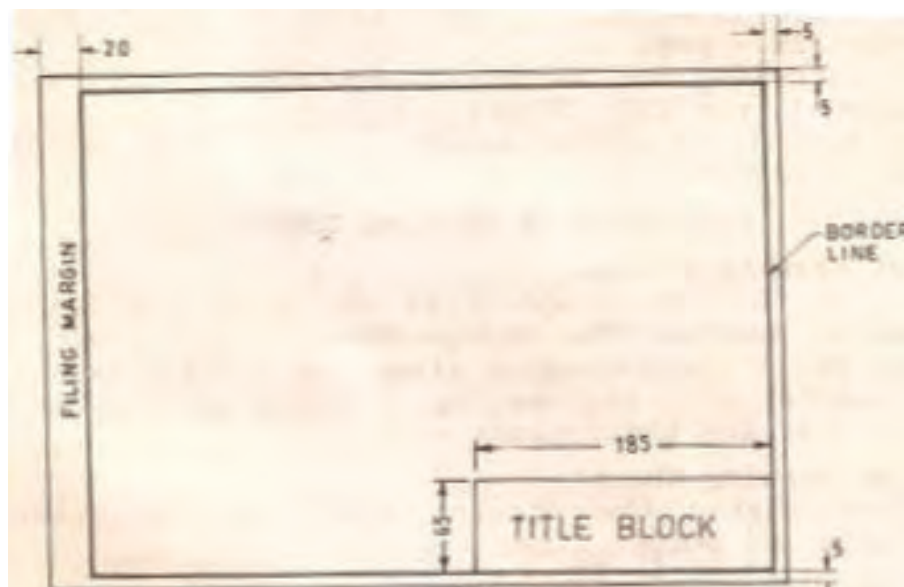
### Activity 3: Familiarising with drawing equipment and basic concepts of drawing

3.1 In groups:

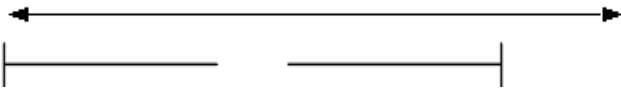

- brainstorm and list the different drawing instruments. I.E Drawing board, TEE-square.
- practise the techniques of using the listed instruments in (a) above.



- lay out the drawing paper to include the title block.



- brainstorm the different types of lines used in engineering drawing; for example, dimension line, construction line etc.

S/ N	Type of line	Illustration
1.	Dimension lines (Thin)	
2.	Construction line (Thin)	

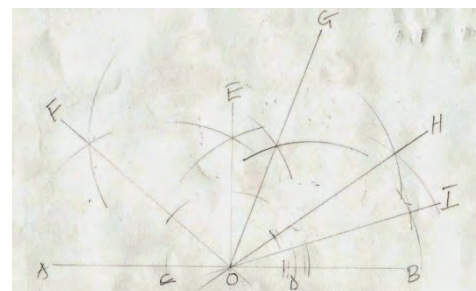
- e. Individually, produce a drawing to illustrate the application of different types of lines.
- f. discuss the different types of angles, including:

- Primary angles
- Secondary angles
- Complementary angles
- Supplementary angles

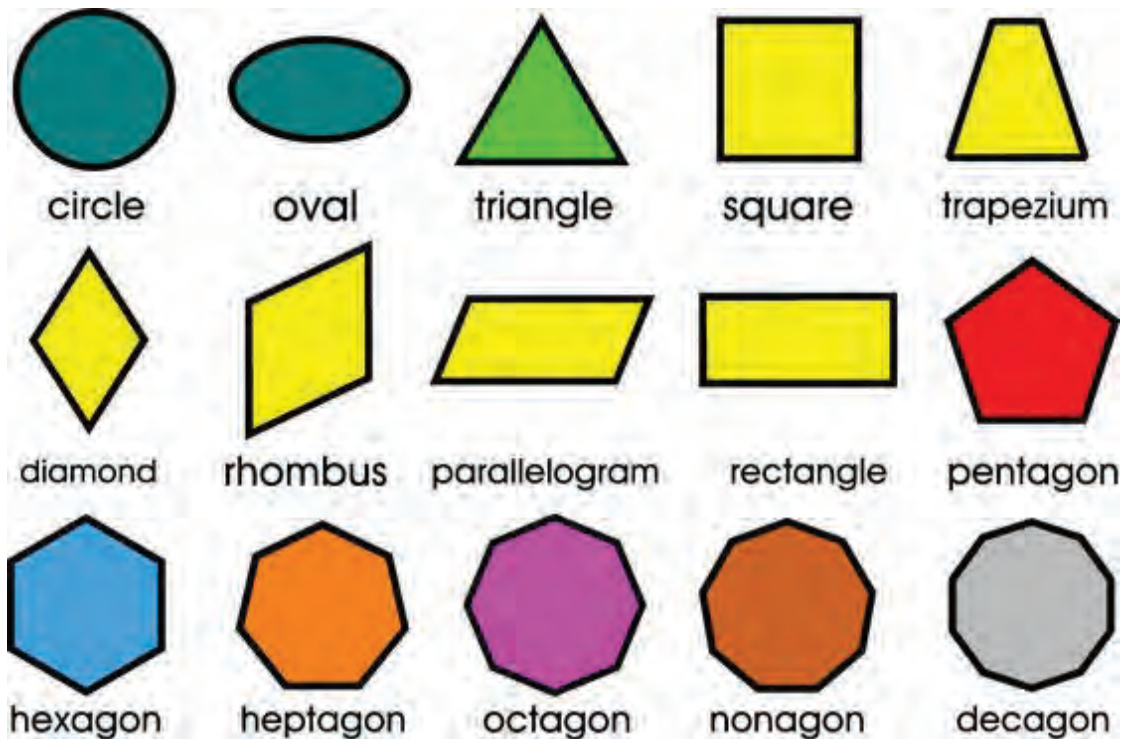


- g. Individually, construct the following angles:

- Primary angles
- Secondary angles



## Chapter 4: Basic Shapes



### Key Words

- shapes
- features
- quadrilaterals
- polygons
- circles
- triangles
- models/mock-ups

### You will need:

1. notebook, drawing pencils (HB, 2H) and pens
2. drawing equipment
3. drawing set
4. engineering articles

After practising activities in this chapter, you will be able to:

1. appreciate common shapes and their features as used in design (k, u).
2. construct different shapes used in design.
3. make models/mock-ups of shapes used in design.



## Introduction

This chapter will introduce you to the basic geometrical shapes and their application in design. After studying this chapter, you will be able to use the shapes to design and make models.

### Activity 4: Practising the application of basic shapes

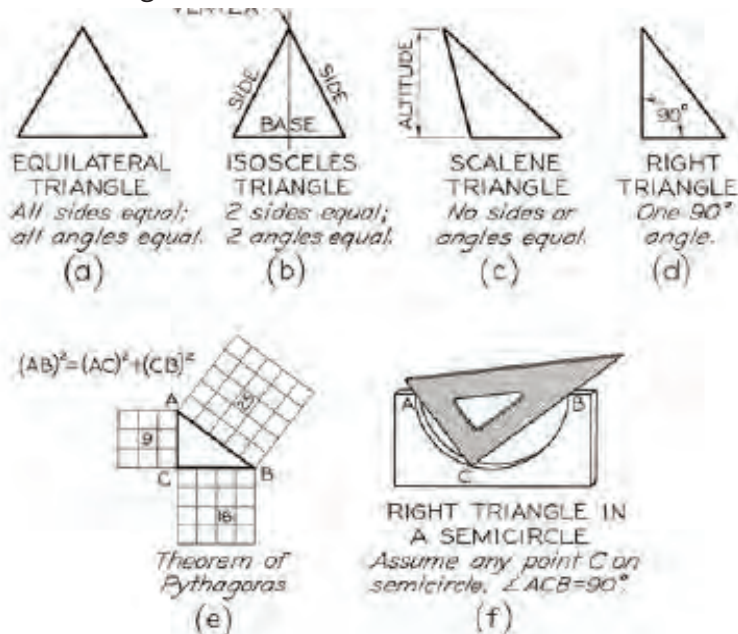
#### 4.1 In groups:

- discuss the basic geometrical shapes used in design.
- discuss the different types of triangles.

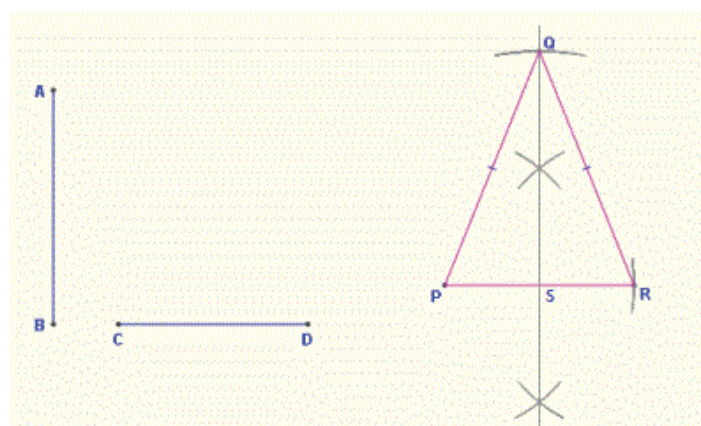
A triangle is a plane figure bounded by three straight sides.

The sum of the interior angles is always

Any triangle inscribed in a semicircle is a right triangle if the hypotenuse coincides with the diameter.

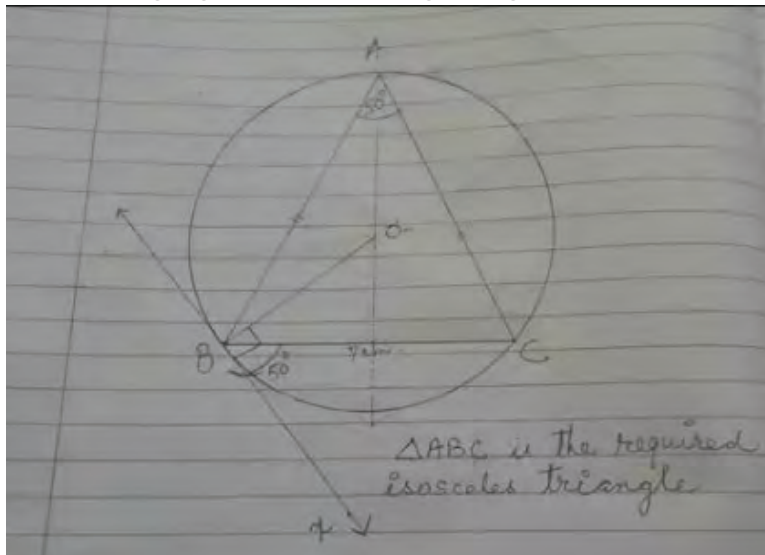


- Individually, practise drawing of triangles.
  - Given Base and Altitude



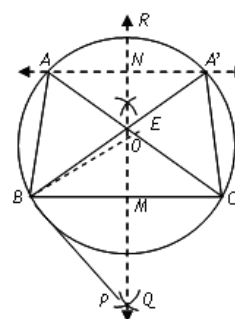


ii) Isosceles triangle given base and right angle

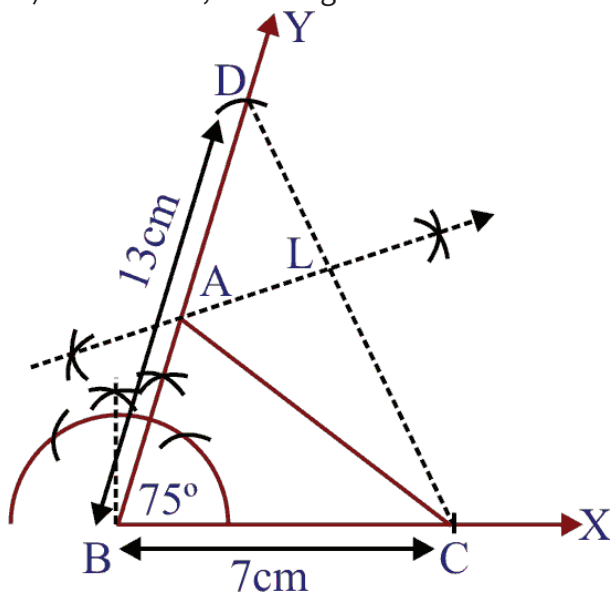


iii) Given base, vertical angle and altitude

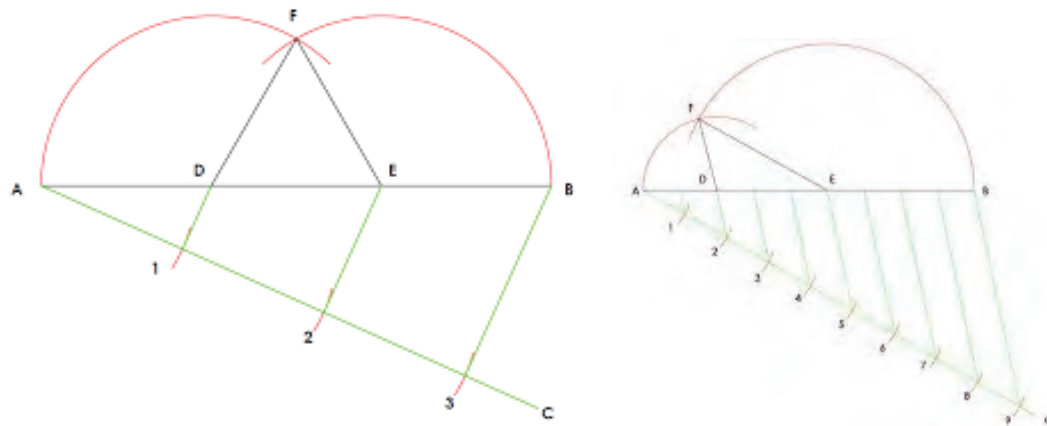
- Step I: Draw a line segment equal to the base  $BC$  (say).  
 Step II: Below  $BC$ , make an  $\angle CBP$  at  $B$  equal to the vertical angle of the triangle.  
 Step III: Draw a line  $BE \perp BP$  at the point  $B$ .  
 Step IV: Draw the right bisector  $QR$  of  $BC$  meeting line  $BE$  at  $O$  and  $BC$  at  $M$ .  
 Step V: With  $O$  as centre and  $OB$  as radius draw a circle.  
 Step VI: Take a point  $N$  on  $QR$  such that  $MN$  is equal to the altitude of the triangle.  
 Step VII: Draw a line parallel to  $BC$  through point  $N$ , intersecting circle drawn in step V at  $A$  and  $A'$ .  
 Step VIII: Join  $AB$ ,  $AC$  and  $A'B$ ,  $A'C$  to obtain triangles  $ABC$  and  $A'BC$  as the required triangles.



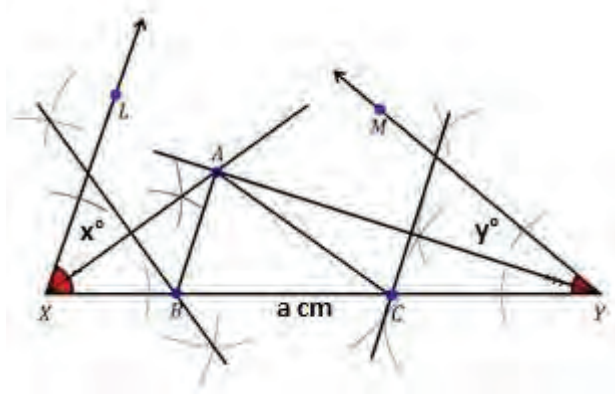
iv) Given base, base angle and sum of two other sides



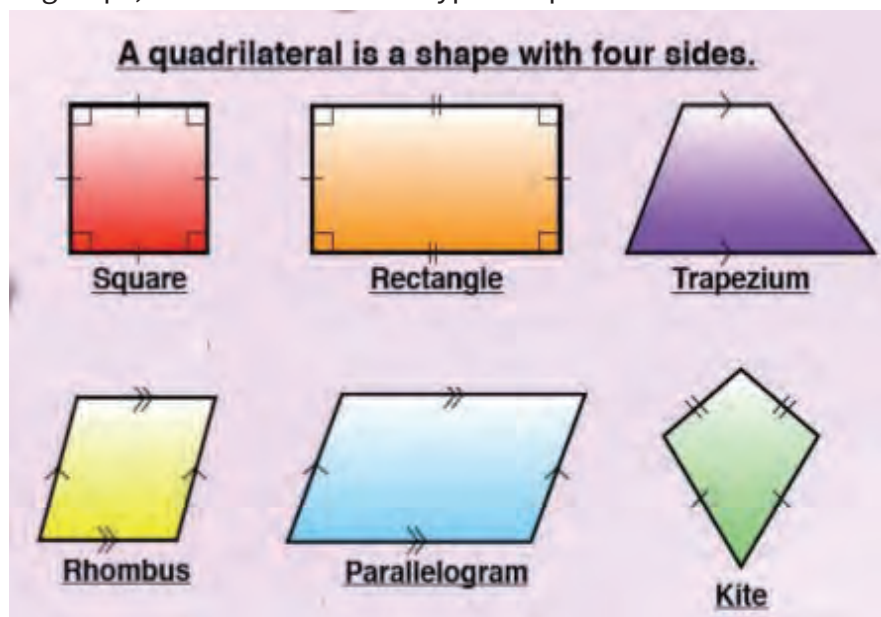
v) Given the perimeter and ratio of sides as 2:3:4



vi) Given perimeter and two base angles

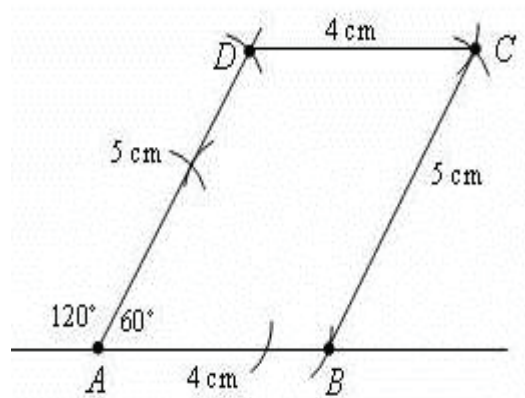


d. In groups, discuss the different types of quadrilaterals.

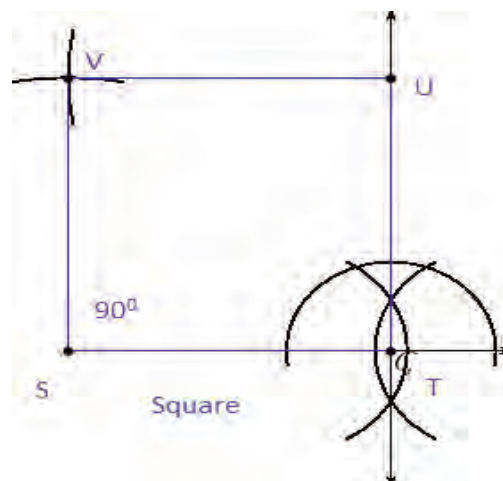


e. Individually, practise construction of different types of quadrilaterals.

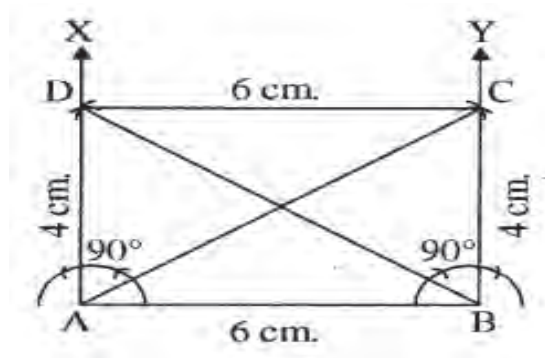
### Parallelogram



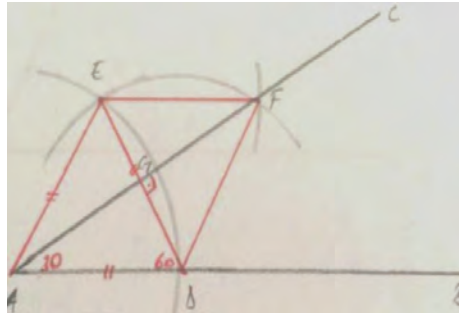
### Square



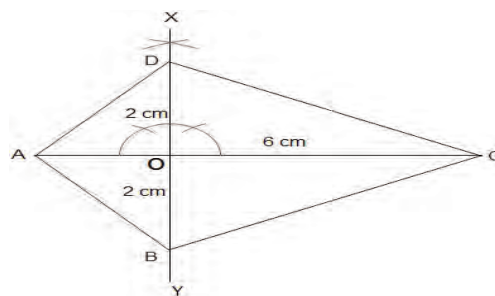
### Rectangle



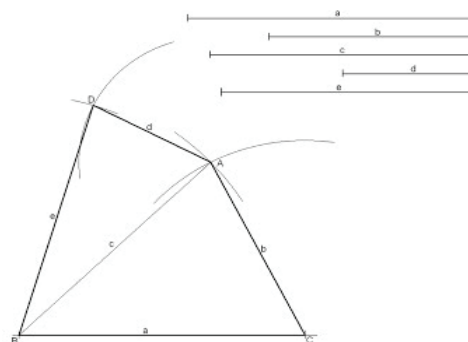
### Rhombus



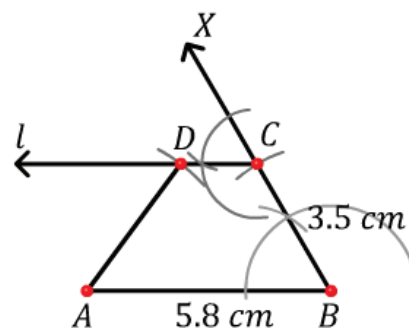
### Kite/Trapezium



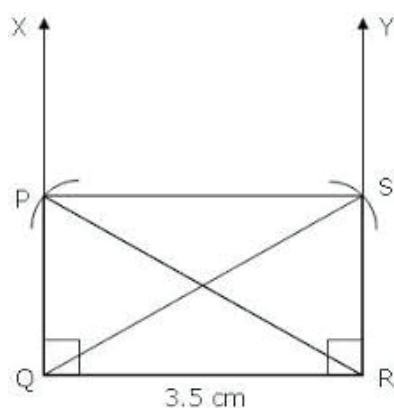
### Trapezoid



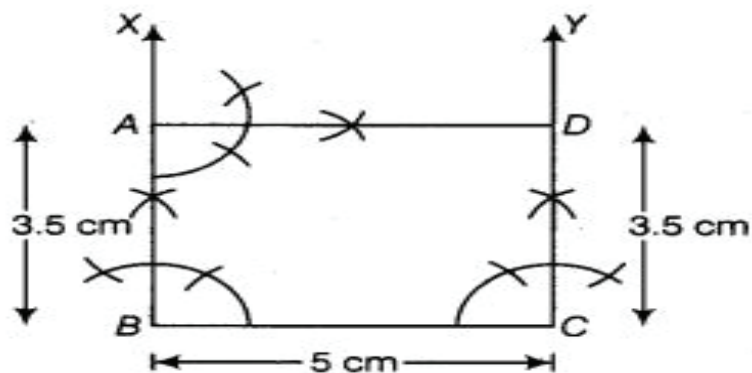
### Trapezium



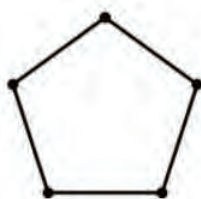
**Construct a rectangle given diagonal and one side**



**Construct a rectangle using right angles**



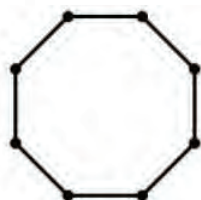
f. In groups, discuss the different types of polygons.



regular pentagon  
sum of angles =  $540^\circ$   
each angle  
=  $540/5 = 108^\circ$



regular hexagon  
sum of angles =  $720^\circ$   
each angle  
=  $720/6 = 120^\circ$



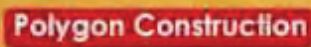
regular octagon  
sum of angles =  $1080^\circ$   
each angle  
=  $1080/8 = 135^\circ$



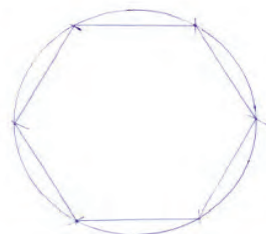
regular decagon  
sum of angles =  $1440^\circ$   
each angle  
=  $1440/10 = 144^\circ$



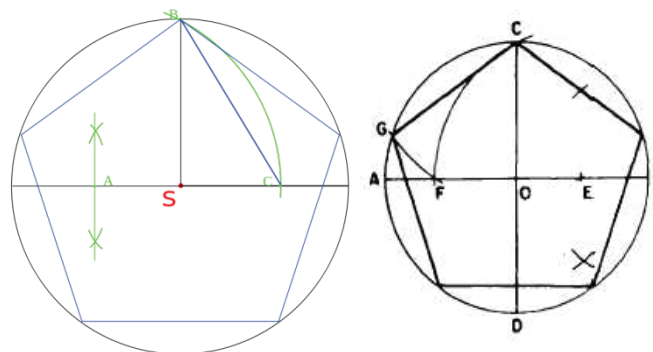
- i) Regular polygons given one side



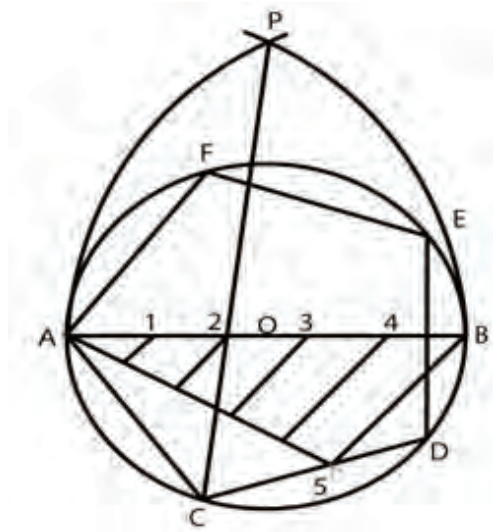
- ii) Hexagon given length of one side/radius of the circle



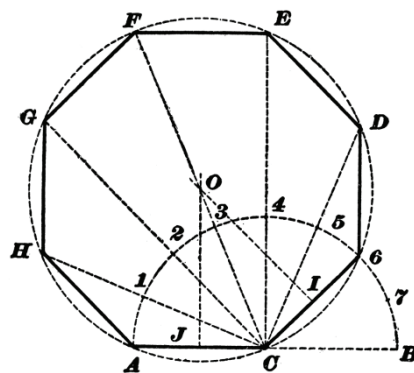
- iii) Pentagon given diameter of the circumscribing circle



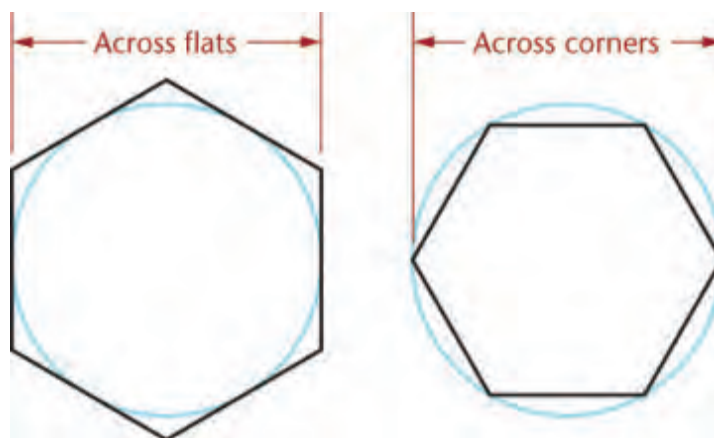
iv) Regular polygons given diameter of the circumscribing circle (General method).



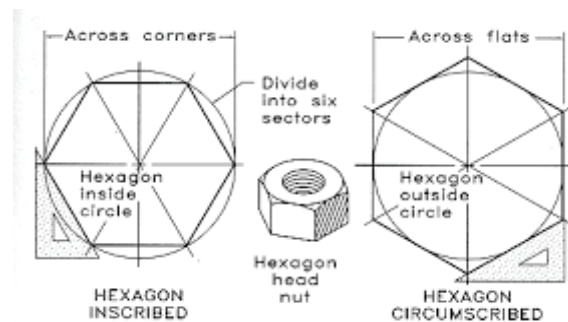
v) Polygon given one side using semi-circle method



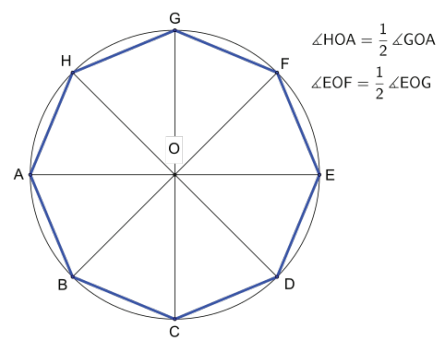
vi) Across corners/flats



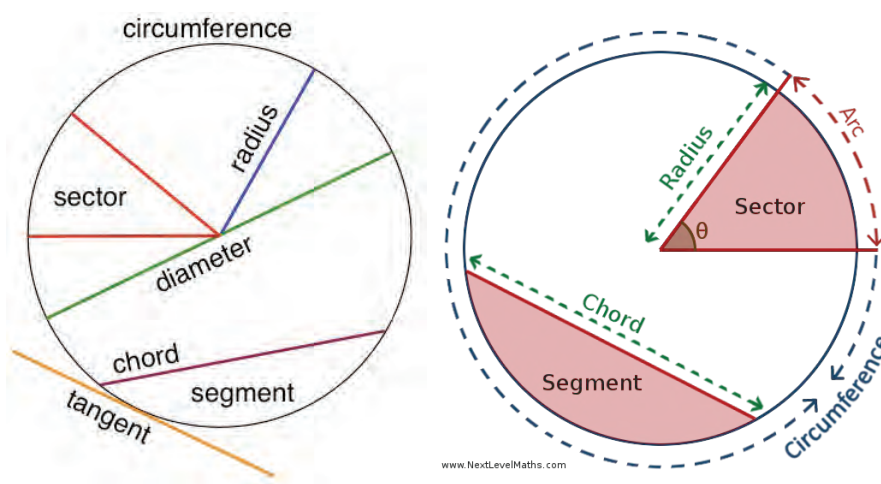
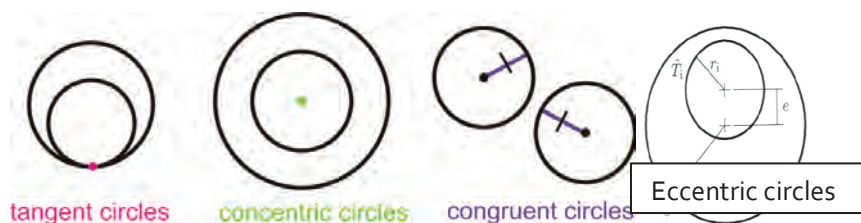
### Hexagon across corners/flats



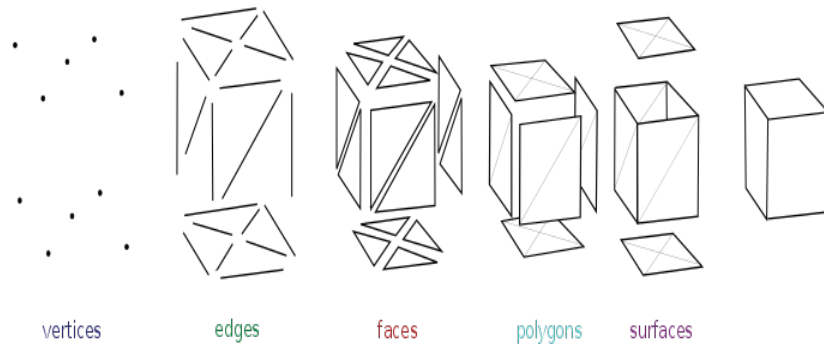
### Octagon across corners



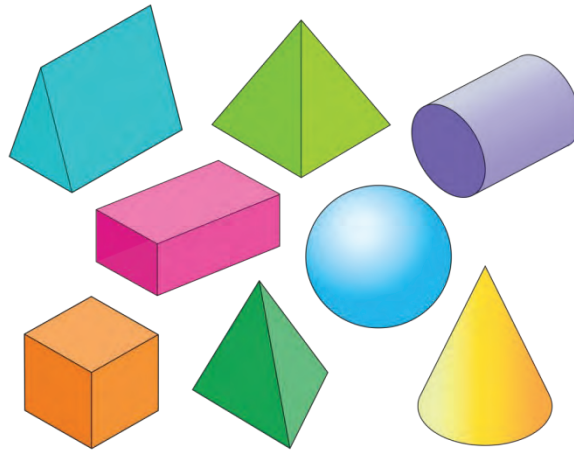
h. In groups, discuss the different types and features of circles.



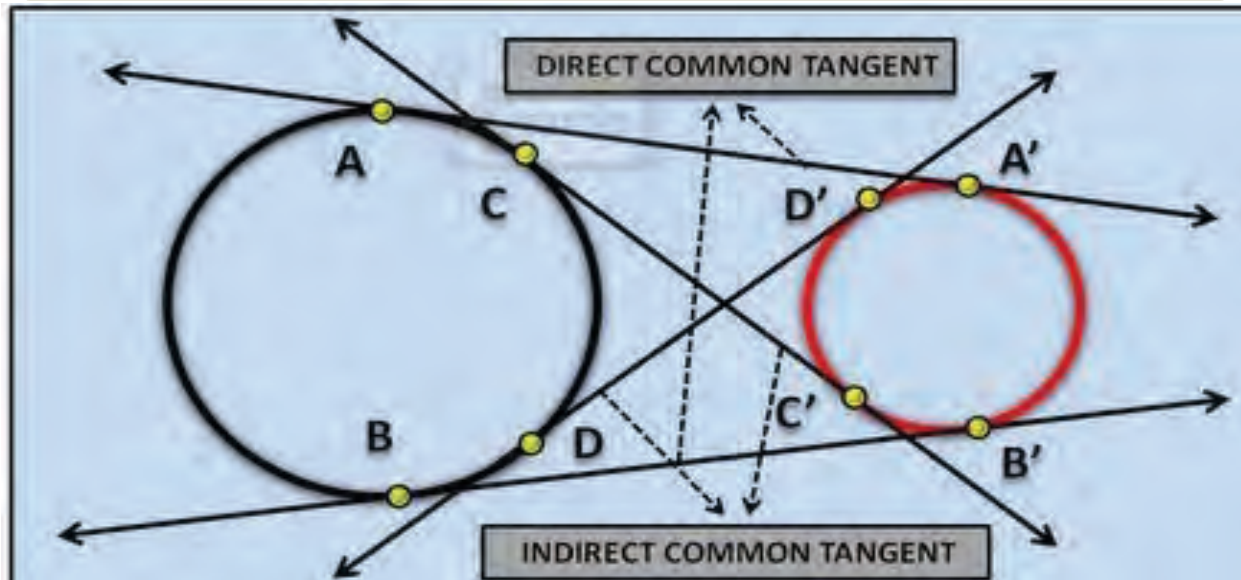
- i. Individually, combine different shapes to form a model.



- j. Individually, use the available materials to produce the designed models.



## Chapter 5: Tangents to Circles



### Key Words

- Tangent
- Normal
- Tangency/point of contact
- Direct common tangent
- Transverse/Indirect common tangent

### You will need:

- notebook, pencil, pens
- engineering articles
- colours
- drawing instruments

After studying this chapter and practising its activities, you should be able to:

1. identify tangents used in design.
2. construct different tangents.
3. make models/mock-ups to show how tangents are applied in design in day-to-day life.



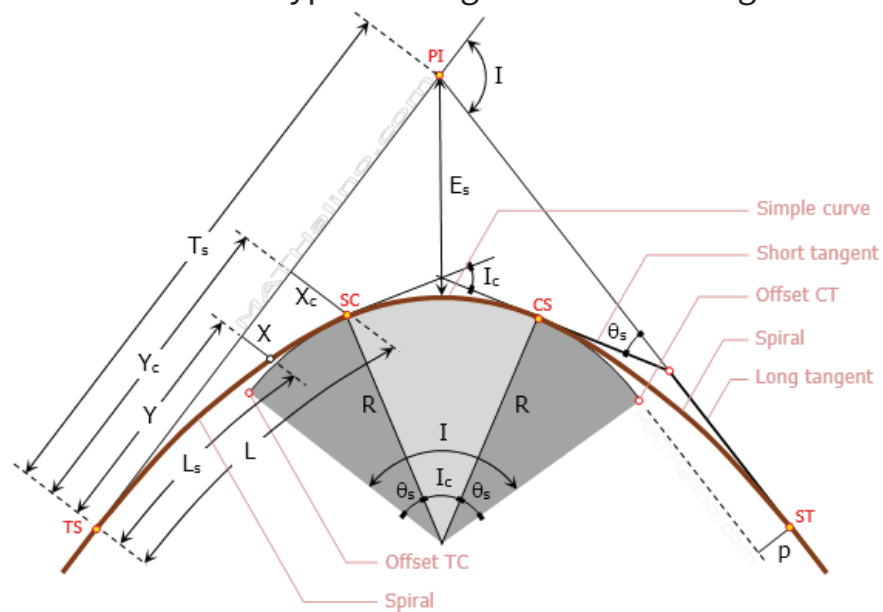
## Introduction

This chapter introduces you to the different types of tangents, their construction and application in design.

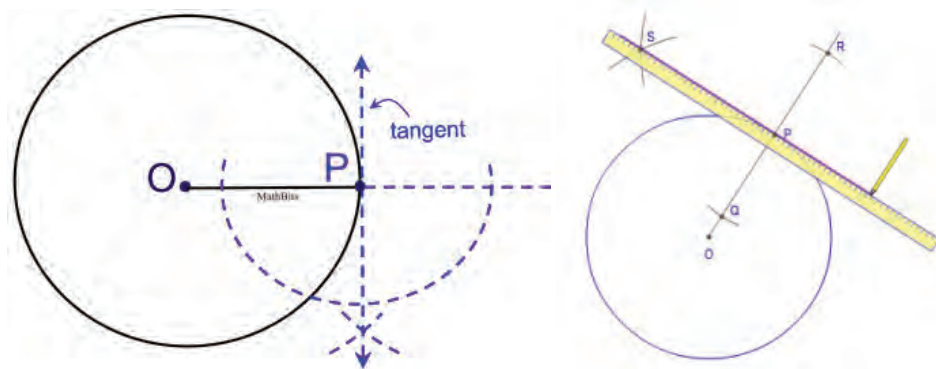
By studying this chapter, you will be equipped with knowledge and skills to apply the different principles of tangency in making models and different engineering designs.

### Activity 6: Observe health, safety, security and environmental rules and regulations

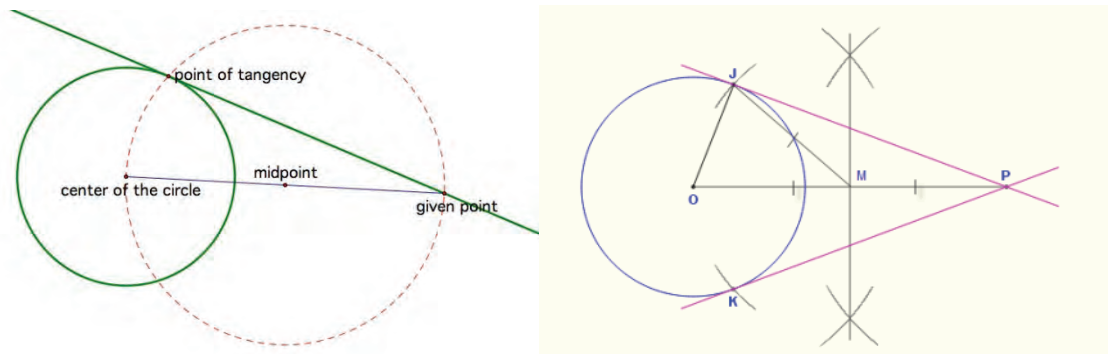
5.1 In groups brainstorm the types of tangents used in design.



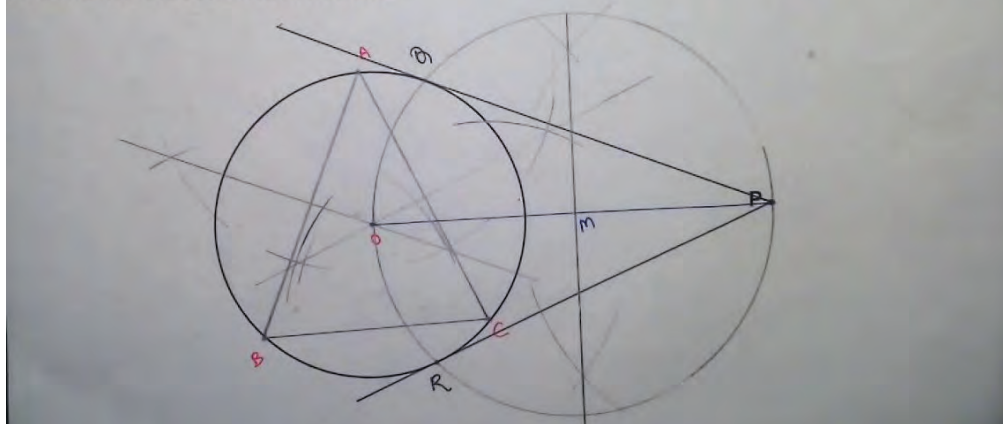
- 5.2 Individually, construct a tangent to a circle from a point on the circumference of the circle.



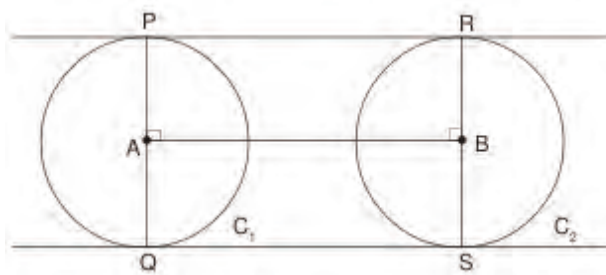
- 5.3 Individually, construct a tangent to a circle from a point outside the circle.



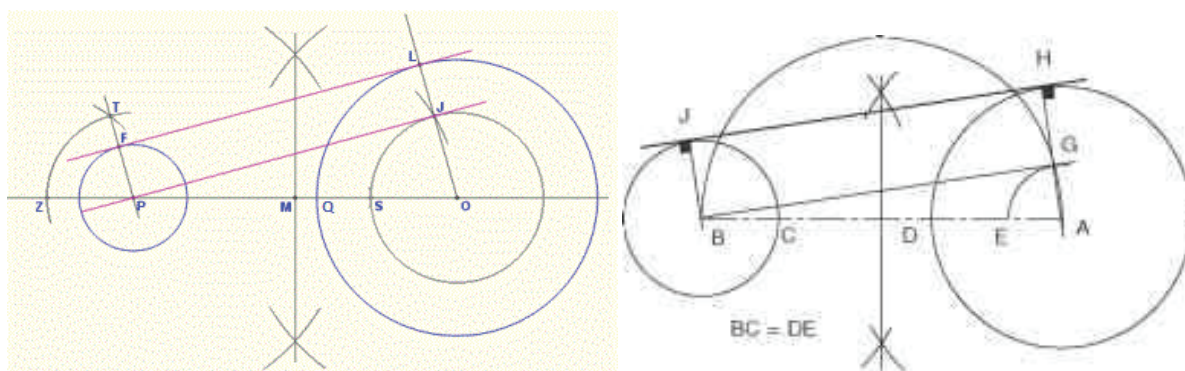
Draw a pair of tangents on a circle, from a point 'P' outside the circle, when center of circle is unknown.



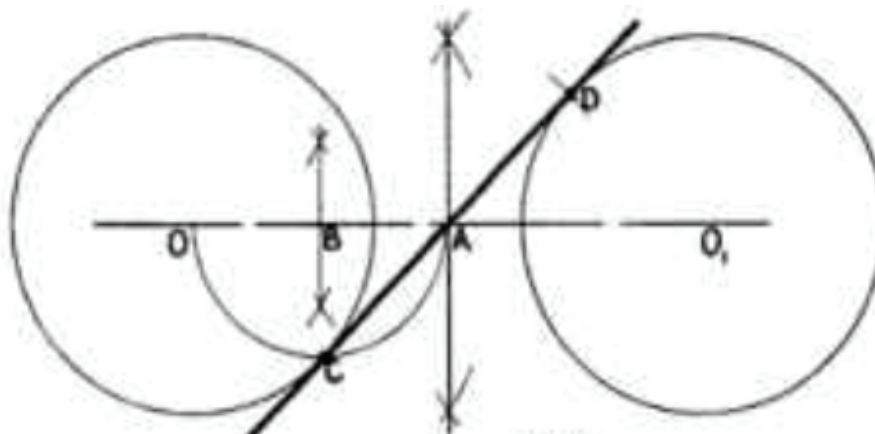
- 5.4 Individually, construct a common:  
i) external tangent to two equal circles.



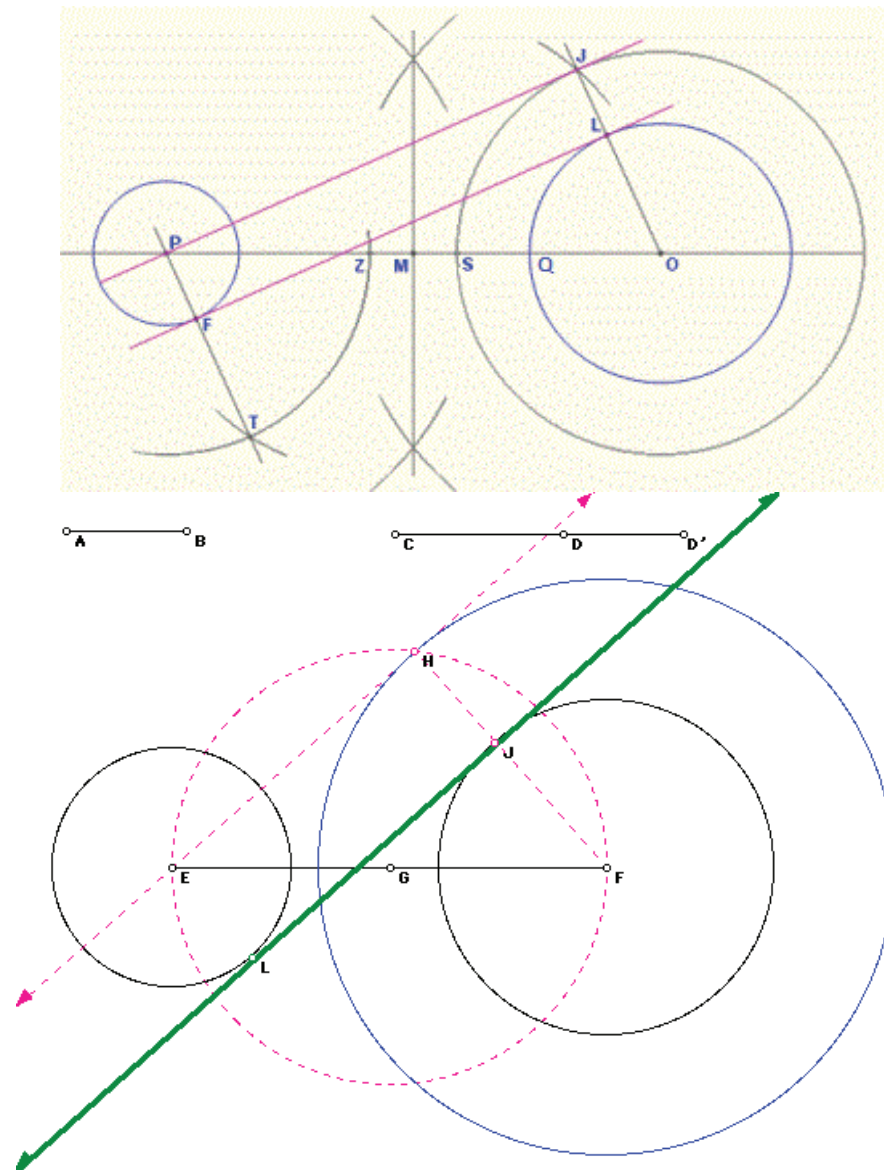
- ii) external tangent to two unequal circles.



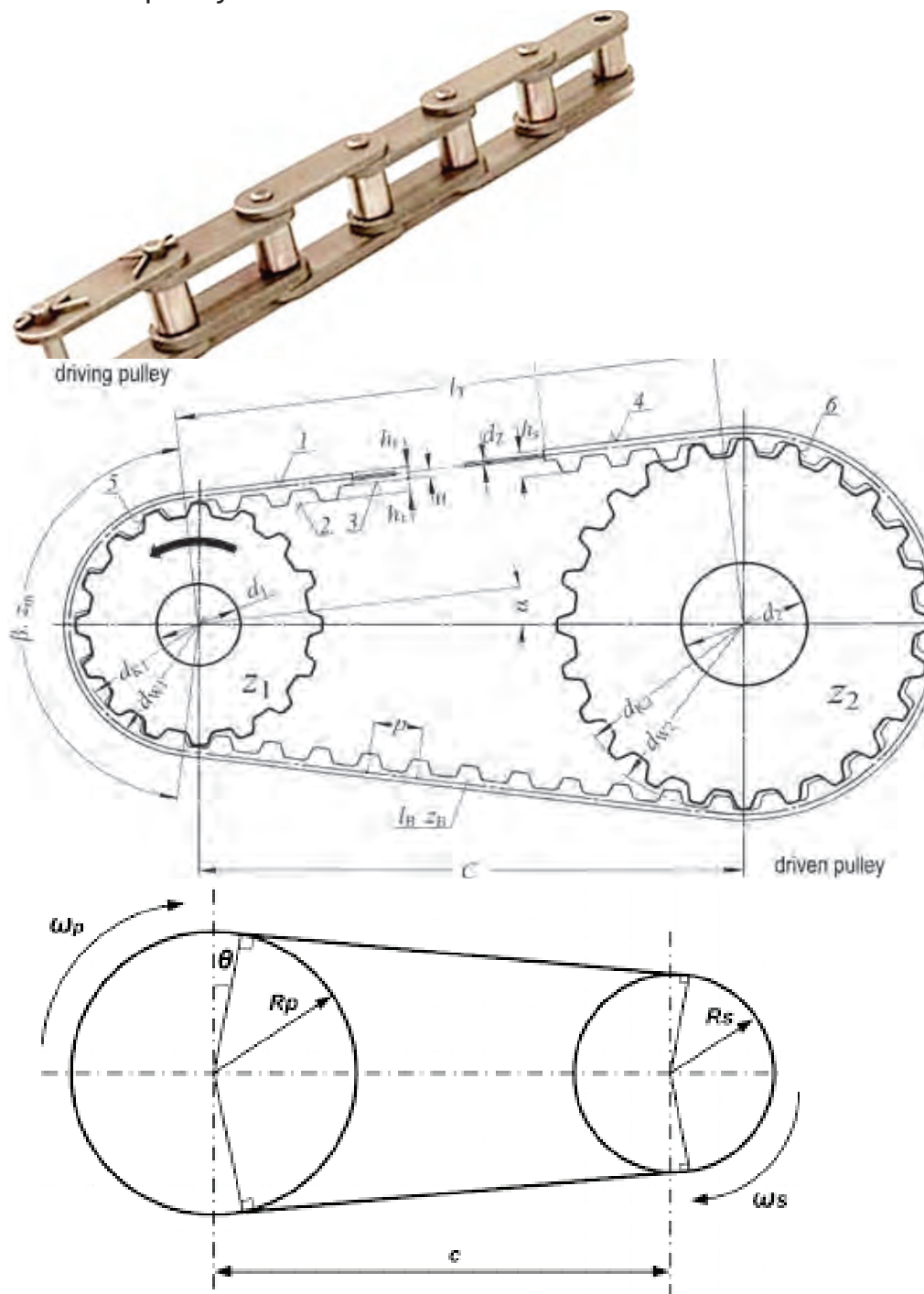
- 5.5 Individually, construct a common internal tangent to two:  
i) equal circles.



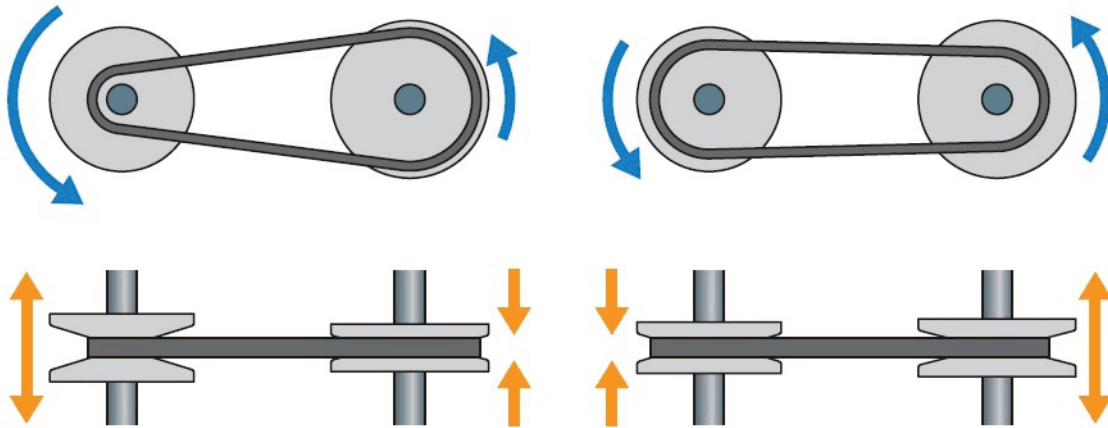
ii) unequal circles.



- 5.6 In pairs, use the principles of tangency to design models e.g. bicycle chain links and pulleys.







- 5.7 In pairs, use appropriate materials to make models of the designed articles using local materials available in the environment.

