

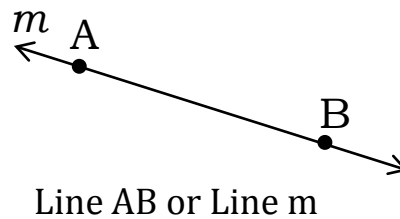
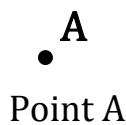


## Points and lines

In mathematics, a point is represented by a dot (.) and is used to tell the exact location in space. It does not have any length, width or height. A point is usually named using upper case (capital) letters.

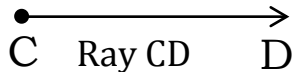
When two or more points are connected, they form a line.

A **line** is defined by two points. It can be marked with a single letter in lower case or by two capital letters. A line has no thickness and can extend indefinitely in both directions as shown in the figures below.

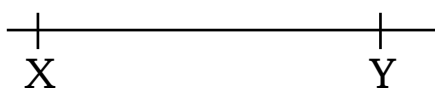


## A ray and a line segment

A ray is a part of a line that has a fixed starting point but one end point. It can extend infinitely in one direction as shown below



A line segment is part of a straight line that is bounded by two distinct end points.



This is line segment XY or YX. It has two end points X and Y whose length is the distance between its end points X and Y.

## Drawing / constructing and measuring line segments

### Revision exercise

1. Draw the following line segments.

- |                        |                         |
|------------------------|-------------------------|
| i) $AB = 3\text{cm}$   | iv) $XP = 7.5\text{cm}$ |
| ii) $XY = 4\text{cm}$  | v) $KL = 5.3\text{cm}$  |
| iii) $MT = 5\text{cm}$ | vi) $PQ = 49\text{cm}$  |

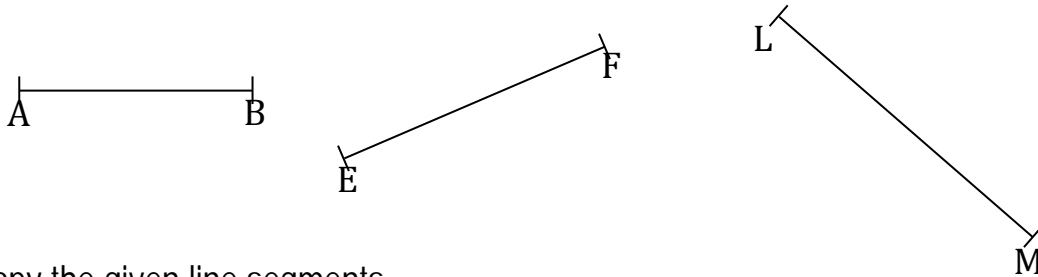
2. Using a ruler, a pencil and of compasses only, construct the following lines.

- |           |           |
|-----------|-----------|
| a) 6.5cm  | e) 5.6 cm |
| b) 7cm    | f) 9.1cm  |
| c) 8.4cm  | g) 5.5cm  |
| d) 4.4 cm | h) 6.8cm  |

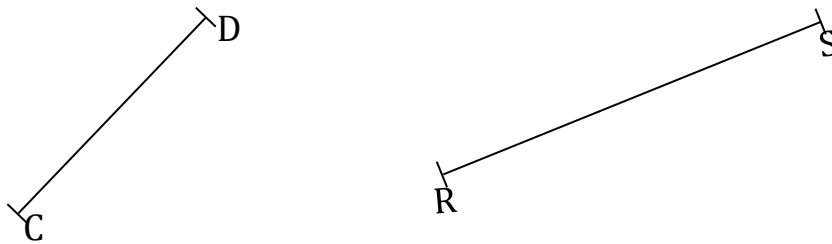
## TOPIC 7: GEOMETRIC CONSTRUCTION



3. Measure the length of the given line segments.



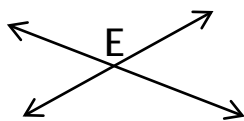
4. Copy the given line segments



### Identifying intersecting lines, parallel lines and skew lines

#### Intersecting lines

When two or more lines cross each other in a plane, they are called intersecting lines.

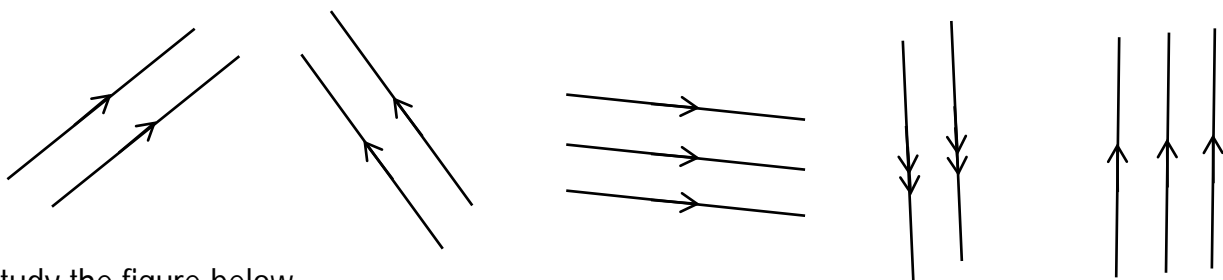


*The two lines intersect at point E*

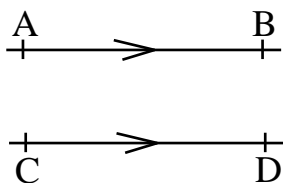
**Note:** Intersecting lines share a common point called the point of intersection.

#### Parallel lines

Parallel lines are straight lines with a constant distance between them. Parallel lines can also be defined as two or more lines in the same plane which are at equal distance from each other and never meet. Below are of parallel lines.



Study the figure below.



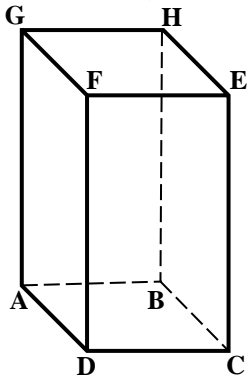
From the figure line AB is parallel to CD, this can also be written as  $AB \parallel CD$



## Skew lines

In three dimensional geometry, skew lines are two lines that do not intersect and are not parallel. Two lines that both lie in the same plane must either cross each other or be parallel, so skew line can only exist in only three or more dimensions.

Study the figure below.



From the figure, the line through segment AD and Segment BH are skew lines because they are not in the same plane.

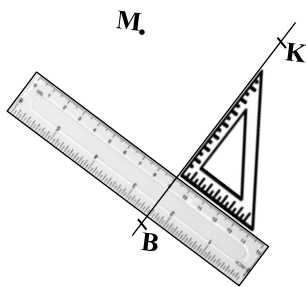
## Drawing parallel lines

### Example

Draw a line parallel to line BK through M using a ruler and a set square.

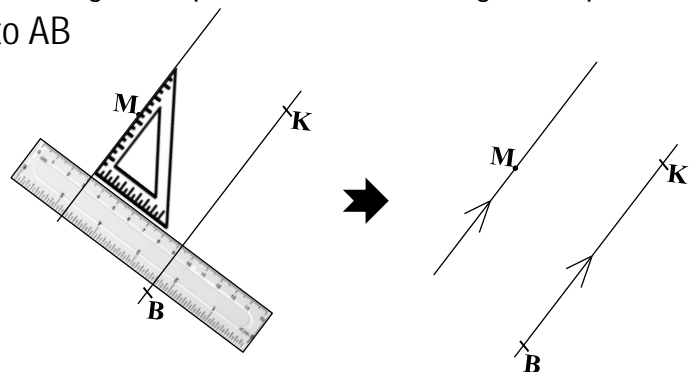
#### Step 1

Place the 60° set squares along the given line BK as shown.



#### Step 2

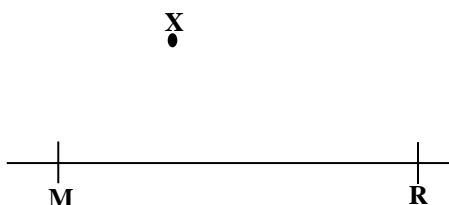
Holding the ruler firmly, slide the set square along the ruler to touch point M and draw a line through M using the square. The line through M is parallel to AB



## Constructing parallel lines

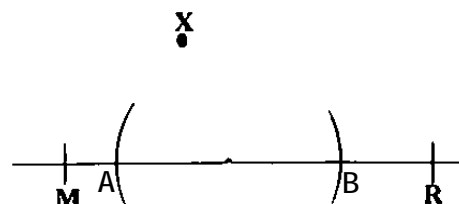
### Example.

Using a ruler, a pencil and a pair of compasses only, construct a line parallel to MR through point X.



#### Step 1

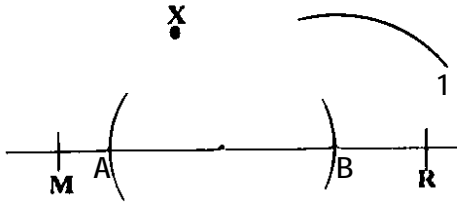
Mark any two points, say A and B on line MR.





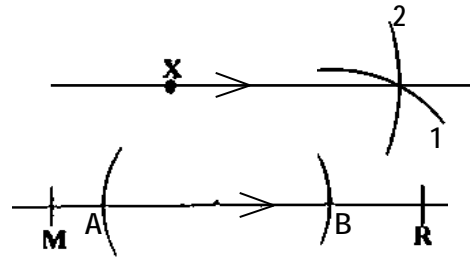
## Step 2

With radius AX and centre B, construct arc 1



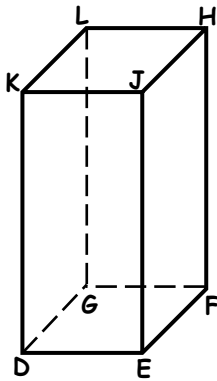
## Step 3

With radius AB and centre X construct the second arc 2. Join point X to the point of intersection of the two arcs



## Exercise

1. Study the figure below and use it to answer questions that follow.



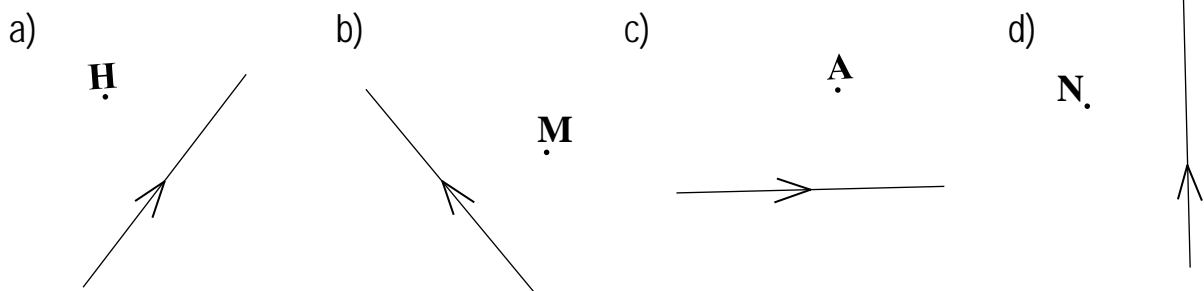
a) Identify skew lines to the following lines from the figure

- i) HF      ii) DE      iii) LG

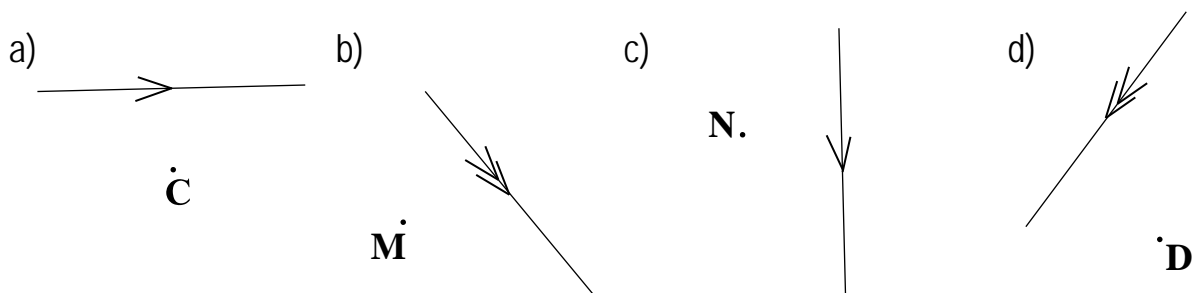
b) State whether they are parallel, skew or intersecting lines.

- i) LH and KJ      iv) DE and HF  
ii) FE and EJ      v) GF and JE  
iii) FE and EJ      vi) KD and GL

2. Using a ruler and a set square, draw lines parallel to the given lines through the given points.



3. Construct parallel lines through the given points.





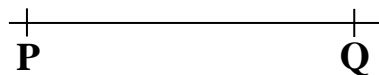
4. Using a ruler, a pair of compasses and a pencil only, construct parallel lines
  - a) 3cm apart
  - b) 2cm apart
  - c) 3.5cm apart
  - d) 4cm apart
  - e) 5.5cm apart
  - f) 4.6cm apart
5. Using a pair of compasses, a ruler and a pencil only, construct the following parallel lines.
  - a) AB and CA = 4cm apart
  - b) KL and WP = 4.3cm apart
  - c) DK and WP = 5.1cm apart
  - d) RN and BD = 4.8cm apart
  - e) XM and YZ = 5.3cm apart
  - f) AR and MT = 6.9cm apart
  - g) TQ and MY = 4.7cm apart
  - i) PR and ST = 3.8cm apart

## Bisecting lines segments

Bisecting means dividing into two equal parts (halves)

### Example

Using a ruler, a pencil and a pair of compasses only, bisect line PQ below.



### Step 1

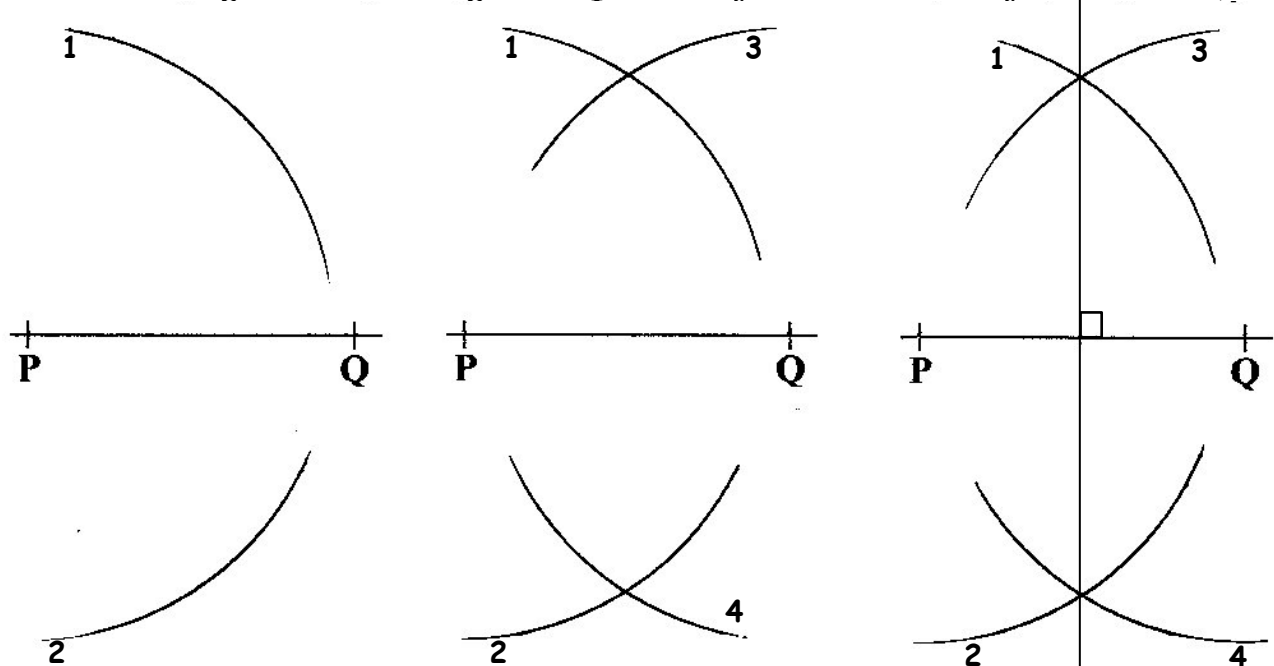
Place the compass at point p and adjust it slightly longer than half of the line segment PQ. Mark arcs 1 and 2.

### Step 2

Using the same radius, place the compass at point Q and mark the arcs 3 and 4.

### Step 3

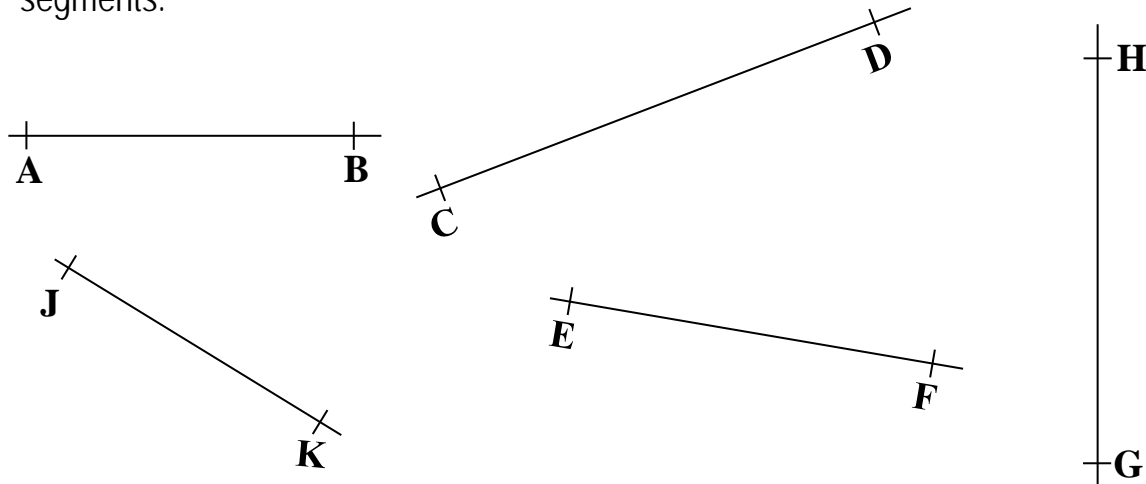
Draw a straight line through the points of intersection of the arcs 1,3



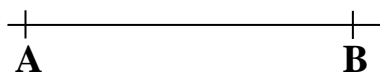


## Exercise

- Using a pair of compasses, a sharp pencil and a ruler only, bisect the following line segments.



- Using a ruler, a pair of compasses and a pencil only

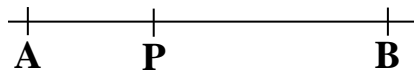


- Construct a line that bisects line AB at P
- Measure line AP in cm.

## Drawing perpendicular lines.

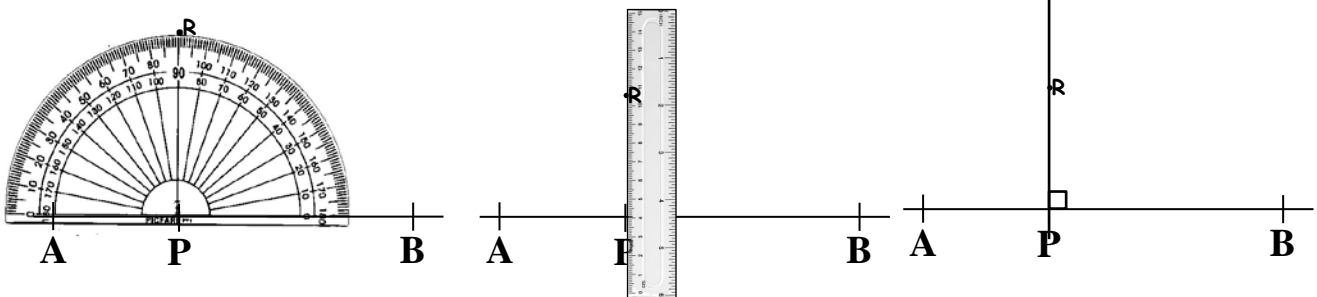
### Example

Draw a perpendicular line at P using a protractor, a ruler and a pencil only.



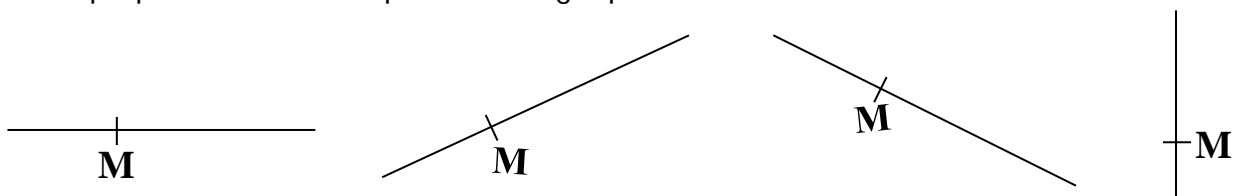
### Steps

- Place the central point of your protractor at P.
- Let line  $0^\circ$  to  $180^\circ$  lie on AB and mark point D.
- Remove the protractor and use a ruler to draw line PR.



## Exercise

Draw a perpendicular line at point M using a protractor and a ruler.



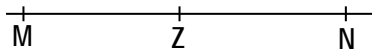
## TOPIC 7: GEOMETRIC CONSTRUCTION



### Constructing perpendicular lines

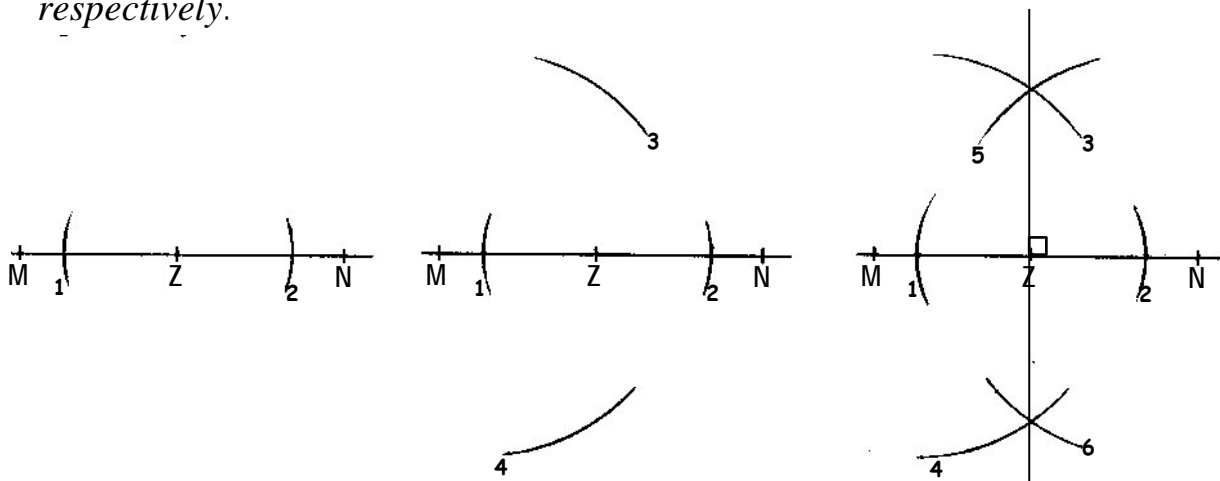
#### Example

Using a ruler and a pair of compasses only, construct a line perpendicular to MN at Z.



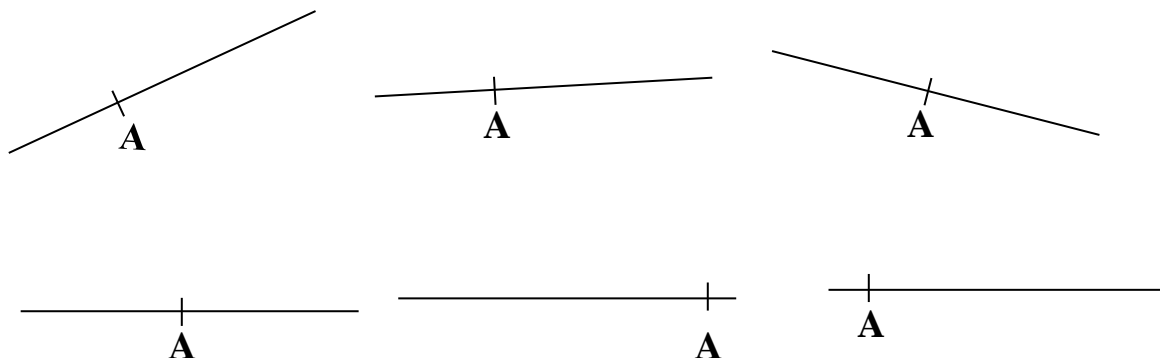
#### Steps

- i) Place the compass at Z and adjust it to a reasonable radius. Mark arcs 1 and 2 on line MN
- ii) Place the compass at the point where arc 1 intersects line MN. Adjust the compass towards arc 2. Construct arcs 3 and 4.
- iii) Using the same radius, place the compass at the point where arc 2 intersects line MN. Construct arcs 5 and 6.
- iv) Draw a straight line through the points of intersection of the arcs 3,5 and 4,6 respectively.



#### Exercise

1. Using a ruler, a pencil and a pair of compass only, construct a perpendicular line at point A on the given lines.



2. Draw the following lines, construct a perpendicular line at P using a ruler, a pencil and a pair of compasses only.

- |          |         |
|----------|---------|
| i) WPS   | iv) APE |
| ii) PQS  | v) QRP  |
| iii) BOP | vi) PEM |

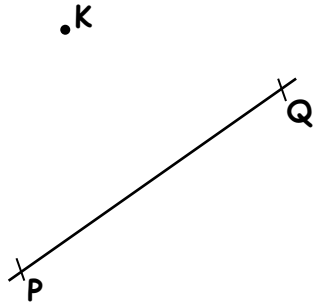
## TOPIC 7: GEOMETRIC CONSTRUCTION



### Dropping a perpendicular line

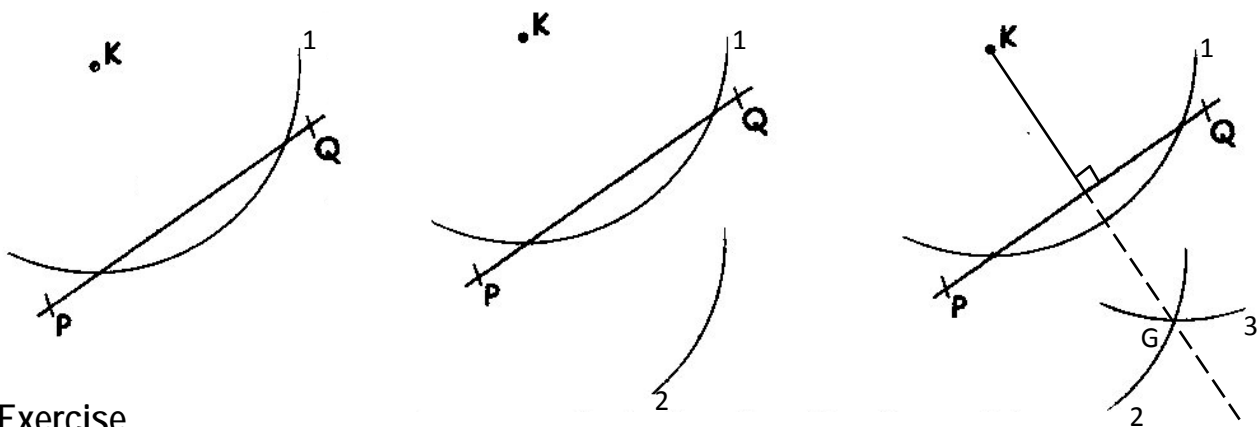
#### Example

Drop a perpendicular line from point K to meet line PQ



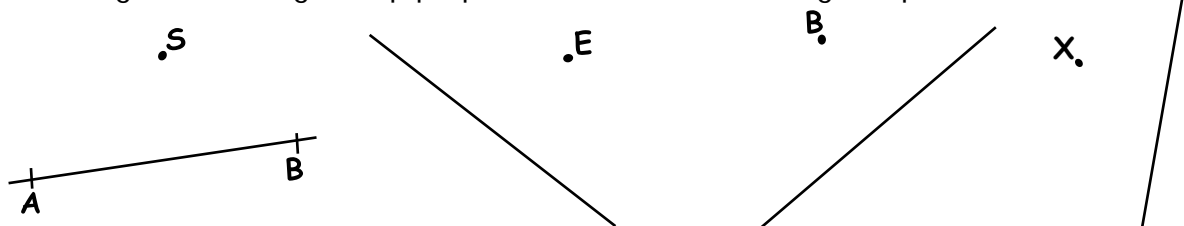
#### Steps

- Set the needle of the compass at K and strike an arc 1 intersecting PQ at E and F
- With E and F as centres and any radius larger than half of EF, strike arcs 2 and 3 intersecting at G. Join KG perpendicular to PQ.

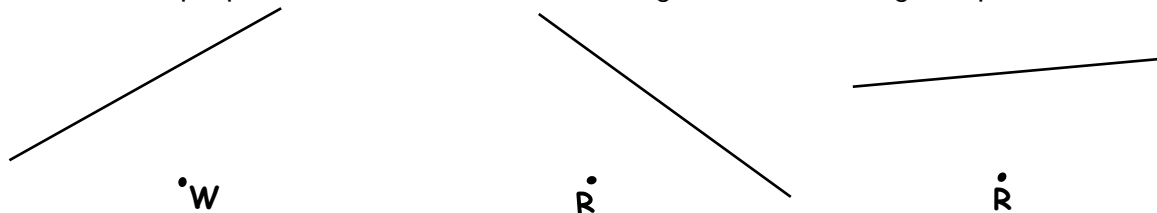


#### Exercise

- In the given drawings, drop perpendicular lines from the given points.



- Construct a perpendicular line onto the line segments from the given points.

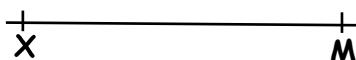


- Using a ruler, a pencil and a pair of compasses only.

•W

•R

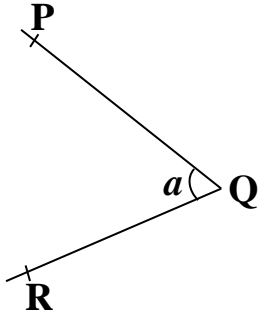
- Drop a perpendicular from R to intersect line XM at A.
- Measure length RA in centimetres.





## ANGLES

An angle is formed when two lines meet or intersect at a point / vertex. The measure of rotation in degrees ( $^{\circ}$ ) from one line segment to the other is an angle as shown in the figure below.



From the figure, we have two line segments PQ and QR which meet at a common point Q.

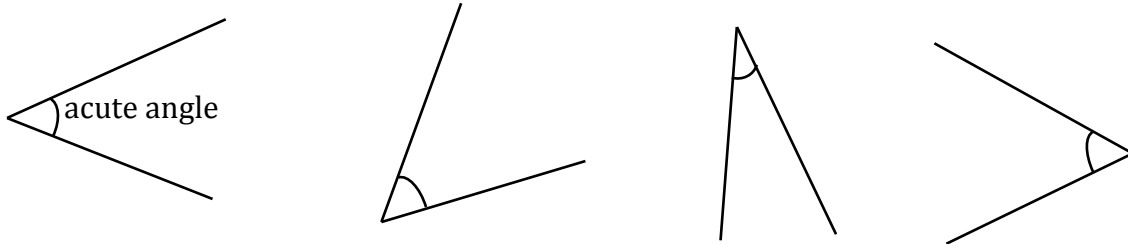
Angle  $a$  is formed at point Q, we can name the marked angle as angle PQR /  $\angle$  PQR or angle RQP /  $\angle$  RQP.

### Main types of angles

#### Acute angles

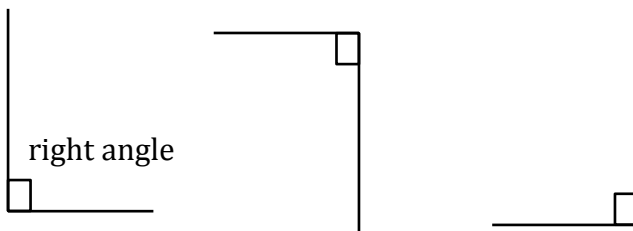
These are angles which are greater than  $0^{\circ}$  but less than  $90^{\circ}$  e.g.  $1^{\circ}$ ,  $2^{\circ}$ ,  $15^{\circ}$ ,  $48^{\circ}$ ,  $85^{\circ}$ ,  $89^{\circ}$ ,  $75^{\circ}$  etc.

#### Drawings showing acute angles



#### Right angles

These are angles formed by two lines perpendicular to each other.

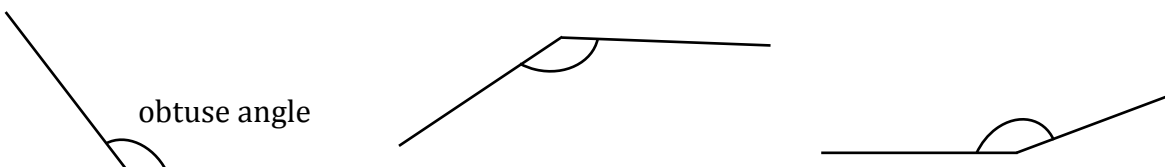


A right angle measures  $90^{\circ}$

#### Obtuse angles

These are angles which are greater than  $90^{\circ}$  but less than  $180^{\circ}$

They are angles between  $90^{\circ}$  and  $180^{\circ}$  e.g.  $91^{\circ}$ ,  $124^{\circ}$ ,  $175^{\circ}$ ,  $189^{\circ}$ ,  $160^{\circ}$  etc.

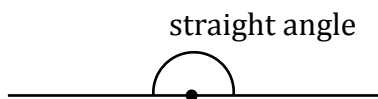


## TOPIC 7: GEOMETRIC CONSTRUCTION



### Straight angles

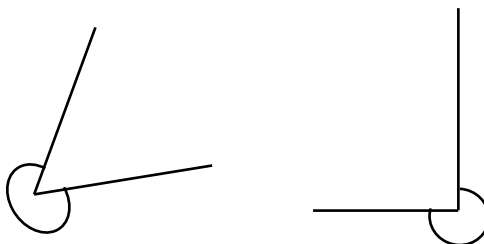
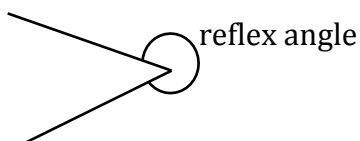
A straight angle measures  $180^\circ$



*Note:* Angles on a straight line add up to  $180^\circ$ .

### Reflex angles

These are angles which are greater than  $180^\circ$  but less than  $360^\circ$  e.g.  $210^\circ$ ,  $190^\circ$ ,  $181^\circ$ ,  $300^\circ$ ,  $350^\circ$ ,  $359^\circ$ ,  $348^\circ$  etc.



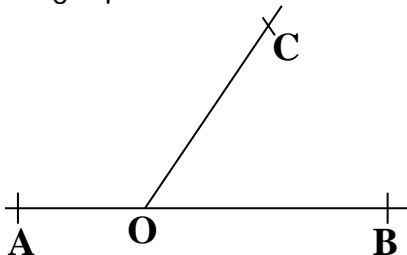
### Angles at a point

Angles at a point add up to  $360^\circ$ .

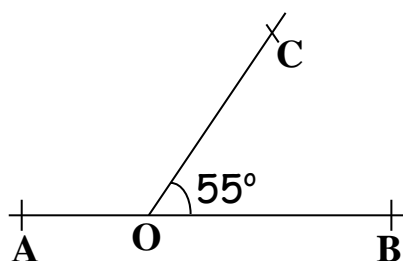
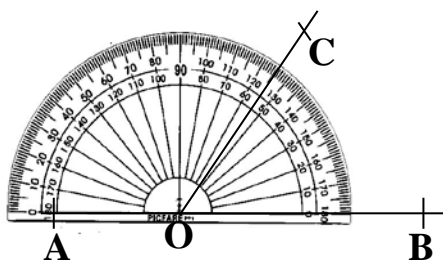
### Measuring angles using a protractor.

#### Example

Using a protractor, measure angles COB



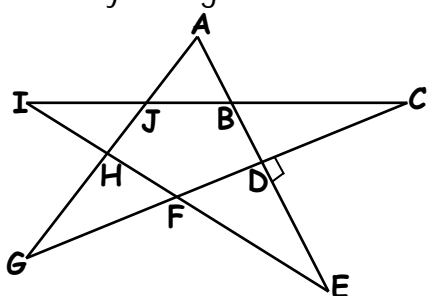
*To measure the angle, place the protractor on line **AB** such that its centre exactly covers the vertex of the angle at **O** and measure using the inner scale as shown below.*



Angle COB =  $55^\circ$

#### Exercise

1. Study the figure below.

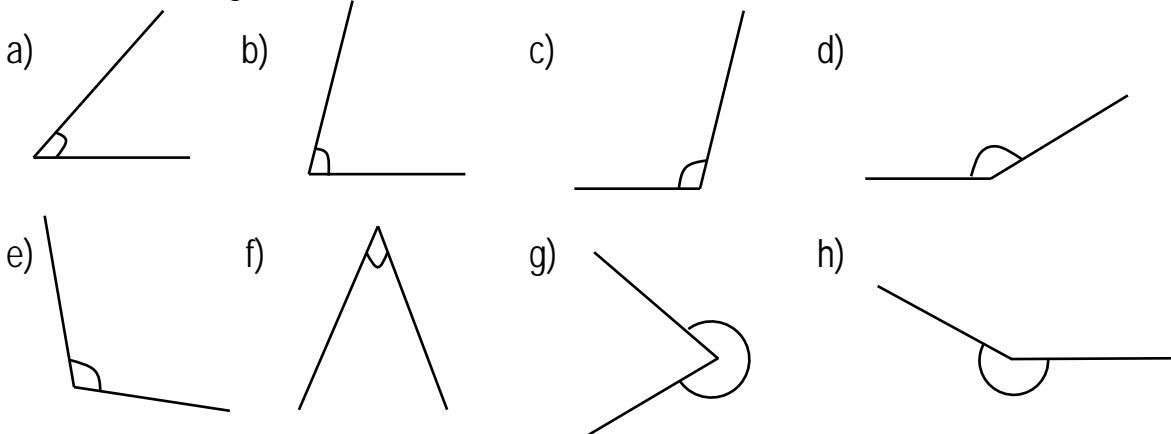


Use acute angle, right angle, obtuse angle and reflex angles to describe the following angles.

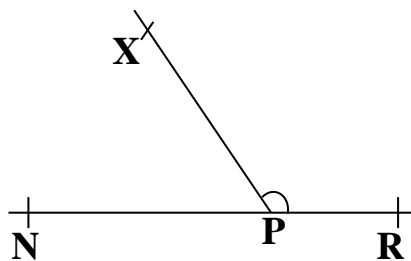
- |                   |                  |                    |
|-------------------|------------------|--------------------|
| i) $\angle ADC$   | iv) $\angle FHA$ | vii) $\angle GFE$  |
| ii) $\angle GFE$  | v) $\angle GFD$  | viii) $\angle FDE$ |
| iii) $\angle IFD$ | vi) $\angle BCD$ | ix) $\angle FED$   |



2. Measure the angles drawn below.



3. Study the figure below and use it to answer the questions that follow.



- Which type of angle is XPR marked on the figure.
- Using a protractor, measure
  - acute angle NPX.
  - obtuse angle RPX.
  - reflex angle XPN.
  - reflex angle RPX.

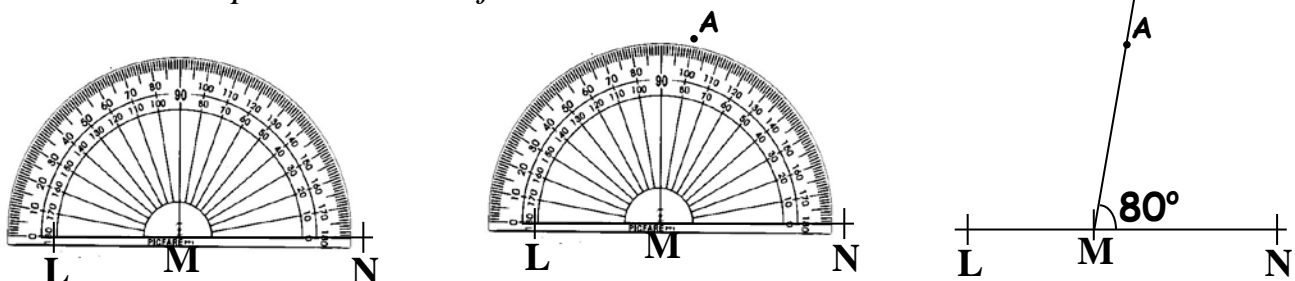
## Drawing angles

### Example

Using a ruler, a pencil and a protractor only, draw an angle of  $80^\circ$  at point M

### Steps

- Place the central point of your protractor at P.
- Let line  $0^\circ$  to  $180^\circ$  lie on LN.
- Count  $80^\circ$  round the edge of the protractor from zero line and put a dot A. Remove the protractor and join A to M.



### Exercise

1. Use a protractor to draw an angle of;

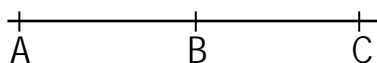
- |               |                |                |                |                |
|---------------|----------------|----------------|----------------|----------------|
| a) $30^\circ$ | d) $78^\circ$  | g) $105^\circ$ | j) $45^\circ$  | m) $110^\circ$ |
| b) $54^\circ$ | e) $49^\circ$  | h) $120^\circ$ | k) $88^\circ$  | n) $135^\circ$ |
| c) $60^\circ$ | f) $100^\circ$ | i) $170^\circ$ | l) $150^\circ$ | o) $30^\circ$  |



2. With the help of a protractor, draw the following angles
 

a) $190^\circ$	d) $330^\circ$	h) $210^\circ$
b) $200^\circ$	e) $300^\circ$	i) $181^\circ$
c) $260^\circ$	f) $270^\circ$	j) $355^\circ$
3. Using a protractor, draw the following angles.
 

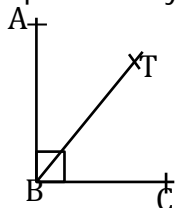
a) $\angle ABC = 45^\circ$	b) $\angle MTR = 60^\circ$	c) $\angle WPS = 82^\circ$	d) $\angle CAR = 100^\circ$
----------------------------	----------------------------	----------------------------	-----------------------------
4. Study the figure below and use it to answer questions that follow.



- a) Draw angle  $\angle ABD = 35^\circ$
- b) Draw angle  $\angle CBX = 52^\circ$
- c) Measure angles;
  - i)  $\angle DBX$
  - ii)  $\angle XBA$

## Complementary angles

- \* When the sum of two angles is  $90^\circ$ , the angles are known as complementary angles.
- \* If two angles add up to form a right angle, then these angles are referred to as complementary angles.



Angles ABT and TBC are complementary angles  
 $\angle ABT + \angle TBC = 90^\circ$

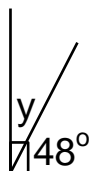
**Note:** Complementary angles are two angles that add up to  $90^\circ$ .

### Example 1

Find the complement of  $48^\circ$

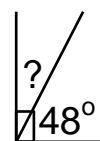
#### Approach 1

Let the complement be  $y$



$$\begin{aligned}
 y + 48^\circ &= 90^\circ \\
 y + 48^\circ - 48^\circ &= 90^\circ - 48^\circ \\
 y &= 42^\circ
 \end{aligned}$$

#### Approach 2



$$90^\circ - 48^\circ = 42^\circ$$

### Example 2

Find the complement of  $y + 20^\circ$

$$\begin{aligned}
 90^\circ - (y + 20^\circ) \\
 90^\circ - y - 20^\circ \\
 90^\circ - 20^\circ - y \\
 70^\circ - y
 \end{aligned}$$

### Example 3

Two complementary angles are in the ratio of 2:3. Find the size of the larger angle.

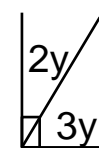
#### Approach 1

Total ratio

$$2 + 3 = 5$$

$$\frac{3}{5} \times 90^\circ = 54^\circ$$

#### Approach 2



$$\begin{aligned}
 2y + 3y &= 90^\circ \\
 \frac{5y}{5} &= \frac{90^\circ}{5} \\
 y &= 18^\circ
 \end{aligned}$$

Larger angle

$$3 \times 18^\circ = 54^\circ$$



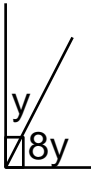
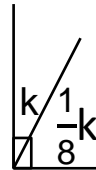
## Example 4

The complement of  $2y + 10^\circ$  is  $70^\circ$ . Find the value of  $y$ .

Approach 1	Approach 2
$2y + 10^\circ + 70^\circ = 90^\circ$ $2y + 80^\circ = 90^\circ$ $2y + 80^\circ - 80^\circ = 90^\circ - 80^\circ$ $2y = 10^\circ$ $\frac{2y}{2} = \frac{10^\circ}{2}$ $y = 5^\circ$	$90^\circ - (2y + 10^\circ) = 70^\circ$ $90^\circ - 2y - 10^\circ = 70^\circ$ $90^\circ - 10^\circ - 2y = 70^\circ$ $80^\circ - 2y = 70^\circ$ $80^\circ - 2y + 2y = 70^\circ + 2y$ $80^\circ = 70^\circ + 2y$ $80^\circ - 70^\circ = 70^\circ - 70^\circ + 2y$ $10^\circ = 2y$ $\frac{10^\circ}{2} = \frac{2y}{2}$ $5^\circ = y$ $y = 5^\circ$

## Example 5

Find the angle which is  $\frac{1}{8}$  of its complement.

Approach 1	Approach 2	Approach 2
$\frac{1}{8} = 1:8$ <p>Total ratio</p> $1+8 = 9$ $\frac{1}{9} \times 90^\circ = 10^\circ$	$\frac{1}{8} = 1:8$  $y+8y = 90^\circ$ $\frac{9y}{9} = \frac{90^\circ}{9}$ $y = 10^\circ$	<p>Let the larger angle be <math>k</math></p>  $k + \frac{1}{8}k = 90^\circ$ $(k \times 8) + (8 \times \frac{1}{8}k) = (90^\circ \times 8)$ $8k + k = 720^\circ$ $\frac{9k}{9} = \frac{720^\circ}{9}$ $k = 80^\circ$ $\frac{1}{8} \times 80^\circ = 10^\circ$

## Exercise

1. Find the complement of each of the following angles

i)  $15^\circ$

iii)  $30^\circ$

v)  $75^\circ$

vii)  $m^\circ$

ix)  $(2x+15)^\circ$

ii)  $65^\circ$

iv)  $88^\circ$

vi)  $45^\circ$

viii)  $(y-16)^\circ$

x)  $3y-29^\circ$

2. What must be added to the given angles to make  $90^\circ$ ?

i)  $40^\circ$

iii)  $62^\circ$

v)  $81^\circ$

vii)  $(20 - 4n)^\circ$

ii)  $65^\circ$

iv)  $89^\circ$

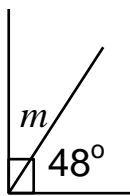
vi)  $30^\circ$

viii)  $(3y-14)^\circ$

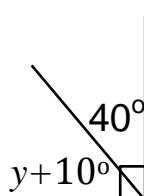


3. Two angles  $2x$  and  $x$  are complementary angles. Find the value of  $x$ .
4. Find the value of the unknown angles.

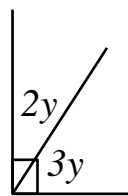
a)



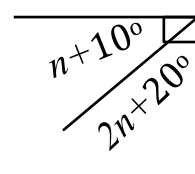
b)



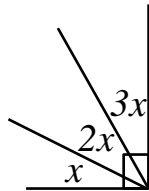
c)



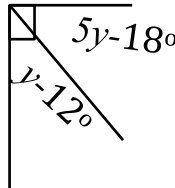
d)



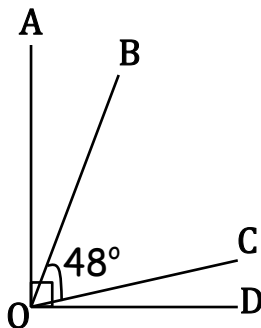
e)



f)



5. Two complementary angles are in the ratio of 1:5. Find the size of each angle.
6. Two complementary angles are in the ratio of 1:3 respectively. Find the size of the larger angle.
7. One of the two complementary angles is  $47^\circ$ . Find the other angle.
8. If  $2y + 40^\circ$  and  $4y + 2^\circ$  are complementary angles
  - a) Find the value of  $y$
  - b) Find the size of the larger angle.
9. In the figure below, angle AOB is twice angle COD.



- a) Find the size of angle
  - i) COD
  - ii) AOB
- b) Calculate the complement of angle COD.

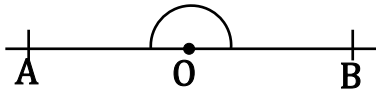
10. What angle is  $\frac{1}{2}$  of its complement?
11. Find the angle which is  $\frac{7}{8}$  of its complement.
12.  $\angle ABC$  and  $\angle CBD$  are complementary angles. If CBD is 4 times ABC, find the size of angle CBD.
13. Find the angle which is 8 times of its complement.
14. The complement of  $p$  is  $30^\circ$ . Find the value of  $p$ .
15. The complement of  $3y + 10^\circ$  is  $5y - 16^\circ$ .
  - a) Find the value of  $y$ .
  - b) Find the actual size of each angle.
16. Two complementary angles are  $12n$  and  $6n$ . Find the value of  $n$ .
17. Add half of the complement of  $48^\circ$  to thrice the complement of  $72^\circ$

# TOPIC 7: GEOMETRIC CONSTRUCTION



## Supplementary angles.

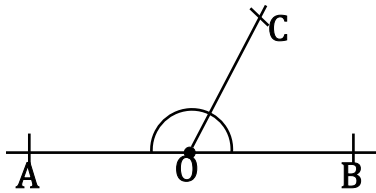
Study the figure below.



It was noted out that for a straight line AOB, angle AOB is a straight angle ( $180^\circ$ )

\*All angles on a straight line add up to  $180^\circ$ .

\* Supplementary are two angles that add up to  $180^\circ$  as shown below.



$$\angle AOC + \angle COB = 180^\circ$$

### Example 1

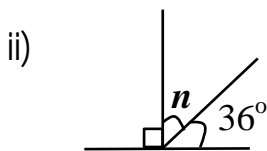
Find the size of  $n$



$$n + 150^\circ = 180^\circ$$

$$n + 150^\circ - 150^\circ = 180^\circ - 150^\circ$$

$$n = 30^\circ$$



$$n + 36^\circ + 90^\circ = 180^\circ$$

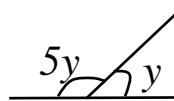
$$n + 126^\circ - 126^\circ = 180^\circ - 126^\circ$$

$$n = 54^\circ$$

### Example 2

Find the angle which is 5 times of its supplement.

Let the smaller angle be  $y$



$$5y + y = 180^\circ$$

$$6y = 180^\circ$$

$$\frac{6y}{6} = \frac{180^\circ}{6}$$

$$y = 30^\circ$$

$$5y = 5 \times y$$

$$= 5 \times 30^\circ$$

$$= 150^\circ$$

The angle is  $150^\circ$

### Example 3

Find the supplement of  $(34 - 2y)^\circ$



$$180^\circ - (34 - 2y)^\circ$$

$$180^\circ - 34^\circ + 2y$$

$$146^\circ + 2y$$

$$(146 + 2y)^\circ$$

## Exercise

1. Find the supplement of each of the following

a)  $46^\circ$

b)  $30^\circ$

c)  $91^\circ$

d)  $84^\circ$

e)  $16^\circ$

f)  $122^\circ$

g)  $130^\circ$

h)  $135^\circ$

i)  $102^\circ$

j)  $80^\circ$

k)  $179^\circ$

l)  $105^\circ$

m)  $k^\circ$

n)  $y + 70^\circ$

o)  $2x - 6^\circ$

p)  $(3y + 12)^\circ$

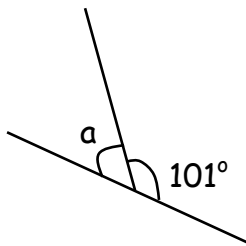
q)  $(12 - p)^\circ$

y)  $(38 + 7m)^\circ$

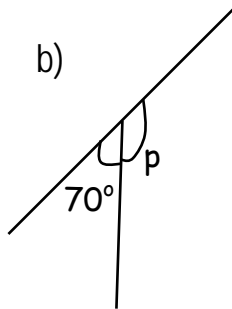


2. Calculate the size of the unknown angles.

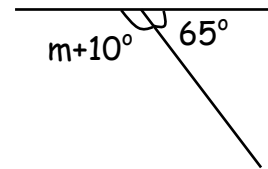
a)



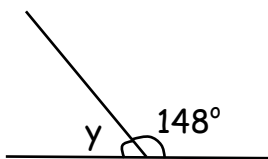
b)



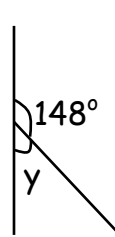
c)



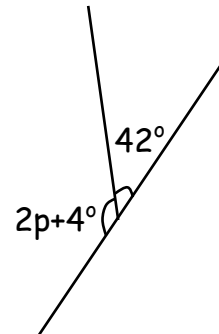
d)



e)

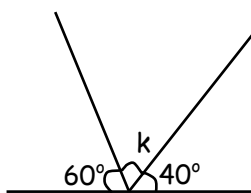


f)

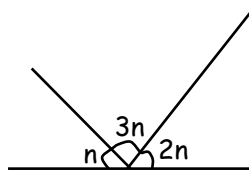


3. Find the size of the unknown angles.

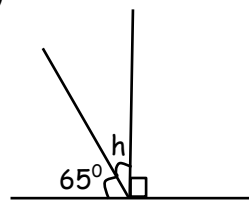
a)



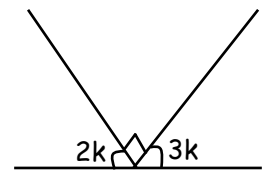
b)



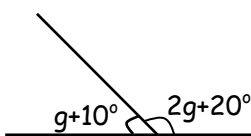
c)



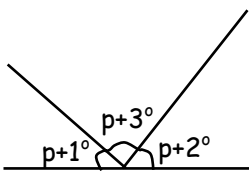
d)



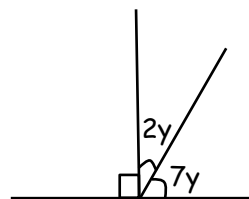
e)



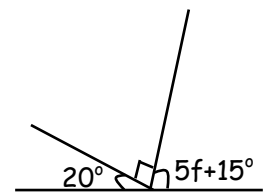
f)



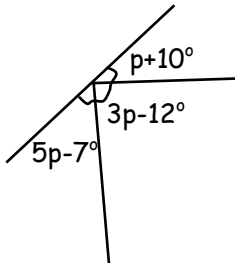
g)



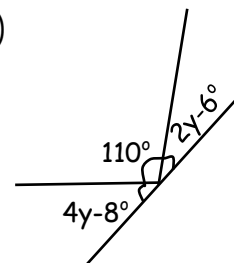
h)



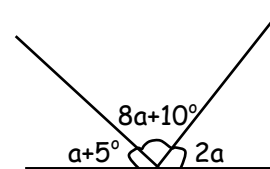
i)



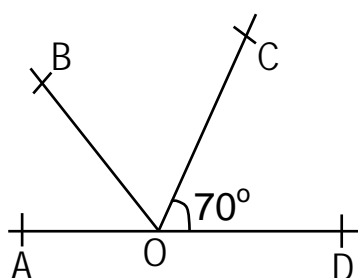
j)



k)



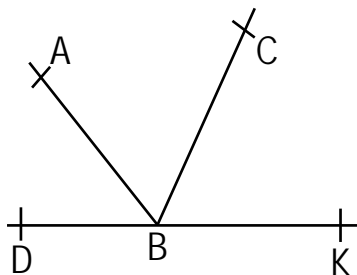
4. In the figure below, AOD is a straight line. Angle BOC is 4 times of angle AOB.



Find the size of angle BOC in degrees.



5. Given that  $3m$ ,  $2m-12^\circ$  and  $2m + 80^\circ$  are angles on the straight line. Find the value of  $m$ .
6. On a straight line, one angle is three times the other. Find the size of the angles.
7. What is the supplement of  $90^\circ$ ?
8. The supplement of  $4m+10^\circ$  is  $70^\circ$ . Find the value of  $m$ .
9. What angle is;
  - a) twice its supplement?
  - b) 8 times of its supplement?
  - c) a half of its supplement?
  - d) a third of its supplement?
  - e)  $\frac{2}{7}$  of its supplement?
  - e)  $\frac{7}{8}$  of its supplement?
  - f)  $\frac{4}{5}$  of its supplement?
10. Two supplementary angles are in the ratio of 5:7 respectively. Find the size of each angle.
11. The difference between two supplementary angles is  $108^\circ$ . Find the size of the smaller angle.
12. One of the two supplementary angles is  $90^\circ$  more than the other. Find the size of each of the angles.
13. In the figure below, DBK is a straight line, AB is perpendicular to CB and angle ABD is  $18^\circ$  less than angle CBK.



Find the size of angle

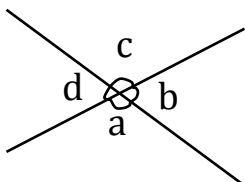
- i) CBK
- ii) ABD

14. Subtract the supplement of  $172^\circ$  from the three quarters of the supplement of  $20^\circ$ .
15. Find the angle which is 4 times larger than its supplement.

## Vertically opposite angles

When two straight lines intersect, they form four angles having a common vertex. The two angles which are on opposite sides of the vertex are called vertically opposite angles.

**Note:** Vertically opposite angles are equal.

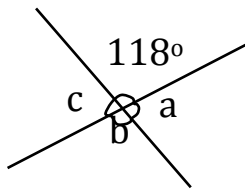


$$\begin{aligned}\angle a &= \angle c \\ \angle b &= \angle d\end{aligned}$$



## Example 1

Find the value of the unknown angles in the figure below.



Value of  $a$

$$a + 118^\circ = 180^\circ \text{ (angles on a straight line)}$$

$$a + 118^\circ - 118^\circ = 180^\circ - 118^\circ$$

$$a = 62^\circ$$

Value of  $b$

$$b = 118^\circ \text{ (Vertically opposite angles)}$$

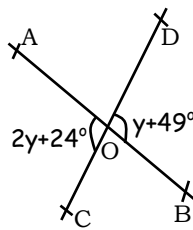
Value of  $c$

$$c = a \text{ (Vertically opposite angles)}$$

$$c = 62^\circ$$

## Example 2

Study the figure below and use it to answer questions that follow.



a) Find the value of  $y$

$$2y+24^\circ = y+49^\circ \text{ (Vert. Opp. } \angle\text{s)}$$

$$2y-y+24^\circ = y-y+49^\circ$$

$$y + 24^\circ = 49^\circ$$

$$y+24^\circ-24^\circ = 49^\circ-24^\circ$$

$$y = 25^\circ$$

b) Find the size of angle AOD

$$\text{Angle BOD} = y + 49^\circ$$

$$= 25^\circ + 49^\circ$$

$$= 74^\circ$$

$$\angle AOD + \angle BOD = 180^\circ \text{ (angles on a straight line)}$$

$$\angle AOD + 74^\circ = 180^\circ$$

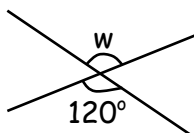
$$\angle AOD + 74^\circ - 74^\circ = 180^\circ - 74^\circ$$

$$\angle AOD = 106^\circ$$

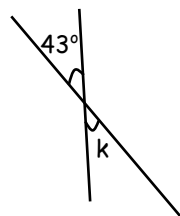
## Exercise

1. Find the size of the unknown angles in degrees.

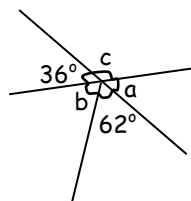
a)



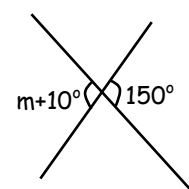
b)



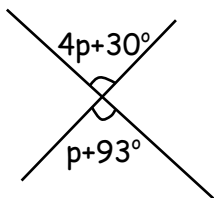
c)



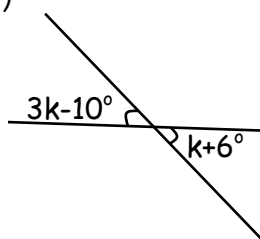
d)



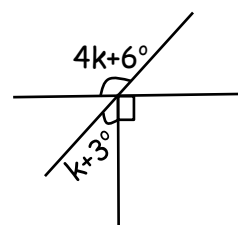
e)



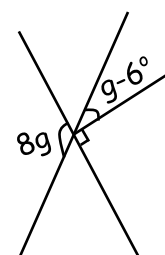
f)



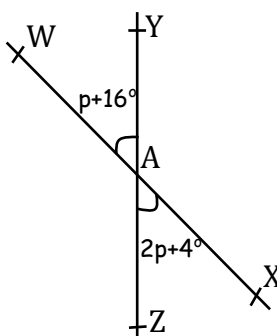
g)



h)



2. Study the figure below.



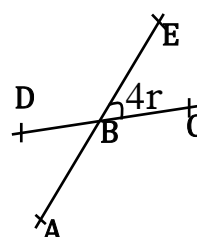
a) Solve for  $p$ .

b) Find the size of angle;

i)  $\angle ZAX$

ii)  $\angle YAX$

3. In the figure below, angle DBE is twice angle EBC.



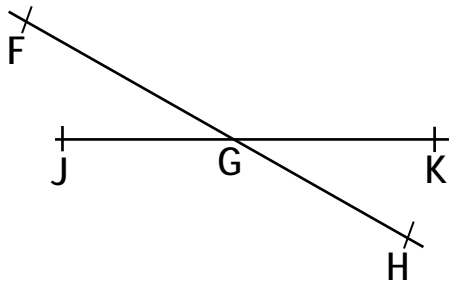
a) Find  $r$  in degrees

b) Find the size of angle DBA

## TOPIC 7: GEOMETRIC CONSTRUCTION



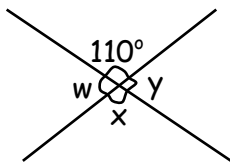
4. In the figure below, angle FGK is  $108^\circ$  more than angle HGK and angle JGH =  $3n$ .



- Find the value of  $n$ .
- Calculate the size of angle JGF.

### Angles at a point

Study the figure below.



Value of y

$$\begin{aligned} y + 110^\circ &= 180^\circ \\ y + 110^\circ - 110^\circ &= 180^\circ - 110^\circ \\ y &= 70^\circ \end{aligned}$$

Value of w

$$\begin{aligned} w &= y \\ w &= 70^\circ \end{aligned}$$

Value of x

$$x = 110^\circ$$

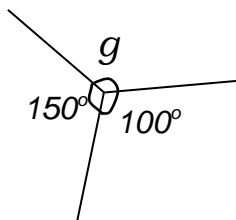
Sum

$$\begin{array}{r} 110^\circ \\ 110^\circ \\ 70^\circ \\ + 70^\circ \\ \hline 360^\circ \end{array}$$

**So, angles at a point add up to  $360^\circ$**

### Example

Find the value of  $g$



$$g + 100^\circ + 150^\circ = 360^\circ \text{ (Angles at a point)}$$

$$g + 250^\circ = 360^\circ$$

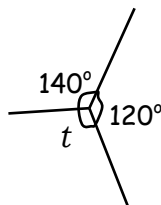
$$g + 250^\circ - 250^\circ = 360^\circ - 250^\circ$$

$$g = 110^\circ$$

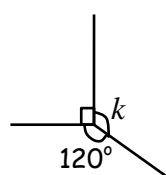
### Exercise

1. Find the size of the unknown angles.

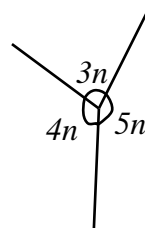
a)



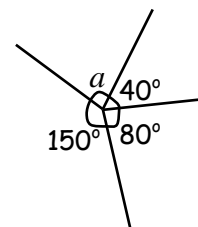
b)



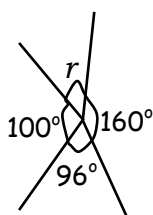
c)



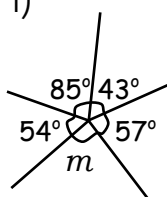
d)



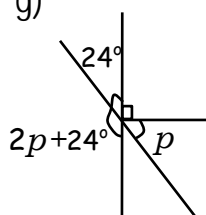
e)



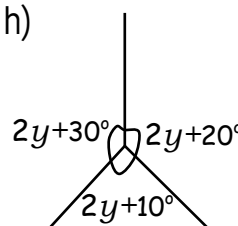
f)



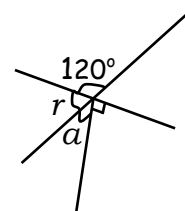
g)



h)



i)



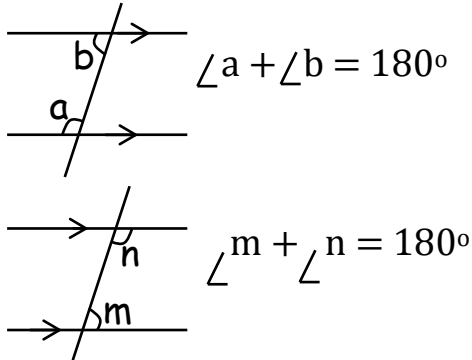


## Angles formed on parallel lines

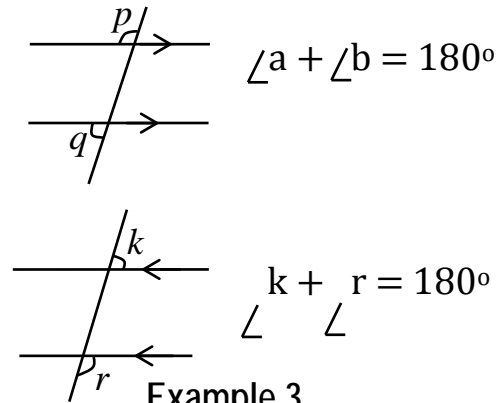
A line which cuts a pair of parallel lines is called a transversal

### Co-interior and co-exterior angles

i) Co-interior angles

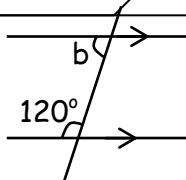


ii) Co-exterior angles



#### Example 1

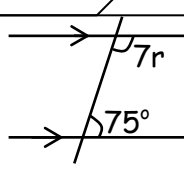
Find the value of  $m$ .



$$\begin{aligned} b + 120^\circ &= 180^\circ \text{ (Co-int. } \angle \text{ s)} \\ b + 120^\circ - 120^\circ &= 180^\circ - 120^\circ \\ b &= 60^\circ \end{aligned}$$

#### Example 2

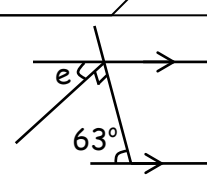
Find the value of  $r$



$$\begin{aligned} 7r + 75^\circ &= 180^\circ \text{ (Co-int. } \angle \text{ s)} \\ 7r + 75^\circ - 75^\circ &= 180^\circ - 75^\circ \\ \frac{7r}{7} &= \frac{105^\circ}{7} \\ r &= 15^\circ \end{aligned}$$

#### Example 3

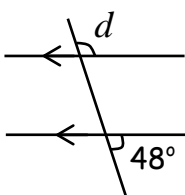
Find the value of  $e$



$$\begin{aligned} (e + 90^\circ) + 63^\circ &= 180^\circ \text{ (Co-int. } \angle \text{ s)} \\ e + 90^\circ + 63^\circ &= 180^\circ \\ e + 153^\circ &= 180^\circ \\ e + 153^\circ - 153^\circ &= 180^\circ - 153^\circ \\ e &= 27^\circ \end{aligned}$$

#### Example 4

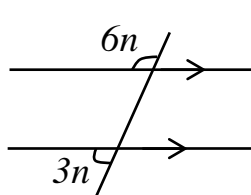
Find the value of  $d$ .



$$\begin{aligned} d + 48^\circ &= 180^\circ \text{ (Co-ext. } \angle \text{ s)} \\ d + 48^\circ - 48^\circ &= 180^\circ - 48^\circ \\ d &= 132^\circ \end{aligned}$$

#### Example 5

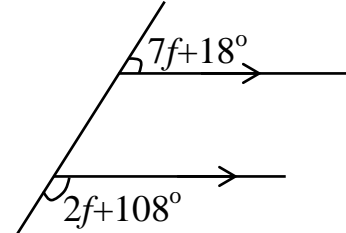
Find the value of  $n$



$$\begin{aligned} 6n + 3n &= 180^\circ \text{ (Co-ext. } \angle \text{ s)} \\ 9n &= 180^\circ \\ \frac{9n}{9} &= \frac{180^\circ}{9} \\ n &= 20^\circ \end{aligned}$$

#### Example 6

Find the value of  $f$  in degrees

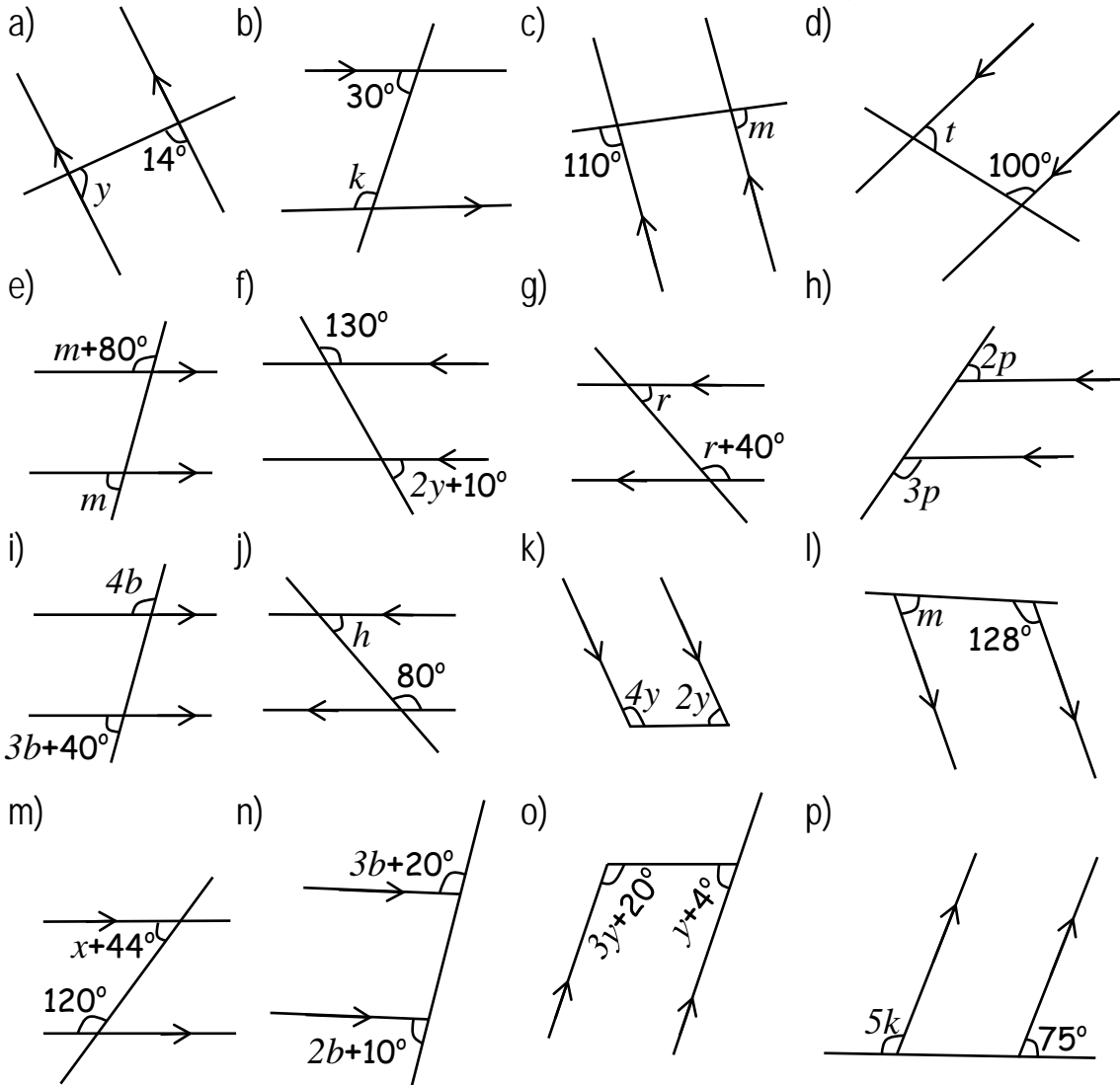


$$\begin{aligned} 7f + 18^\circ + 2f + 108^\circ &= 180^\circ \text{ (Co-ext. } \angle \text{ s)} \\ 7f + 2f + 18^\circ + 108^\circ &= 180^\circ \\ 9f + 126^\circ &= 180^\circ \\ 9f + 126^\circ - 126^\circ &= 180^\circ - 126^\circ \\ 9f &= 54^\circ \\ \frac{9f}{9} &= \frac{54^\circ}{9} \\ f &= 6^\circ \end{aligned}$$

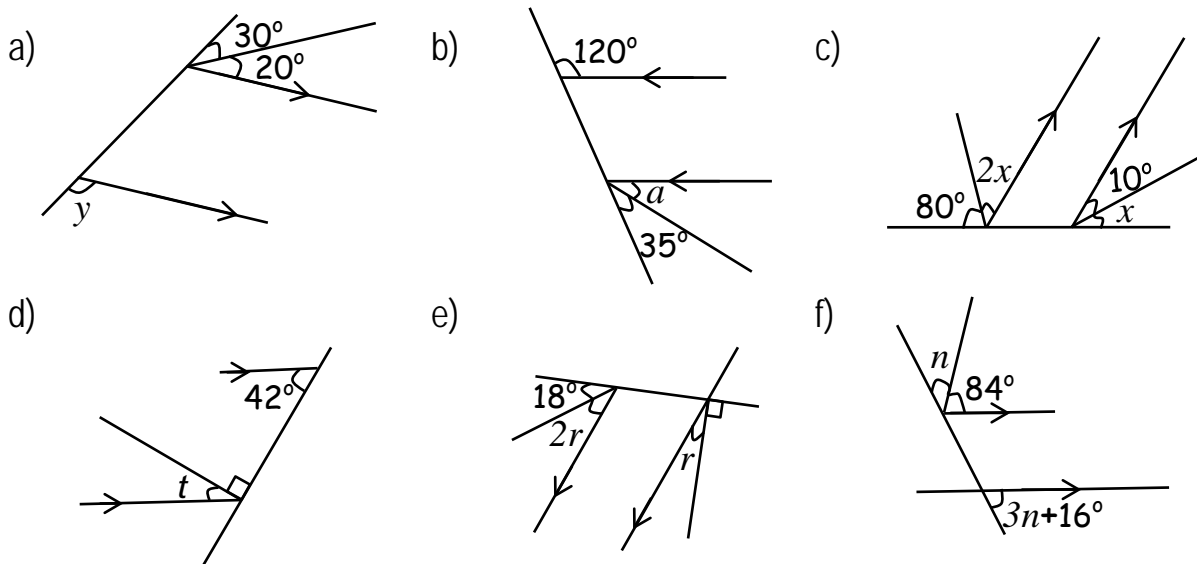


## Exercise

1. Find the value of the angles represented by letters in the diagrams.

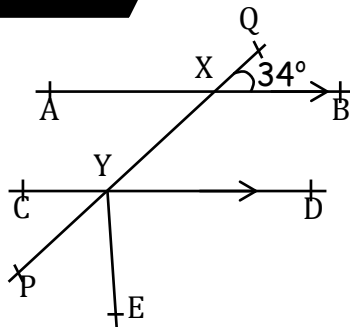


2. Find the size of the unknown angles in the diagrams below.



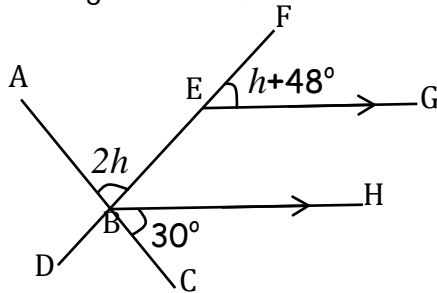


3.



In the figure, AB is parallel to CD. Line PQ cuts AB and CD at X and Y respectively. If EY is perpendicular to CD, find the size of angle PYD.

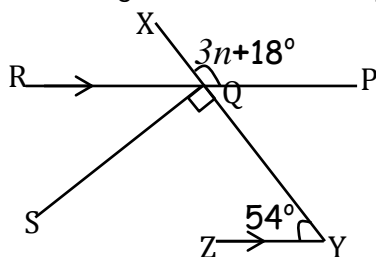
4. In the figure below, ABC is a straight line, EG is parallel to BH and angle CBH =  $30^\circ$ .



a) Find the value of h in degrees.

b) Find the size of angle FBH.

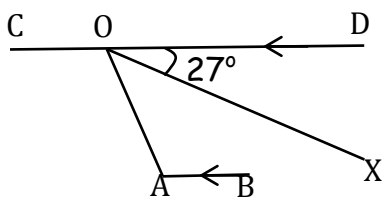
5. In the figure below, PR is parallel to YZ,  $\angle XYZ = 54^\circ$  and QS is perpendicular to XY.



a) Find the size of  $\angle SQR$  in degrees.

b) Find the value of n.

6. In the figure below, CD is parallel to AB.  $\angle DOX = 27^\circ$  and  $\angle BAO$  is twice  $\angle AOX$ .

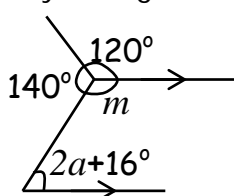


Find the size of angle

i)  $\angle AOX$

ii)  $\angle BAO$

7. Study the figure below and use it to answer the question that follows.

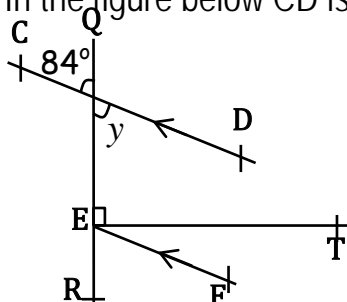


Find the value of

i) m

ii) a

8. In the figure below CD is parallel to EF and ET is perpendicular to QR.

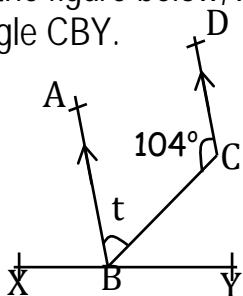


a) Find the size of angle marked y.

b) Find the size of  $\angle TEF$ .

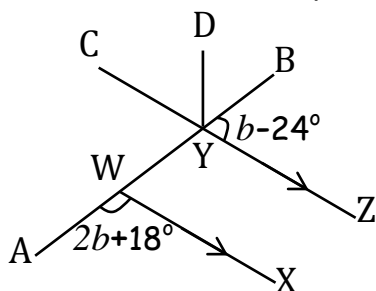


9. In the figure below, AB is parallel to CD,  $\angle BCD = 104^\circ$  and  $\angle ABX$  is a quarter of angle CBY.



- Find the value of  $t$  in degrees.
- Find the size of angle  $ABY$ .

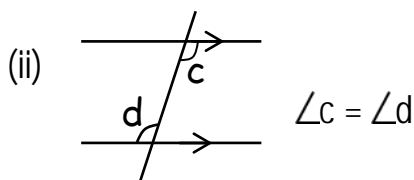
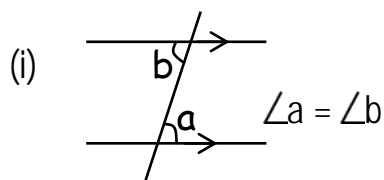
10. In the figure below  $WX \parallel CZ$ ,  $\angle CYD$  is  $26^\circ$  less than  $\angle DYB$ . Study the figure carefully and use it to answer questions that follow.



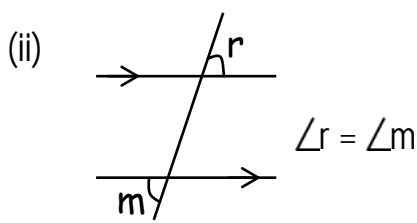
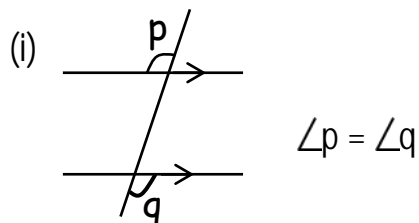
- Find the value of  $b$
- Find the size of angle  $CYD$

## Alternate interior and alternate exterior angles

Alternate interior angles are angles formed when a transversal line intersects two or more parallel lines. They lie on the inner side of parallel line but on opposite sides of the transversal. Alternate interior angles are equal.



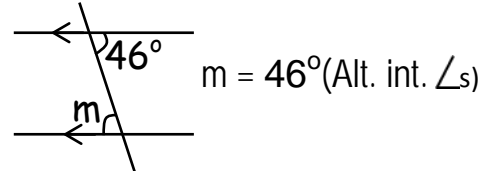
Alternate exterior angles are angles formed when a transversal line intersects two or more parallel lines. They lie on the outer side of the parallel lines but on opposite sides of the transversal. Alternate exterior angles are equal.



*Alternate interior and alternate exterior angles are also called  $z$  angles.*

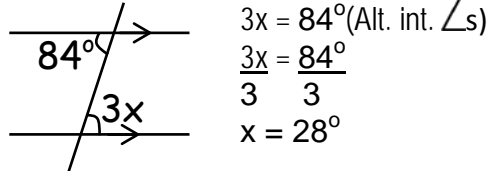
### Example 1

Find the value of  $m$



### Example 2

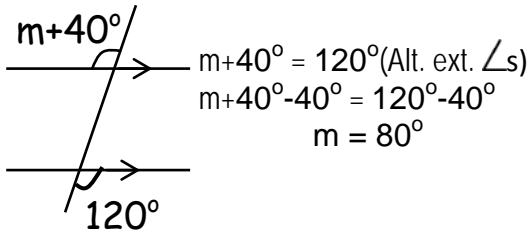
Find the value of  $x$





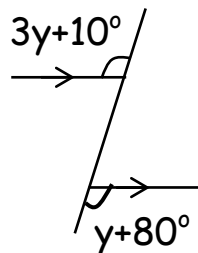
## Example 3

Find the size of the unknown angle in the drawing below.



## Example 4

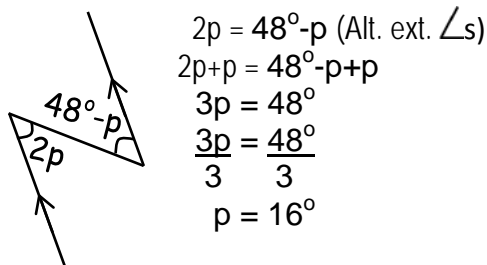
Find the value of  $y$



$$\begin{aligned}
 3y+10^\circ &= y+80^\circ \text{ (Alt. ext. } \angle\text{s)} \\
 3y-y+10^\circ &= y-y+80^\circ \\
 2y+10^\circ &= 80^\circ \\
 2y+10^\circ - 10^\circ &= 80^\circ - 10^\circ \\
 2y &= 70^\circ \\
 \frac{2y}{2} &= \frac{70^\circ}{2} \\
 y &= 35^\circ
 \end{aligned}$$

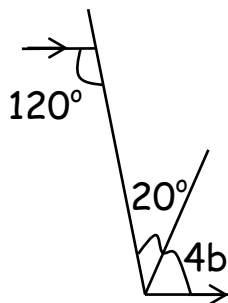
## Example 5

Find the value of  $p$



## Example 6

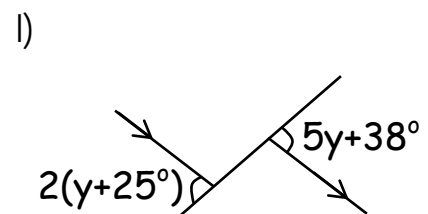
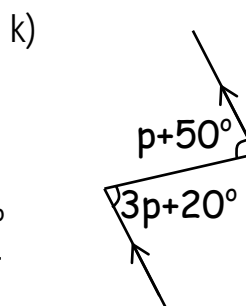
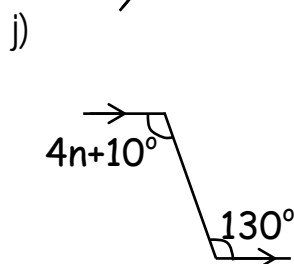
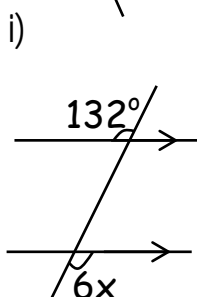
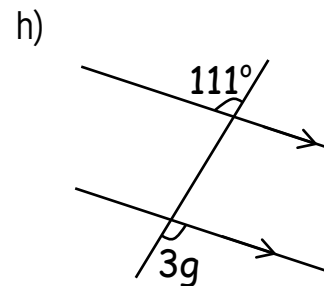
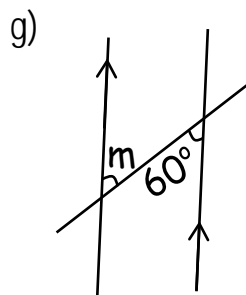
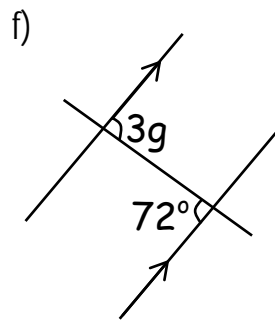
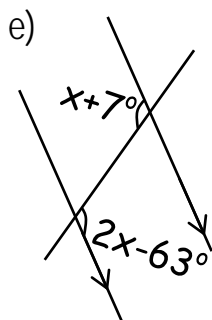
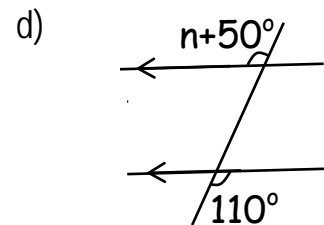
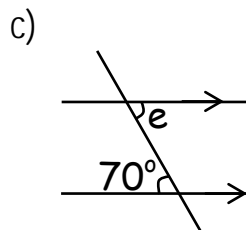
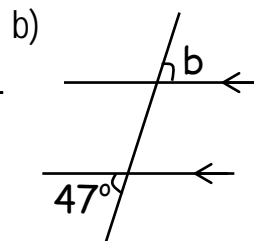
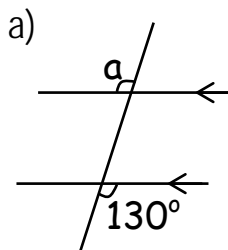
Find the value of  $b$



$$\begin{aligned}
 4b+20^\circ &= 120^\circ \text{ (Alt. int. } \angle\text{s)} \\
 4b+20^\circ - 20^\circ &= 120^\circ - 20^\circ \\
 4b &= 100^\circ \\
 \frac{4b}{4} &= \frac{100^\circ}{4} \\
 b &= 25^\circ
 \end{aligned}$$

## Exercise

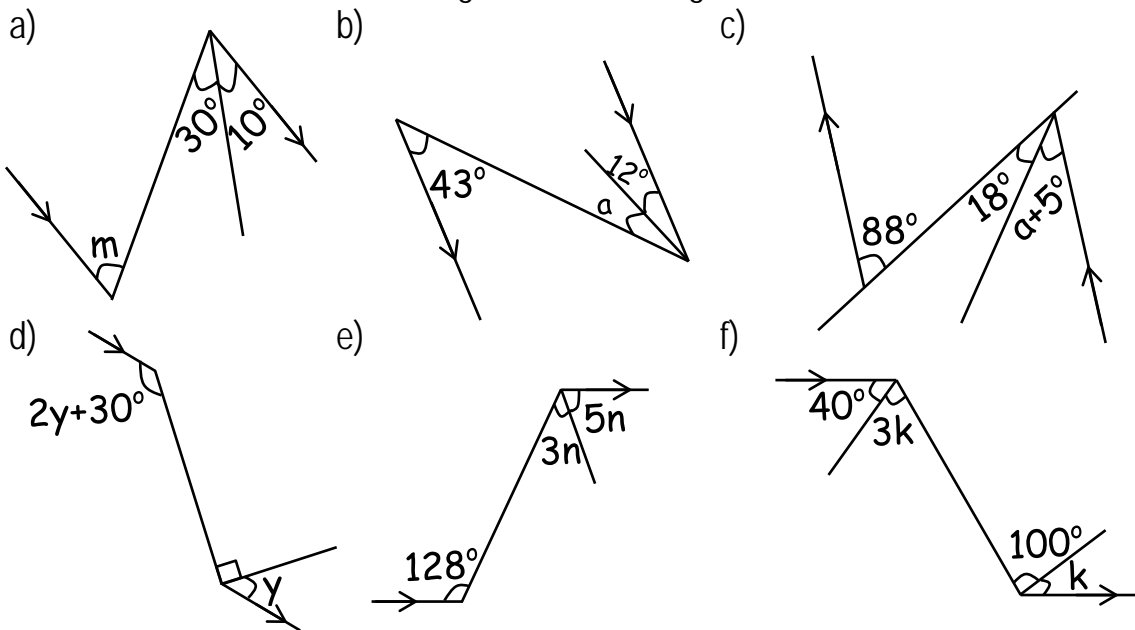
1. Find the value of the unknown angles.



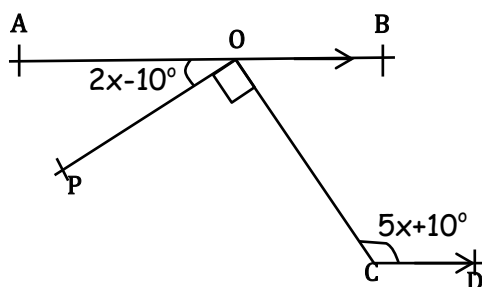
## TOPIC 7: GEOMETRIC CONSTRUCTION



2. Find the size of the unknown angle in the drawings below.

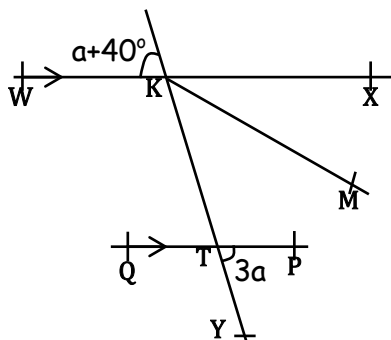


3. Study the diagram below and use it to answer questions that follow.



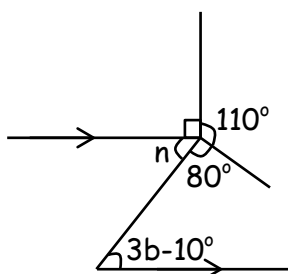
- Find the value of  $x$
- Find the size of angle  $AOC$

4. Study the figure below.



- Find the value of  $a$
- If  $\angle TKM$  is 4 times  $\angle MKX$ , find the size of  $\angle WKM$

5. Study the drawing below carefully, use it to answer questions that follow.



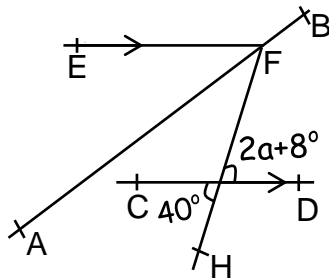
Find the value of;

- $n$
- $b$

# TOPIC 7: GEOMETRIC CONSTRUCTION



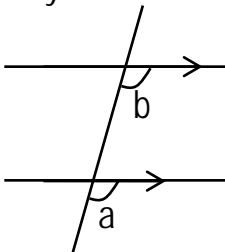
6. In the diagram below,  $\angle AFE$  is  $6^\circ$  more than  $\angle AFH$ . Use the diagram to answer the questions that follow.



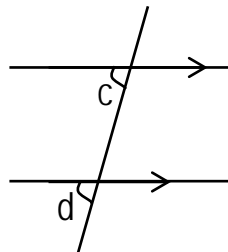
- Find the value of  $a$ .
- Find the size of obtuse angle  $EFB$ .

## Corresponding angles

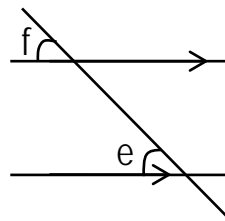
Corresponding angles are angles which occur on the same side of the transversal line. They are either both acute or both obtuse.



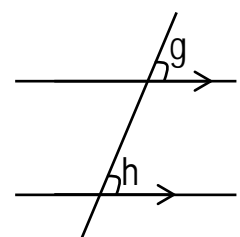
$$\angle a = \angle b$$



$$\angle c = \angle d$$



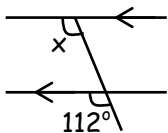
$$\angle f = \angle e$$



$$\angle h = \angle g$$

### Example 1

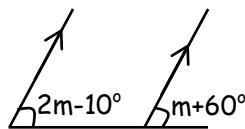
Find the value of  $x$



$$x = 112^\circ (\text{Corr. } \angle s)$$

### Example 2

Find the value of  $m$



$$2m - 10^\circ = m + 60^\circ (\text{Corr. } \angle s)$$

$$2m - m - 10^\circ = m - m + 60^\circ$$

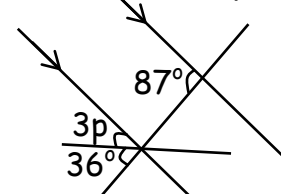
$$m - 10^\circ = 60^\circ$$

$$m - 10^\circ + 10^\circ = 60^\circ + 10^\circ$$

$$m = 70^\circ$$

### Example 3

Find the value of  $p$



$$3p + 36^\circ = 87^\circ (\text{Corr. } \angle s)$$

$$3p + 36^\circ = 87^\circ$$

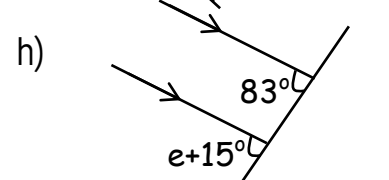
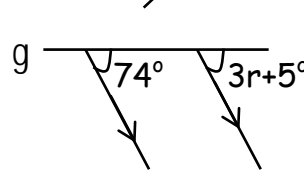
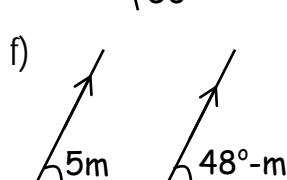
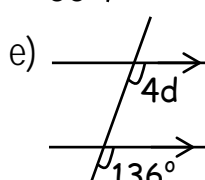
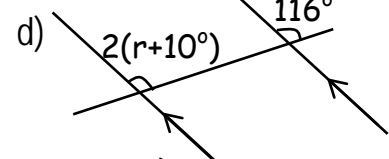
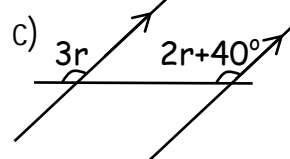
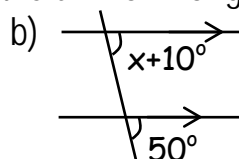
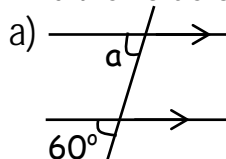
$$3p + 36^\circ - 36^\circ = 87^\circ - 36^\circ$$

$$\frac{3p}{3} = \frac{51^\circ}{3}$$

$$p = 17^\circ$$

## Exercise

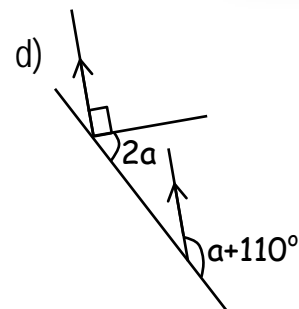
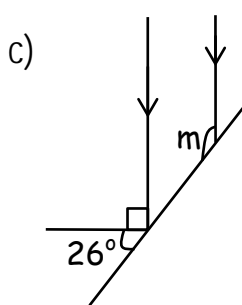
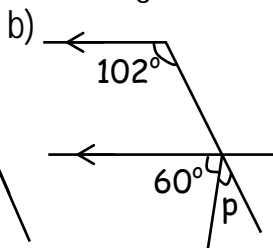
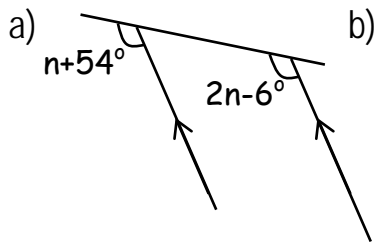
1. Find the value of the unknown angles.



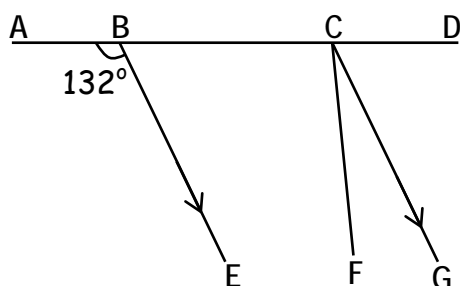
# TOPIC 7: GEOMETRIC CONSTRUCTION



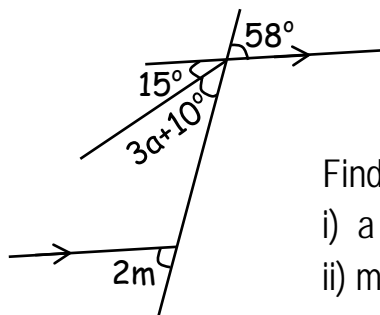
2. Find the value of the unknown angles.



3. In the figure below,  $BE \parallel CG$ ,  $\angle BCF$  is 3 times  $\angle FCG$  and  $\angle ABE = 132^\circ$ .



4. Study the drawing below and use it to answer question that follows.



Find the value of

- a
- m

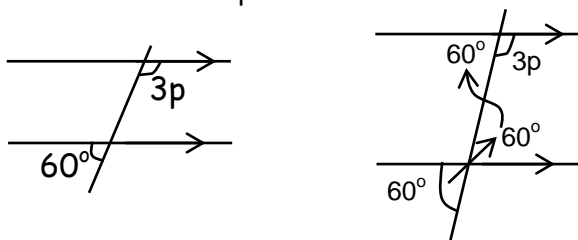
Find in degrees, the size of angle;

- FCG
- BCF
- FCD

## Solving problem involving transfer of angles on parallel lines

### Example

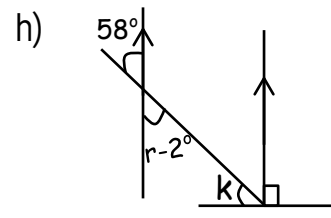
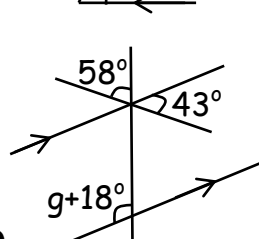
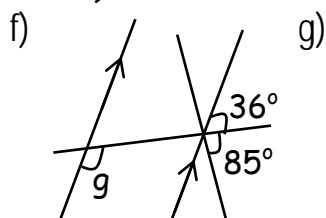
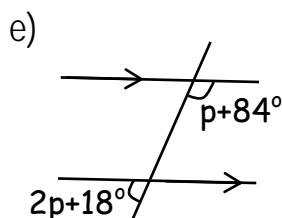
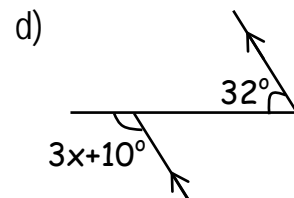
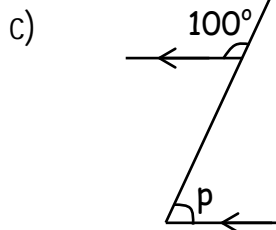
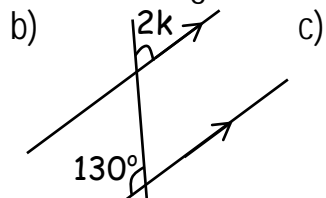
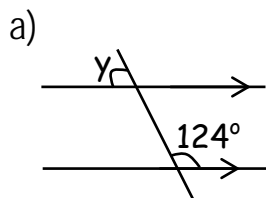
Find the value of p.



$$\begin{aligned}
 3p + 60^\circ &= 180^\circ \text{ (Co. interior } \angle\text{s)} \\
 3p + 60^\circ - 60^\circ &= 180^\circ - 60^\circ \\
 \frac{3p}{3} &= \frac{120^\circ}{3} \\
 p &= 40^\circ
 \end{aligned}$$

### Exercise

Find the value of the unknown angles.

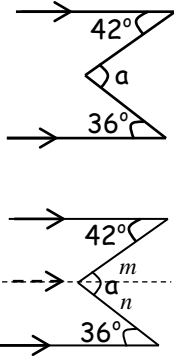




More problems involving angles on parallel lines.

### Example 1

Find the value of  $a$



$$m = 42^\circ \text{ (Alt. int. } \angle \text{ s)}$$

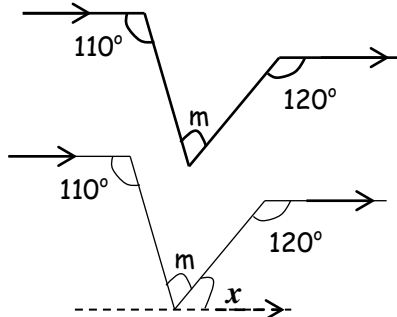
$$n = 36^\circ \text{ (Alt. int. } \angle \text{ s)}$$

$$a = 42^\circ + 36^\circ$$

$$a = 78^\circ$$

### Example 2

Find the value of  $m$



$$x + 120^\circ = 180^\circ \text{ (Co-int. } \angle \text{ s)}$$

$$x + 120^\circ - 120^\circ = 180^\circ - 120^\circ$$

$$x = 60^\circ$$

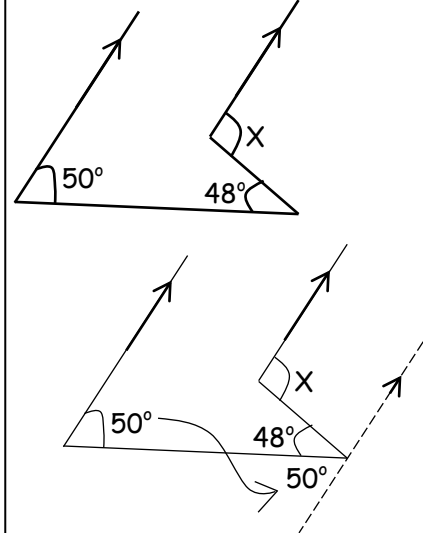
$$m + 60^\circ = 110^\circ$$

$$m + 60^\circ - 60^\circ = 110^\circ - 60^\circ$$

$$m = 50^\circ$$

### Example 3

Find the value of  $x$

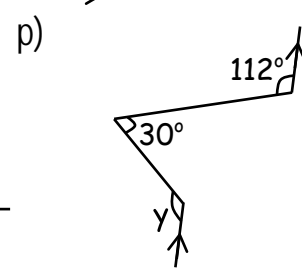
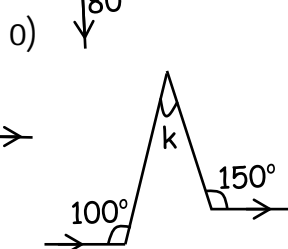
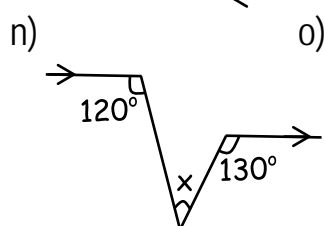
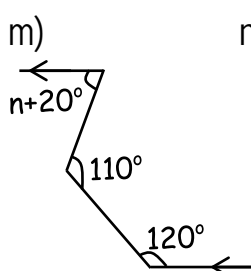
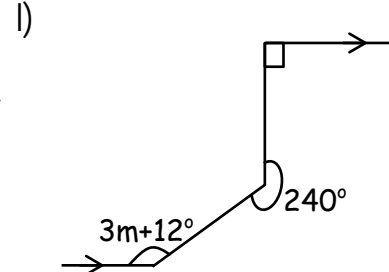
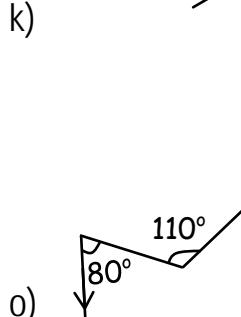
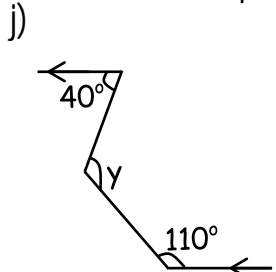
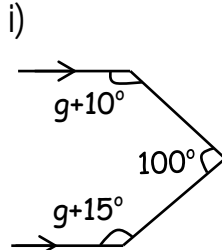
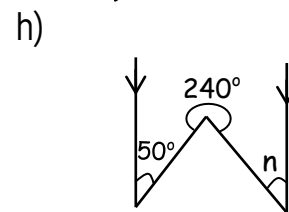
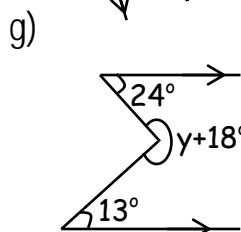
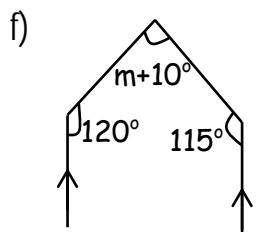
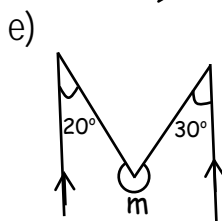
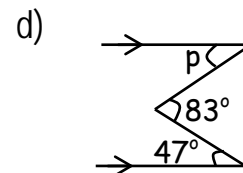
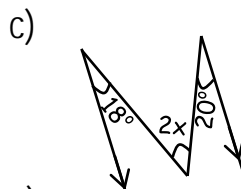
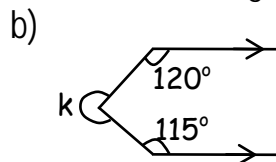
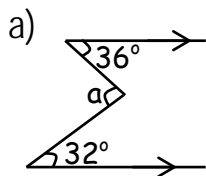


$$x = 50^\circ + 48^\circ \text{ (Alternating } \angle \text{ s)}$$

$$x = 98^\circ$$

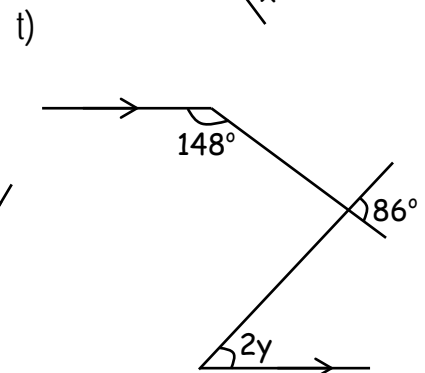
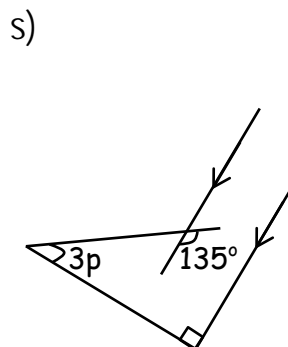
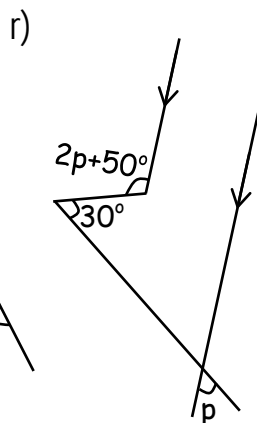
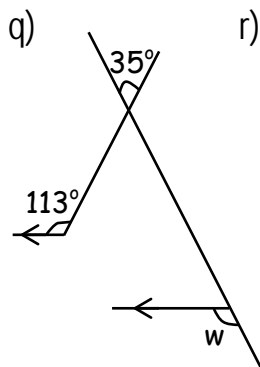
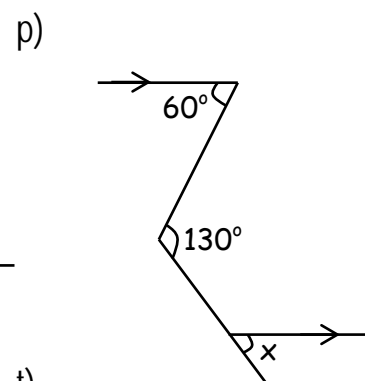
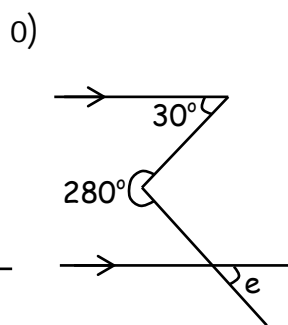
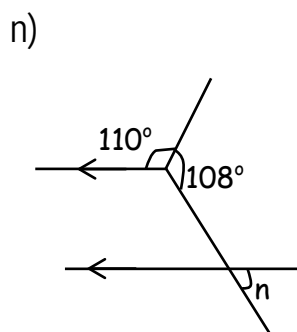
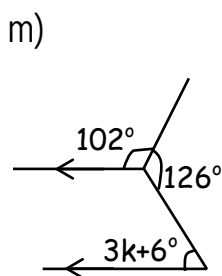
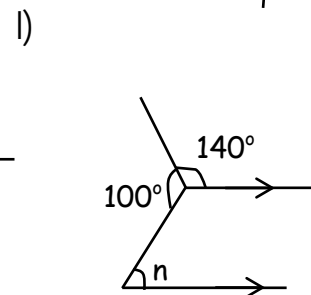
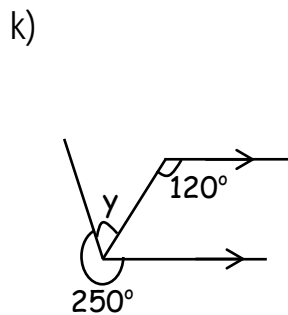
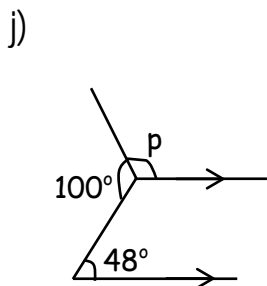
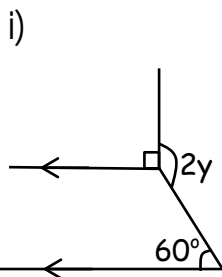
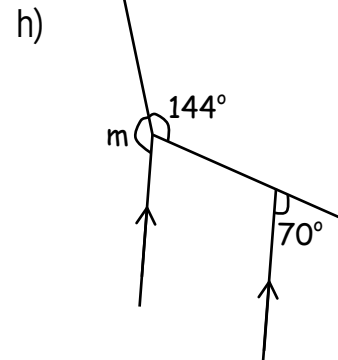
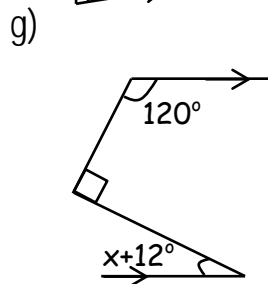
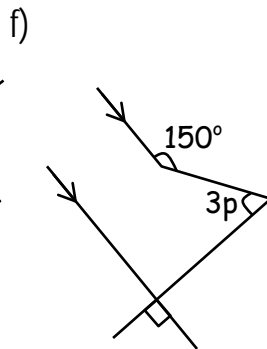
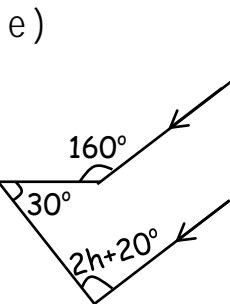
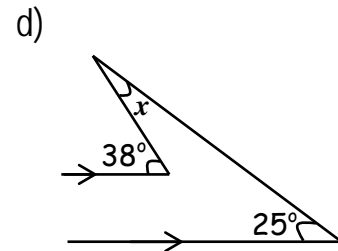
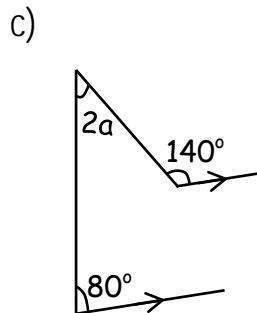
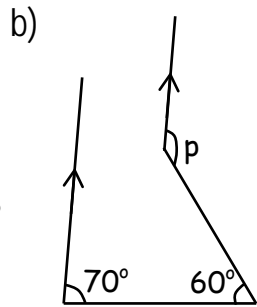
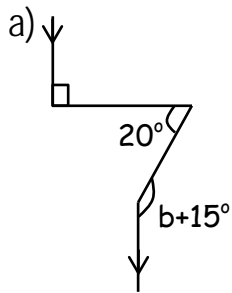
### Exercise

1. Find the value of the unknown angles.





2. Find the size of the angles represented by the letters.





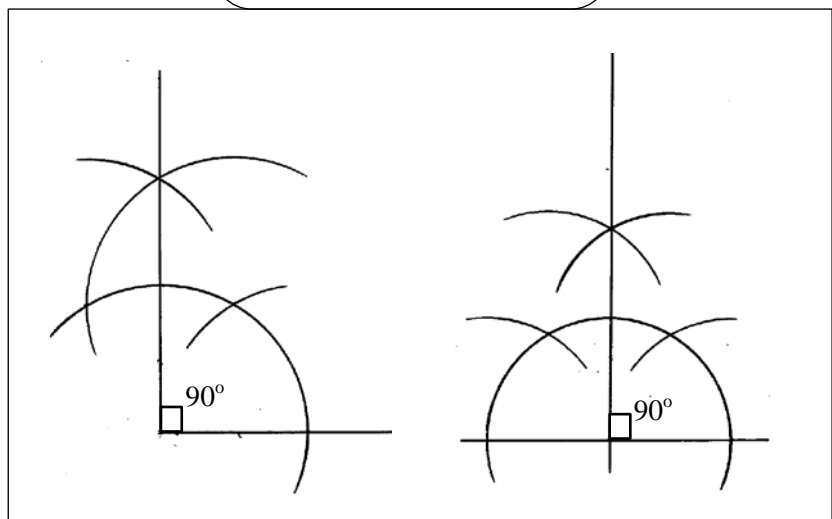
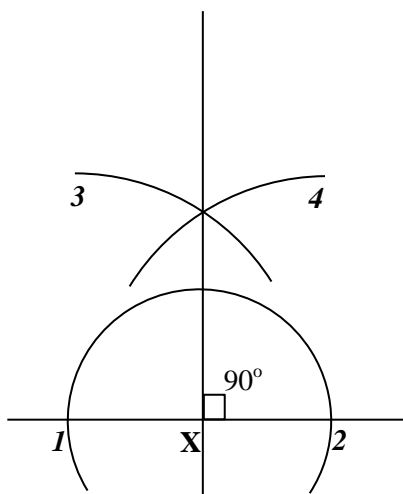
## GEOMETRIC CONSTRUCTION

### Constructing an angle of $90^\circ$

#### **Steps .**

- \* Draw a straight line and mark point **X**.
- \* From **X**, draw an arc to bisect the line at **1** and **2** .
- \* Place the compass at point **1** and draw arc **3** and later at **2** draw arc **4**.
- \* Draw a straight line to join the point of intersections of the above arcs and point **X**.

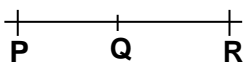
#### Other approaches



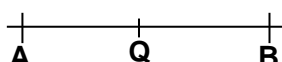
#### Exercise

1. Using a ruler, a pencil and a pair of compasses only, construct an angle of  $90^\circ$
2. With the help of a ruler, a pencil and a pair of compasses only, construct an angle of  $90^\circ$  at point Q.

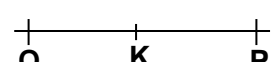
a)



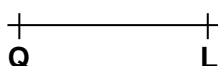
b)



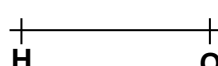
c)



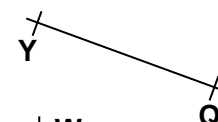
d)



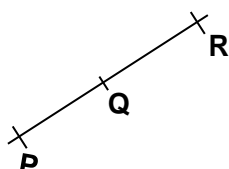
e)



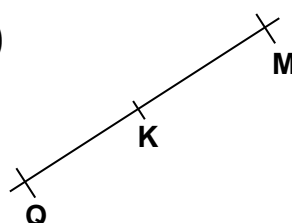
f)



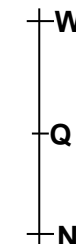
g)



h)



i)



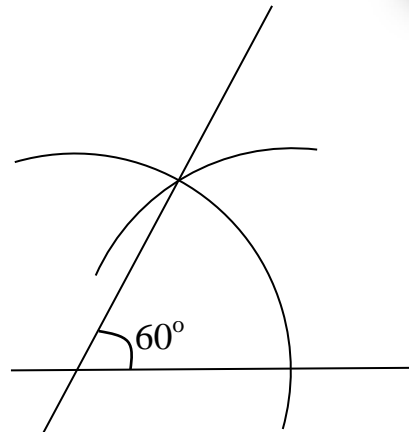
## TOPIC 7: GEOMETRIC CONSTRUCTION



### Constructing angle of $60^\circ$

#### Steps

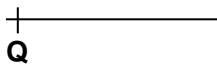
- \* Draw a straight line, mark point **P**.
- \* Taking **P** as the centre and any convenient radius, draw arc **1** intersecting the line at **Q**.
- \* With **Q** as the centre and the radius, draw an arc intersecting the previous arc at **T**.



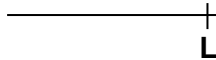
#### Exercise

1. Using a ruler, a pencil and a pair of compasses only, construct an angle of  $60^\circ$ .
2. Draw a line segment  $PQ = 4.5\text{cm}$ . Construct an angle of  $60^\circ$  at point P.
3. Draw a line segment  $AB = 3.8\text{ cm}$ . Construct an angle of  $60^\circ$  at point B.
4. Construct an angle of  $60^\circ$  at the marked points..

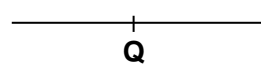
a)



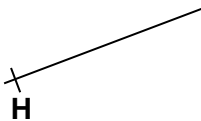
b)



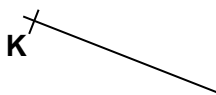
c)



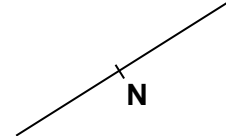
d)



f)



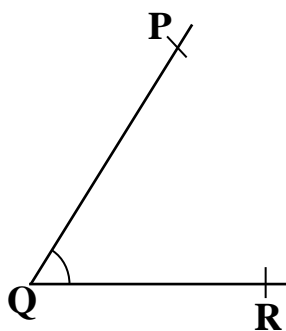
g)



### Copying angles

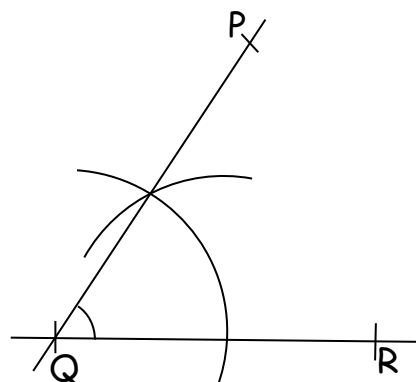
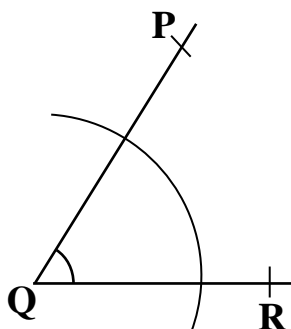
#### Example

Using a ruler, a pencil and a pair of compasses only, copy angle PQR.



#### Steps

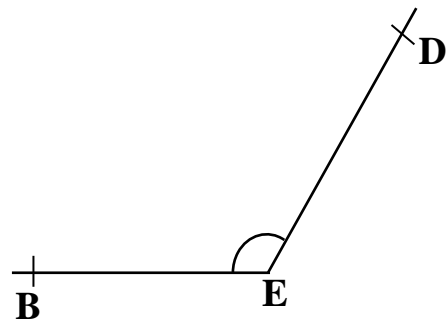
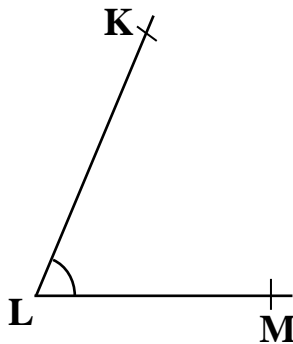
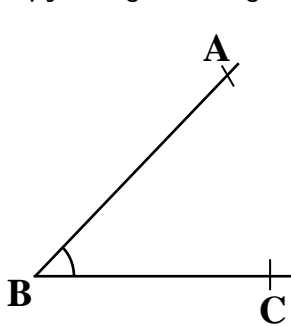
- \* Draw line  $QR$ .
- \* From point  $Q$  of the given angles, draw an arc touching angles  $PQR$ .
- \* Mark the same arc from point  $Q$  as shown below .
- \* Adjust the compasses to fit arc that makes angle  $PQR$ .
- \* Transfer the exact radius and mark the same size of angle.





## Exercise

Copy the given angles



## Bisecting angles

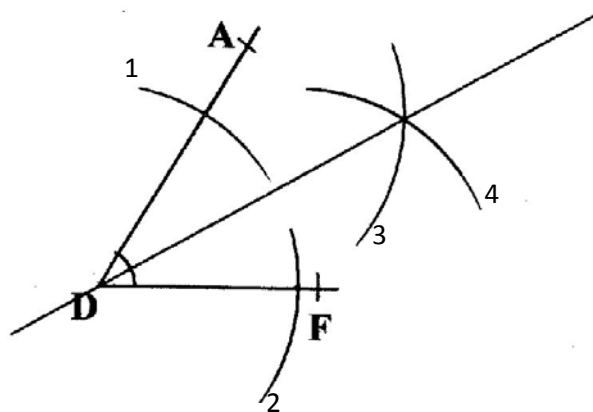
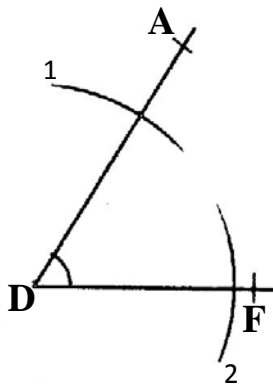
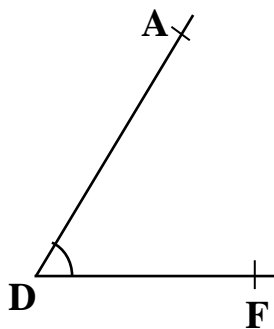
Angle bisector in geometry refers to a line that splits an angle into two equal parts.

## Example

Using a pair of compasses and a sharp pencil, bisect angle ADF.

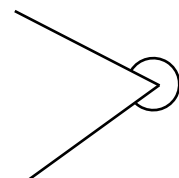
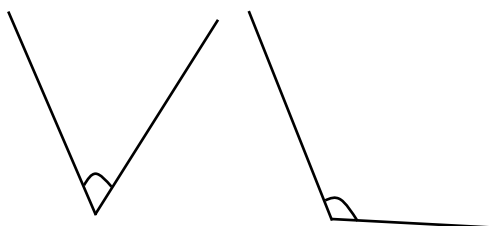
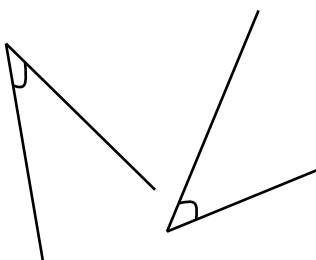
### Steps

- \* Place the compasses at D and adjust it to mark arcs 1 and 2
- \* Place the compass at point 1 and mark arc 3, transfer the compasses to arc 2 and mark arc 4.
- \* Draw a line joining point D to the point of intersection of the two arcs 3 and 4.
- \* Draw a line joining point D to the point of intersection of the two arcs 3 and 4.



## Exercise

Bisect the marked angles.

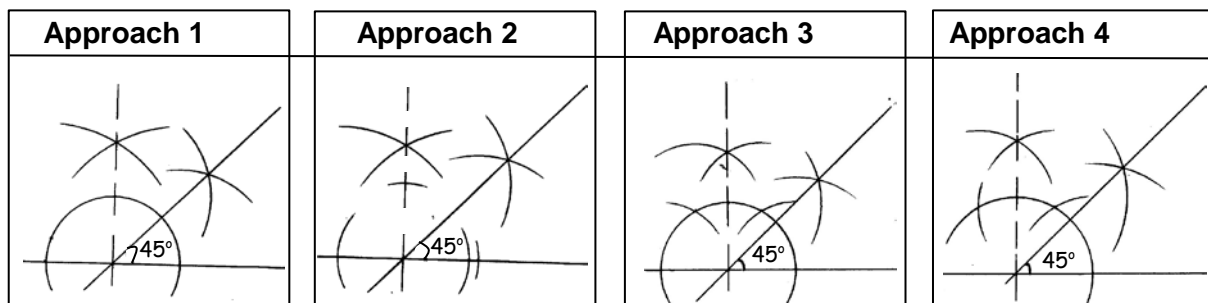


## TOPIC 7: GEOMETRIC CONSTRUCTION



### Constructing an angle of $45^\circ$ .

To construct an angle of  $45^\circ$ , you first construct an angle of  $90^\circ$  then bisect it as shown below.



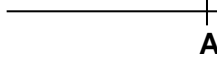
### Exercise

- Construct an angle of  $45^\circ$  at point A.

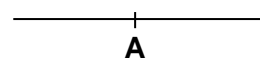
a)



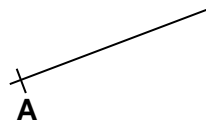
b)



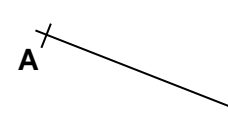
c)



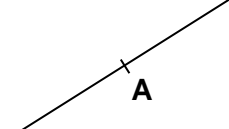
d)



e)



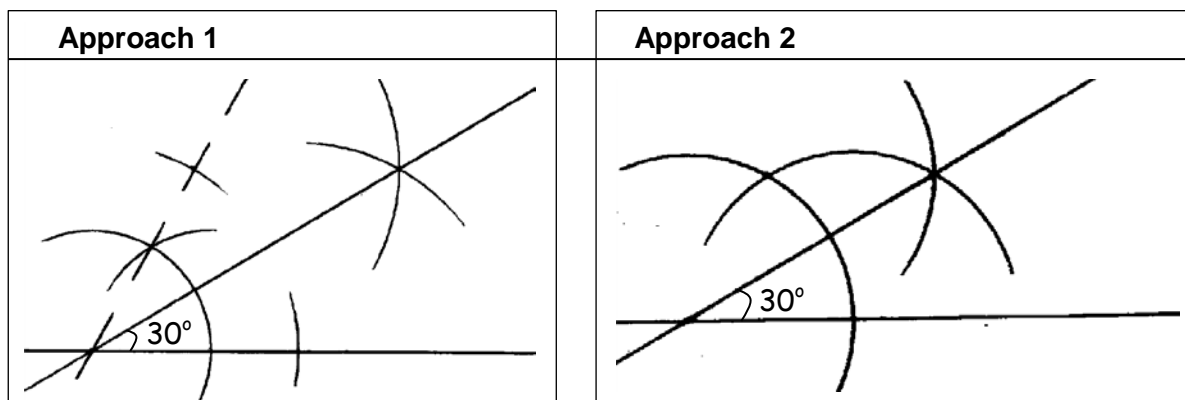
f)



- Using a pair of compasses, a ruler and sharp pencil only, construct an angle of  $45^\circ$ .
- Draw a line segment  $XY = 4\text{cm}$  and construct angle of  $45^\circ$  at point Y.

### Constructing an angle of $30^\circ$

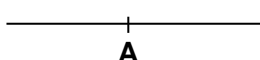
To construct an angle of  $30^\circ$ , construct an angle of  $60^\circ$  and bisect it.



### Exercise

- Using a ruler, pencil and a pair compasses only, construct an angle of  $30^\circ$ .
- Construct an angle of  $30^\circ$  at the given points.

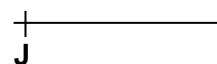
a)



b)



c)



- Draw a line segment  $MN = 5.2\text{cm}$  and construct an angle of  $30^\circ$  at point N.



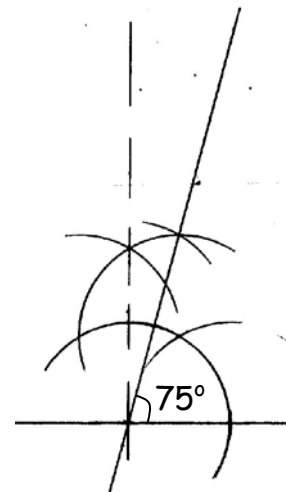
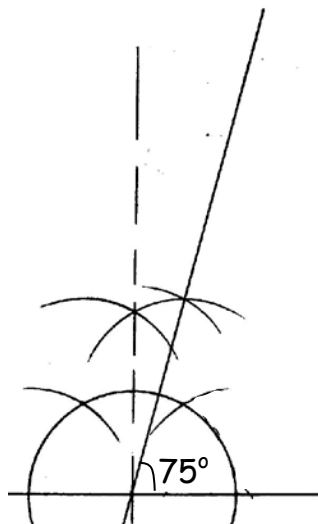
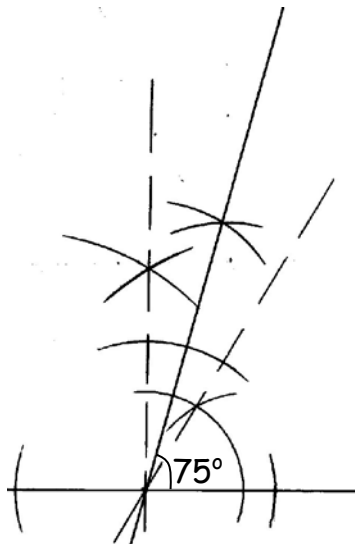
## Constructing an angle of $75^\circ$

### Approach 1

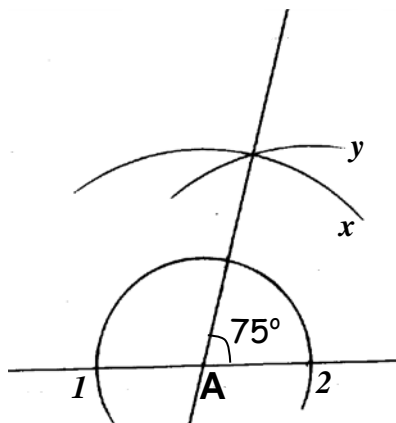
To construct an angle of  $75^\circ$

\* Construct angles;  $90^\circ$  and  $60^\circ$  at the same point

\* Bisect the acute angle formed between  $60^\circ$  and  $90^\circ$  as shown in the drawings below.



### Approach 2 .



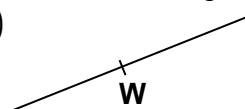
### Steps

- \* Draw a line and mark point A. At A, draw a semi-circular arc to intersect the line at 1 and 2.
- \* Place the compasses at 1 and adjust it to point 2.
- \* Draw arc x from point A
- \* Using the same radius draw an arc y from point 2 .
- \* Join the points as shown.

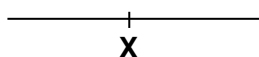
### Exercise

1. Using a sharp pencil, a pair of compasses and a ruler only, construct an angle of  $75^\circ$ .
2. Construct an angle of  $75^\circ$  at the marked points.

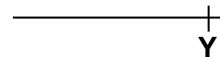
a)



b)



c)



3. Draw a line segment  $XY = 4.7\text{cm}$  and construct angle of  $75^\circ$  at point X.

### Group activity

Using a ruler, a pencil and a pair of compasses only, construct an angle of

a)  $15^\circ$

b)  $22\frac{1}{2}^\circ$

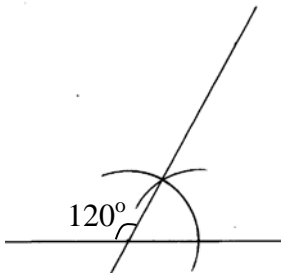
c)  $67\frac{1}{2}^\circ$

# TOPIC 7: GEOMETRIC CONSTRUCTION

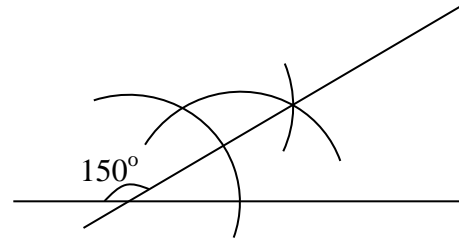


## Constructing obtuse angles

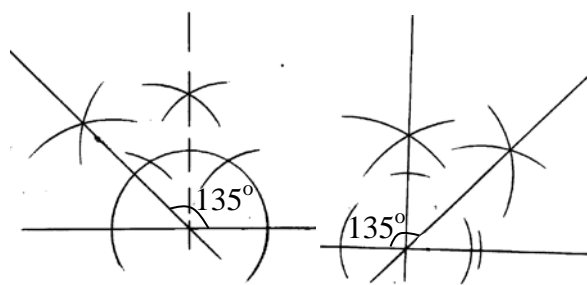
An angle of  $120^\circ$



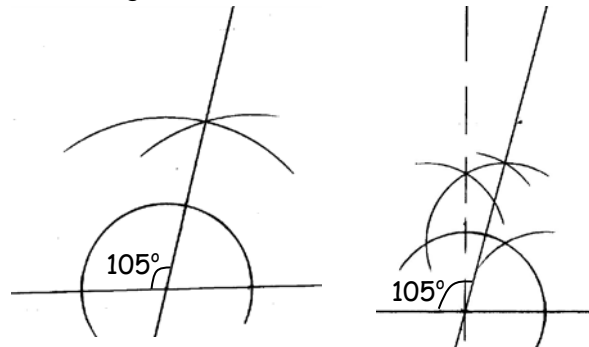
An angle of  $150^\circ$



An angle of  $135^\circ$

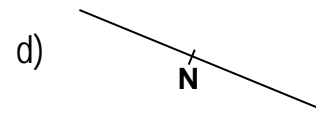
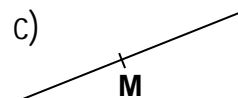
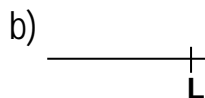
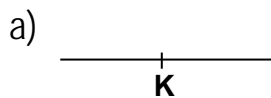


An angle of  $105^\circ$



## Exercise

- Using a ruler, a pair of compasses and a pencil only, construct an angle of;
  - $120^\circ$
  - $150^\circ$
  - $135^\circ$
  - $105^\circ$
- Copy the lines below and construct each of the following angles:  $135^\circ$ ,  $150^\circ$ ,  $105^\circ$  and  $120^\circ$



## CONSTRUCTING POLYGONS

### Constructing an equilateral triangle in a circle

#### Example

- Construct an equilateral triangle ABC in a circle of radius 3cm.

Centre angle

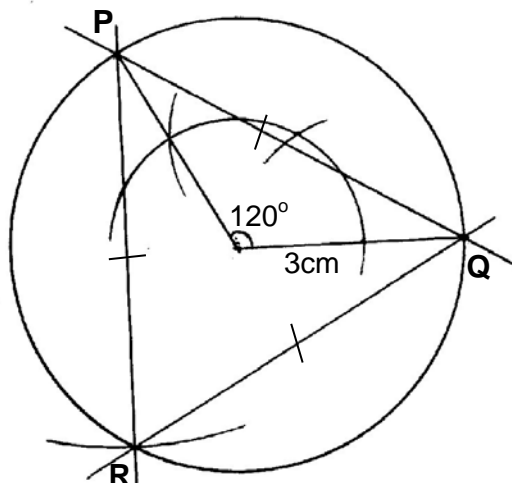
$\frac{360^\circ}{3}$

Sides

$\frac{360^\circ}{3}$

3

$120^\circ$



- Measure length PQ in centimeters

PQ = 5.2cm

- Measure angle RPQ

Angle RPQ =  $60^\circ$



## Exercise

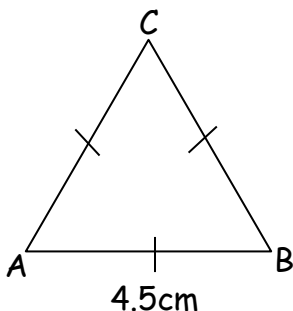
1. Using a ruler, a pencil and a pair of compasses only, construct a triangle
  - a)  $AXY$  in a circle of radius 3.5cm.
  - b)  $PLE$  in a circle of radius 4.5cm.
  - c)  $STV$  in a circle of radius 4cm.
  - d)  $WXY$  in a circle of radius 5cm.
2.
  - a) Construct a triangle  $NUP$  in a circle of radius 4.8cm.
  - b) Measure;
    - i) length  $NP$
    - ii) angle  $PNU$

## Constructing a triangle when all sides are given (SSS)

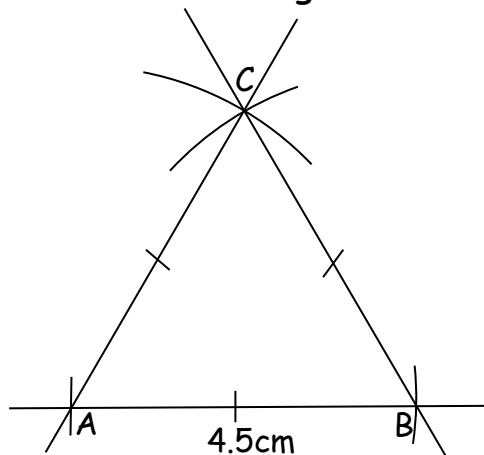
### Example 1

Using a ruler, a pencil and a pair of compasses only, construct a triangle  $ABC$  such that  $AB = BC = CA = 4.5\text{cm}$ .

#### Sketch



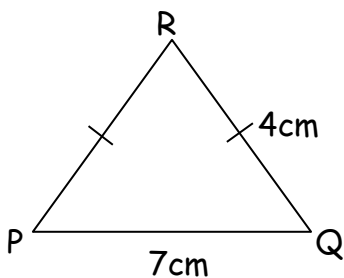
#### Accurate diagram



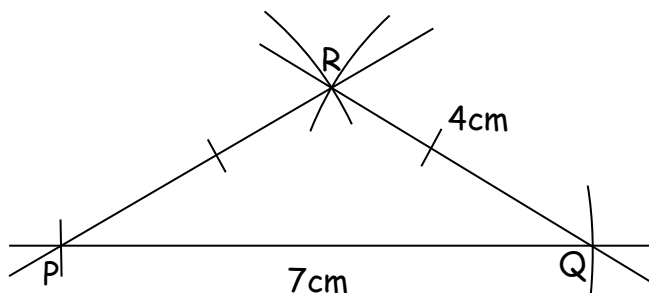
### Example 2

Using a ruler, a pencil and pair of compasses only, construct a triangle  $PQR$  such that  $PQ = 7\text{cm}$ ,  $QR = PR = 4\text{cm}$ .

#### Sketch



#### Accurate diagram



Measure

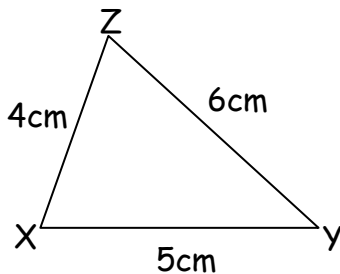
- i) angle  $QRP = 118^\circ$
- ii) angle  $PQR = 31^\circ$



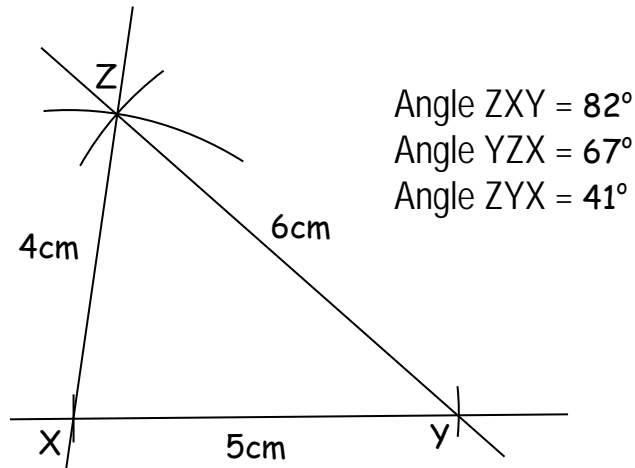
## Example 3

Construct a triangle XYZ in which  $XZ = 4\text{cm}$ ,  $XY = 5\text{cm}$  and  $YZ = 6\text{cm}$ .

### Sketch



### Accurate diagram



## Exercise

- Using a ruler, a pair of compasses and pencil only, construct a triangle;
  - ABC where  $AB = AC = BC = 4\text{cm}$
  - DEF in which  $DE = EF = 4.5\text{cm}$  and  $DF = 3.5\text{cm}$
  - HIG where  $IG = 6\text{cm}$  and  $IH = HG = 4.5\text{cm}$
  - JKL in which  $JK = 5.4\text{cm}$  and  $JL = LK = 4\text{cm}$ .
  - MON where  $OM = 4.5\text{cm}$ ,  $ON = 7\text{cm}$  and  $MN = 6\text{cm}$
  - DRQ where  $DQ = 5\text{cm}$ ,  $RQ = 6.5\text{cm}$  and  $RD = 3.5\text{cm}$
  - STU where  $UT = 3.5\text{cm}$ ,  $TS = 5\text{cm}$  and  $US = 7.6\text{cm}$
  - XWV where  $XW = WV = 4.5\text{cm}$  and  $XV = 8.5\text{cm}$
  - MTN such that  $MN = 8\text{cm}$ ,  $MT = 6\text{cm}$  and  $NT = 10\text{cm}$ .
- Using a ruler, a pencil and a pair compasses only, construct a triangle WPS such that  $PS = 8\text{cm}$ ,  $WS = 7\text{cm}$   $WP = 4.5\text{cm}$ .
  - Measure angle
    - WPS
    - PWS
    - PSW
- Construct a triangle APK such that  $AP = 6.5\text{cm}$  and point K lies on a perpendicular bisector of AP. Point K is  $5.5\text{cm}$  above line AP.
  - What special names is given to triangle APK?
  - Measure
    - line PK
    - angle AKP.
- Construct an equilateral triangle PQR of sides  $5.5\text{cm}$ .
  - Construct a perpendicular line from point R to meet line PQ at K
  - Measure
    - angle PRQ
    - line RK

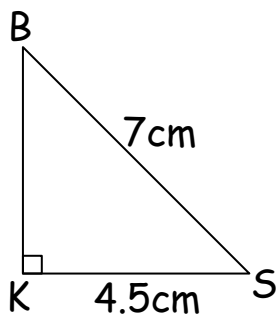


## Constructing a triangle when one angle and two sides (ASS) are given

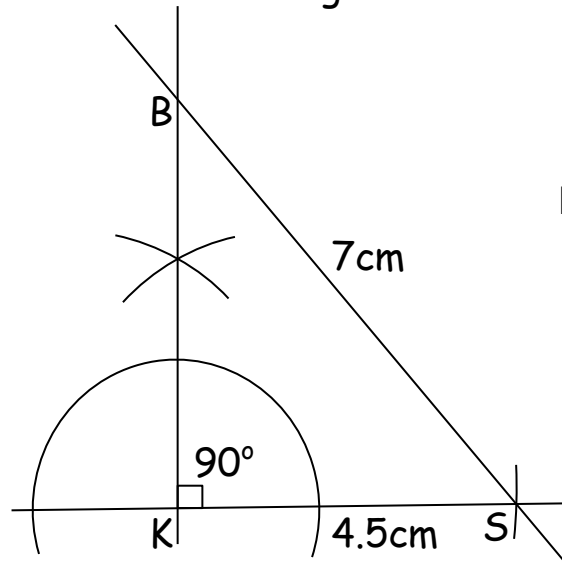
### Example 1

Using a ruler, a pair of compasses and a pencil only, construct triangle KBS such that  $BS = 7\text{cm}$ ,  $KS = 4.5\text{cm}$  and  $\angle SKB = 90^\circ$ .

#### Sketch



#### Accurate diagram



Measure i) line BK

5.5cm

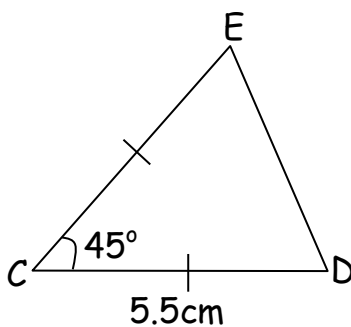
ii) angle SBK

$41^\circ$

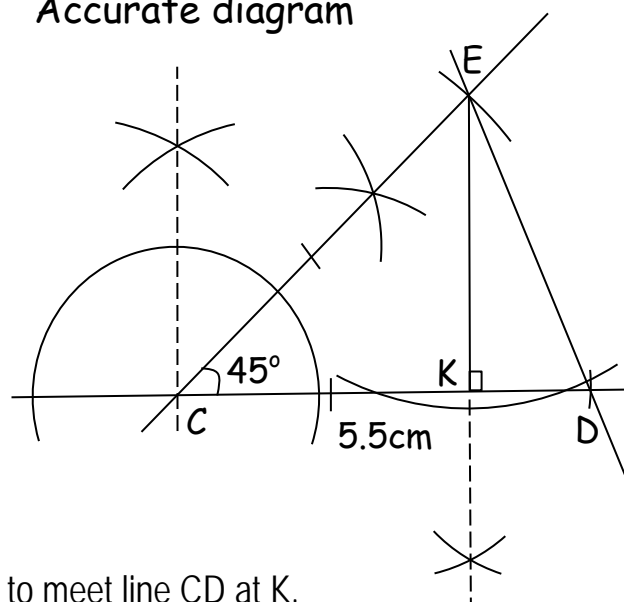
### Example 2

a) Construct a triangle CDE where  $CD = CE = 5.5\text{cm}$  and angle  $\angle ECD = 45^\circ$

#### Sketch



#### Accurate diagram



b) Drop a perpendicular from E to meet line CD at K.

c) Measure;

i) line EK = **4cm**

ii) line ED = **4.3cm**

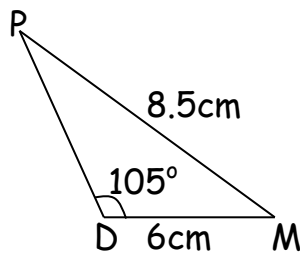
iii) angle CDE =  **$67^\circ$**



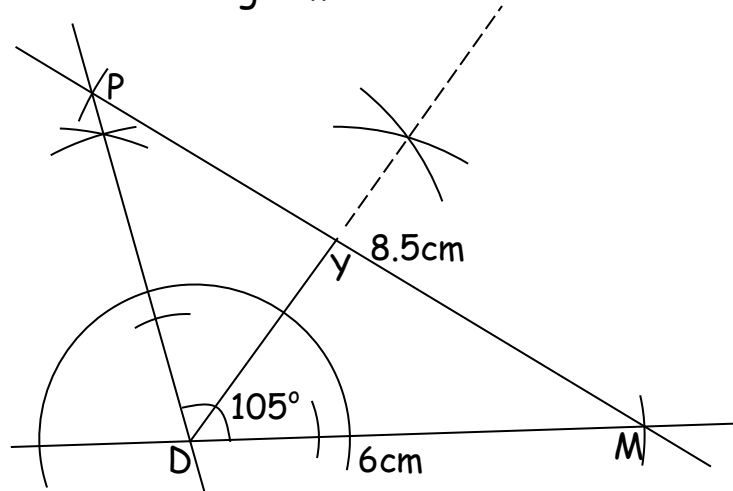
## Example 3

- a) Construct a triangle PDM such that  $DM = 6\text{cm}$ ,  $PM = 8.5\text{cm}$  and angle  $PDM = 105^\circ$ .

Sketch



Accurate diagram



- b) Bisect angle PDM such that the bisector meets line PM at Y.  
 c) Measure;  
 i) line  $DY = 3.2\text{cm}$   
 ii) angle  $DMY = 33^\circ$

## Exercise

- Construct a triangle;
  - MTN such that  $MT = 4.5\text{cm}$ ,  $\angle NTM = 60^\circ$  and  $TN = 6\text{cm}$ .
  - TVS where  $TV = VS = 4.5\text{cm}$  and  $\angle STV = 60^\circ$ .
  - PQR in which  $RQ = QP = 5\text{cm}$  and  $\angle PRQ = 45^\circ$ .
  - WRP such that  $RP = 5\text{cm}$ ,  $PW = 5\text{cm}$  and  $\angle WRP = 90^\circ$ .
  - LKM where angle  $MLK = 90^\circ$  and  $ML = LK = 4.8\text{cm}$ .
  - EFD where angle  $D = 90^\circ$ ,  $FD = 5\text{cm}$  and  $DE = 4.8\text{cm}$ .
  - WYX where angle  $Y = 45^\circ$ ,  $WX = 5\text{cm}$  and  $YX = 4.5\text{cm}$ .
  - FED where  $\angle EFD = 30^\circ$ ,  $FD = 5\text{cm}$  and  $FE = 9\text{cm}$ .
  - ABC in which  $\angle BCA = 75^\circ$ ,  $CA = 6\text{cm}$  and  $AB = 7\text{cm}$ .
  - MNL where  $ML = NL = 4.5\text{cm}$  and  $\angle NLM = 120^\circ$ .
- Construct a triangle EFG where  $EF = 7\text{cm}$ , angle  $FEG = 60^\circ$  and  $EG = 5\text{cm}$ .
  - What is the size of angle GFE?
- Construct a triangle XYZ, such that  $YZ = 5\text{cm}$ ,  $\angle XYZ = 120^\circ$ ,  $XY = 4\text{cm}$ .
  - Measure
    - angle ZXY
    - line XZ
- Construct an isosceles triangle XYZ such that line  $XY = XZ = 6\text{cm}$  and  $\angle YXZ = 90^\circ$ .
  - Measure angle XYZ.



5. a) Construct a triangle ABC such that  $AB = 6\text{cm}$ ,  $\angle BAC = 75^\circ$  and  $BC = 8\text{cm}$ .  
 b) Measure line AC.  
 c) Measure angle ABC.
6. a) Construct a triangle PQR such that  $PQ = 5.8\text{cm}$ ,  $QR = 7\text{cm}$  and angle  $PQR = 60^\circ$ .  
 b) Drop a perpendicular from point R to meet line PQ at N.  
 c) Measure line RN.
7. a) Construct a triangle ABC where  $AB = 4\text{cm}$ ,  $\angle ABC = 135^\circ$  and  $BC = 6.5\text{cm}$ .  
 b) Measure  
     i) angle ACB  
     ii) line AC
8. a) Construct a triangle DAP where  $DA = 9\text{cm}$ ,  $PA = 4.5\text{cm}$  and angle  $PDA = 30^\circ$ .  
 b) Drop a perpendicular line from P to meet line DA at T.  
 c) Measure line PT,  $\angle DPT$ ,  $\angle DAP$
9. a) Construct a triangle CBS in which  $CS = 9\text{cm}$ ,  $\angle SBC = 120^\circ$  and line  $BC = 4.5\text{cm}$ .  
 Drop a perpendicular line from C to meet line BS at Y.  
 b) Measure line CY.  
 c) Measure angle BCS.
10. a) Construct a triangle CAT such that  $TA = 6.5\text{cm}$ ,  $\angle TCA = 60^\circ$  and  $CA = 8\text{cm}$ . Drop a perpendicular line from T to meet CA at X.  
 b) Measure angle CAT.  
 c) Using TX as the height, find the area of triangle CAT.
11. a) Construct a triangle CTV where  $TV = 6\text{cm}$ ,  $CV = 9.7\text{cm}$  and angle  $CTV = 105^\circ$ .  
 Draw a perpendicular line from C to meet TV at P.  
 b) Measure line CP.  
 c) Calculate the area of triangle CTV in square centimeters.
12. a) Follow the instructions below to construct triangle MTN.  
     i) Draw line segment  $TN = 6\text{cm}$ .  
     ii) Construct an angle of  $105^\circ$  at point N.  
     iii) Locate point M such that M and N are  $4.2\text{cm}$  apart.  
     iv) Join T to M to make a triangle.  
 b) Measure  
     i)  $\angle MTN$   
     ii) line MT
13. a) Construct a triangle EHN where  $HN = 6.9\text{cm}$ ,  $\angle NHE = 45^\circ$ , point K is half-way between H and N such that EK is perpendicular to HN.  
 b) Measure line EN.  
 c) Measure angle HEN.



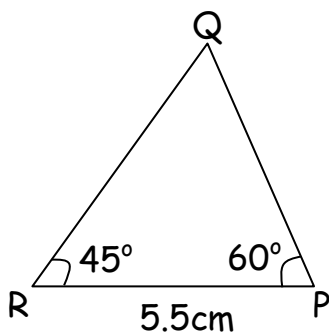
## Constructing a triangle when one side and two angles (ASS) are given

**Note:** To construct such triangles, you should always start with the base line.

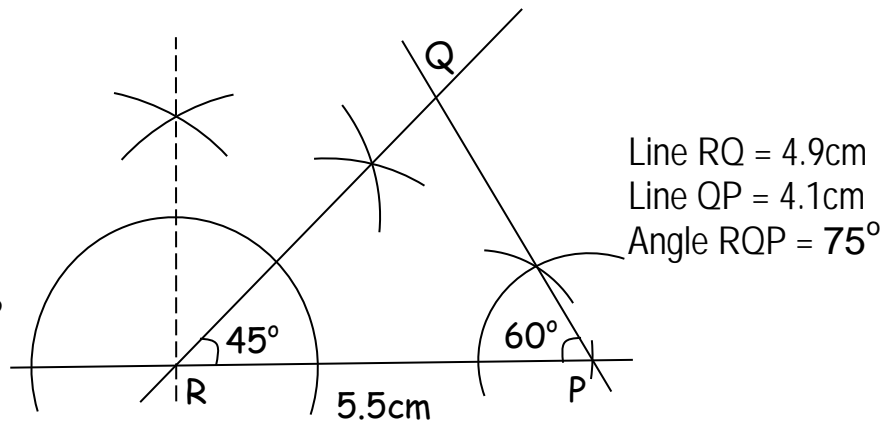
### Example 1

Using a ruler, a pencil and a pair of compasses only, construct a triangle PQR where line  $RP = 5.5\text{cm}$ ,  $\angle QRP = 45^\circ$  and  $\angle RPQ = 60^\circ$ .

#### Sketch



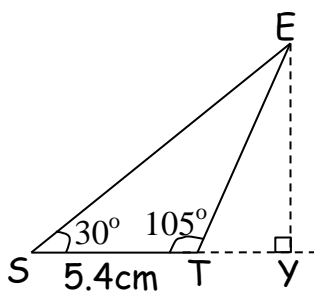
#### Accurate diagram



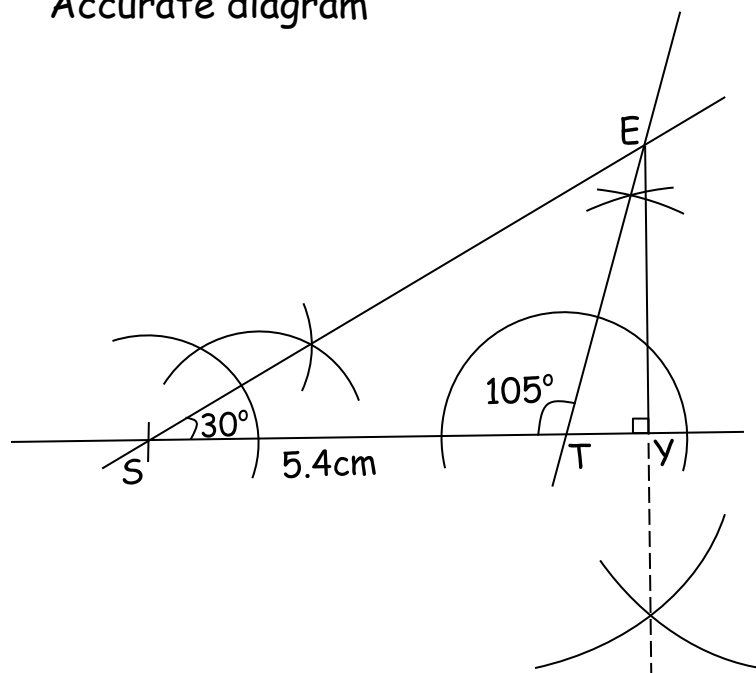
### Example 3

Construct a triangle ETS where  $\angle T = 105^\circ$ ,  $TS = 5.4\text{cm}$  and  $\angle S = 30^\circ$ . Drop a perpendicular from E to meet TS at Y.

#### Sketch



#### Accurate diagram



$$EY = 3.8\text{cm}$$

$$SE = 7.6\text{cm}$$

$$TE = 4\text{cm}$$

$$\angle SET = 45^\circ$$

$$\angle TEY = 16^\circ$$

$$\angle SEY = 60^\circ$$



## Exercise

1. Using a ruler a pencil and a pair of compasses only, construct a triangle.
  - a) ABC where  $CB = 4.5\text{ cm}$ ,  $\angle ACB = 90^\circ$  and  $\angle ABC = 45^\circ$ .
  - b) FDC in which  $\angle DFC = 30^\circ$ ,  $FC = 6.5\text{ cm}$  and  $\angle FCD = 90^\circ$ .
  - c) GHI where  $\angle GIH = 45^\circ$ ,  $\angle IHG = 60^\circ$ , and  $IH = 5.5\text{ cm}$ .
  - d) JKL in which  $\angle K = 45^\circ$ ,  $\angle L = 30^\circ$  and  $LK = 6.5\text{ cm}$ .
  - e) KML such that  $\angle L = 45^\circ$ ,  $\angle M = 105^\circ$  and line  $ML = 4\text{ cm}$ .
  - f) NTV in which  $\angle NVT = \angle NTV = 30^\circ$  and  $VT = 8.3\text{ cm}$ .
  - g) LNM where  $\angle NML = 90^\circ$ ,  $\angle LNM = 75^\circ$  and  $NM = 2.8\text{ cm}$ .
  - h) PQR in which  $\angle QRP = 30^\circ$ ,  $\angle RQP = 120^\circ$  and  $RQ = 45\text{ cm}$ .
  - i) STU where  $UT = 5\text{ cm}$ ,  $\angle T = 150^\circ$  and  $\angle U = 15^\circ$
  - j) TVS where  $\angle V = 105^\circ$ ,  $\angle T = 30^\circ$  and line  $TV = 6.2\text{ cm}$
2.
  - a) Construct a triangle PQR where  $\angle R = 60^\circ$ ,  $\angle Q = 30^\circ$  and  $RQ = 7.1\text{ cm}$
  - b) Draw a perpendicular line from P to meet RQ at Y
  - c) Measure line PY.
3.
  - a) Construct a triangle ABC in which  $AB = 6\text{ cm}$ , angle  $CAB = 45^\circ$ ,  $CBA = 60^\circ$ .  
Drop perpendicular line from C to meet line AB at X.
  - b) Measure XC.
  - c) Find the area of the triangle ABC.
4.
  - a) Construct a triangle ABC where angle  $A = 60^\circ$ ,  $AB = 7\text{ cm}$  and angle  $B = 45^\circ$ .  
Drop perpendicular from C to meet AB at P.
  - b) Measure CP.
5.
  - a) Construct a triangle RST where  $RT = 7\text{ cm}$ , angle  $SRT = 45^\circ$  and angle  $RTS = 60^\circ$ .
  - b) Measure length RS.
6.
  - a) Construct a triangle ABC where  $AB = 7\text{ cm}$ ,  $\angle BAC = 120^\circ$  and  $\angle CBA = 30^\circ$ .
  - b) Measure length CB.
7.
  - a) Construct a triangle UBC where  $BC = 7.5\text{ cm}$ ,  $\angle UBC = 45^\circ$  and  $\angle UCB = 30^\circ$ .  
Drop a perpendicular line from point M to meet BC at Y.
  - b) Measure UY in centimeters.
8.
  - a) Construct a triangle ATM such that  $TM = 5.4\text{ cm}$ ,  $\angle ATM = 45^\circ$  and  $\angle TMA = 60^\circ$ .
  - b) Measure;
    - i) TA
    - ii) MA
9. Construct a triangle;
  - a) PQR where  $PQ = 5\text{ cm}$ ,  $\angle RQP = 45^\circ$  and  $\angle QPR = 30^\circ$ .
  - b) SBN where  $BS = 6.5\text{ cm}$ ,  $\angle NBS = 45^\circ$ ,  $\angle BSN = 75^\circ$ .

## TOPIC 7: GEOMETRIC CONSTRUCTION



10. Construct a triangle;
  - a) ARC where  $AR = 6.8\text{cm}$ ,  $\angle RAC = 60^\circ$  and  $CRA = 45^\circ$ 
    - i) Measure line CA.
    - ii) Measure CAR
  - b) BOX where  $XO = 5.5\text{cm}$ ,  $\angle XOB = 120^\circ$ ,  $BXO = 30^\circ$ .
11. a) Using a protractor, a pencil and a ruler only, draw a triangle MFK where  $FM = 6\text{cm}$ ,  $\angle KFM = 50^\circ$  and  $\angle M = 65^\circ$ .  
b) Draw a perpendicular line from K to meet line FM at Y.
12. a) Construct a triangle MKL in which  $\angle LMK = 30^\circ$ ,  $\angle K = 105^\circ$  and  $MK = 6\text{cm}$ .  
Drop a perpendicular from L to meet MK at X.  
b) Measure;
  - i) line LX in centimetres.
  - ii) angle KLX in degrees .
13. a) Construct a triangle ABC such that  $\angle CBA = 135^\circ$ ,  $\angle CAB = 30^\circ$  and line  $AB = 4.5\text{cm}$ .  
Drop a perpendicular from C to meet AB at M.  
b) Measure
  - i) line AC
  - ii) line CM
  - iii) Angle ACM

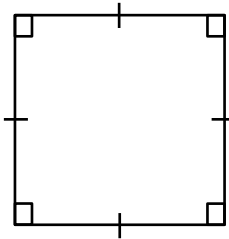
### Group activity

1. Construct a triangle SVT such that  $\angle SVT = 105^\circ$ , line  $SV = 4.2\text{cm}$  and  $\angle VTS = 30^\circ$
2. a) Construct a triangle WPS in which  $WP = 6\text{cm}$ ,  $SPW = 30^\circ$  and  $WSP = 45^\circ$   
b) Measure line WS.
3. a) Construct a triangle SNQ where  $SQ = 7\text{cm}$ ,  $\angle SNQ = 90^\circ$  and  $\angle S = 60^\circ$ .  
b) Drop a perpendicular from N to meet SQ at Y. Measure NY.
4. a) Construct a triangle WMX such that  $MX = 4.5\text{cm}$ ,  $\angle WMX = 120^\circ$  and  $\angle XWM = 30^\circ$ .  
Drop a perpendicular from W to meet MX at C.  
b) Measure
  - i) WC
  - ii) WX
  - iii)  $\angle XWC$
5. a) Construct a triangle KTR in which  $\angle RTK = 90^\circ$ ,  $\angle TKR = 60^\circ$  and line  $RT = 6\text{cm}$ .  
Bisect angle TRK and let the bisector meet line TK at X.  
b) Measure
  - i) Angle RXK
  - ii) Line RX
  - iii) Line XK.



## CONSTRUCTING QUADRILATERALS

### SQUARE

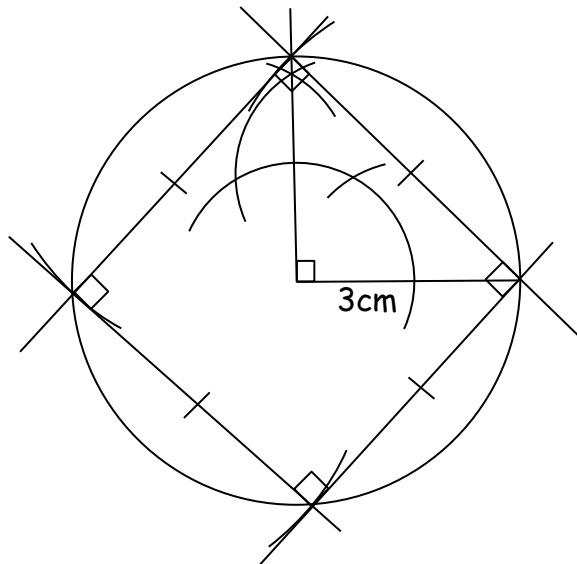


#### Properties of a square

- All sides are equal.
- Opposite sides are parallel.
- Has an angle of  $90^\circ$  at each vertex.
- Diagonals are equal.
- Diagonals bisect each other at right angles.
- Has four lines of folding symmetry.

#### Example 1

Construct a square in a circle of radius 3cm.

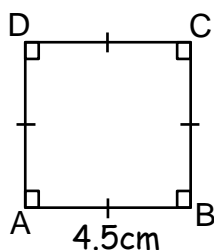


Length of each side = 4.2cm

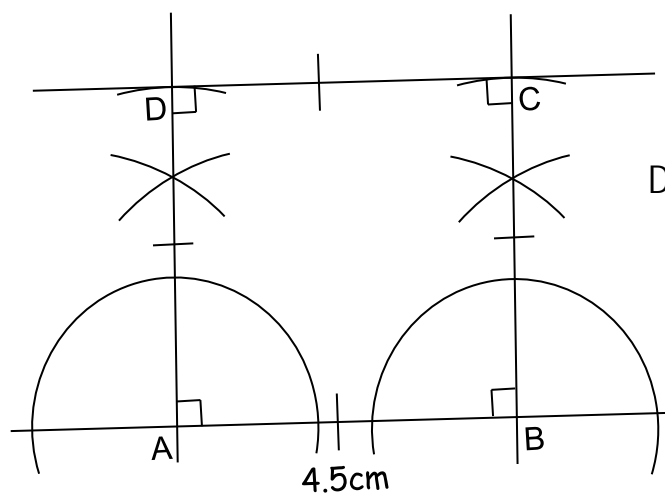
#### Example 2

Construct a square ABCD in which  $AB = BC = CD = DA = 4.5\text{cm}$ .

#### Sketch



#### Accurate diagram



Diagonal AC = 6.4cm

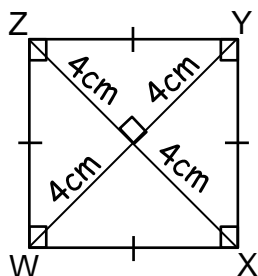
## TOPIC 7: GEOMETRIC CONSTRUCTION



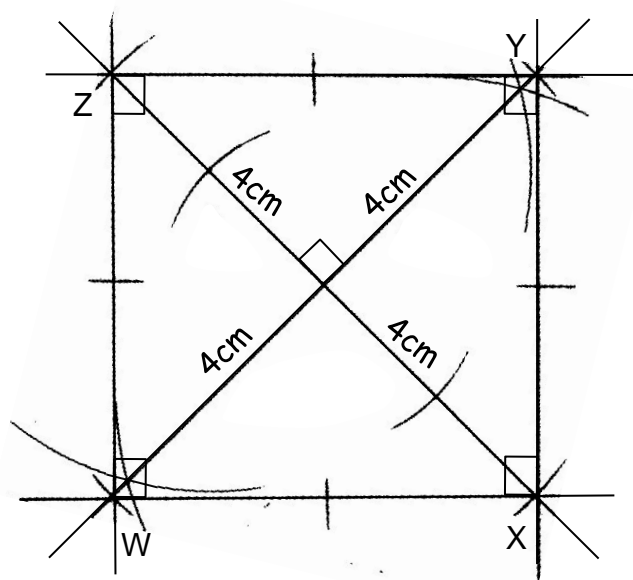
### Example 3

Construct a square WXYZ such that diagonal  $WY = 8\text{cm}$ .

#### Sketch



#### Accurate diagram



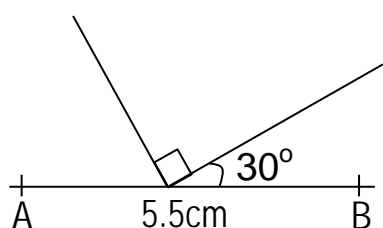
Length  $WX = 5.6\text{cm}$

### Exercise

- Using a pair of compasses a pencil and a ruler only, construct a square of the sides given below.
 

a) 3.5cm	c) 3cm	e) 6cm	g) 4.3 cm	i) 8cm
b) 4cm	d) 5cm	f) 5.5 cm	h) 5.2cm	j) 9cm
- Construct a square UVWX such that  $UV = VW = 4.5\text{cm}$ .
  - Measure the length of diagonal UW.
- Use a ruler, a protractor and a pencil only to draw a square EFGH of sides 4cm.
 

a) 6cm	c) 9cm	e) 10cm	g) 6.4 cm
b) 12cm	d) 8cm	f) 8.5cm	h) 11.6cm
- Construct a square ABCD such that diagonal  $AC = 10.5\text{cm}$ .
- Construct a quadrilateral PQRS such that  $PQ = QR = RS = SP = 6.2\text{cm}$ .
- The drawing below shows part of a sketch diagram of the square KLMN of side 4cm, angle  $LKB = 30^\circ$ , K bisects line AB and line AB = 5.5cm.



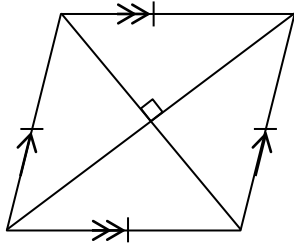
- Copy and complete the sketch diagram.
  - Use a pair of compasses, a ruler and a pencil to construct an accurate diagram.
  - Drop a perpendicular from N to meet line AB at Y.
  - Measure line NY.
- Construct a square in a circle whose radius is:
 

a) 3.5cm	b) 4cm	c) 3cm	d) 4.5 cm	e) 4.8cm	f) 3.7cm
----------	--------	--------	-----------	----------	----------
  - Construct a square PQRS in a circle of radius 4.2cm.
    - Measure line PQ in cm.



10. a) Construct a square DEFG in a circle whose diameter is 6.6cm.
- b) Measure length FG in centimetres.

## RHOMBUS



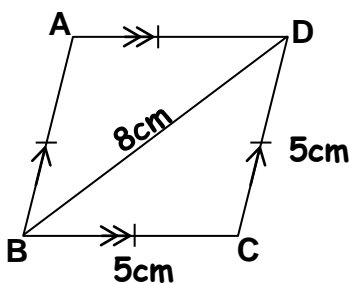
### Properties of a rhombus.

- All sides are equal .
- Opposite sides are parallel .
- Opposite angles are equal.
- Diagonals bisect each other at right angles.
- Has two lines of folding symmetry.

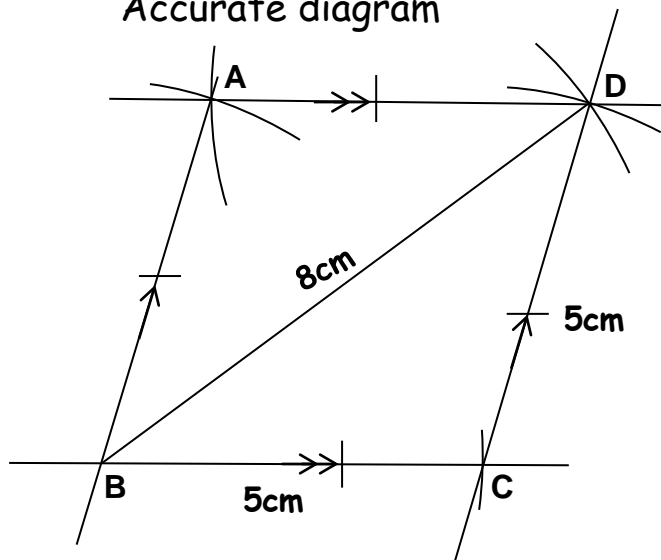
### Example 1

Construct a rhombus ABCD in which DC = 5cm and diagonal DB = 8cm.

#### Sketch



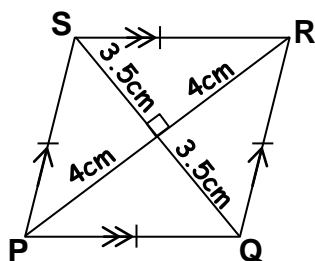
#### Accurate diagram



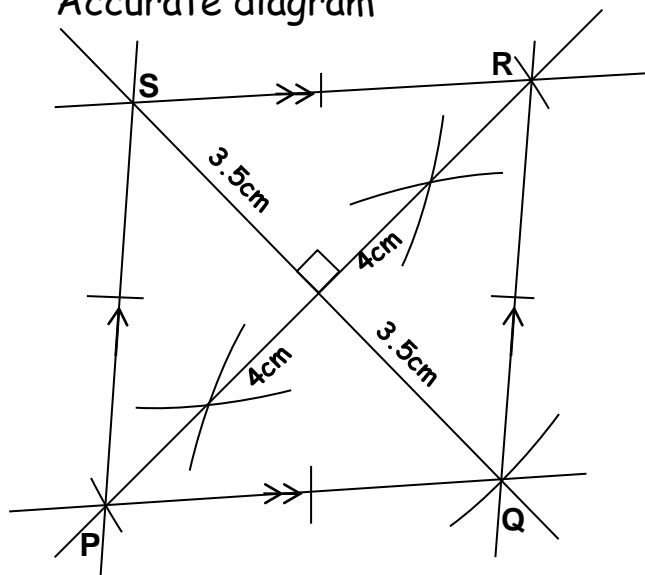
### Example 2

Construct a rhombus PQRS where diagonal SQ = 7cm and diagonal PR = 8cm.

#### Sketch



#### Accurate diagram

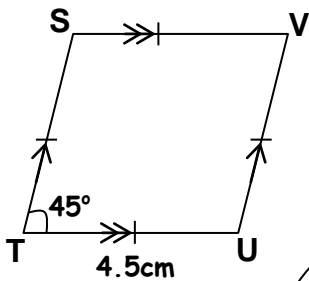




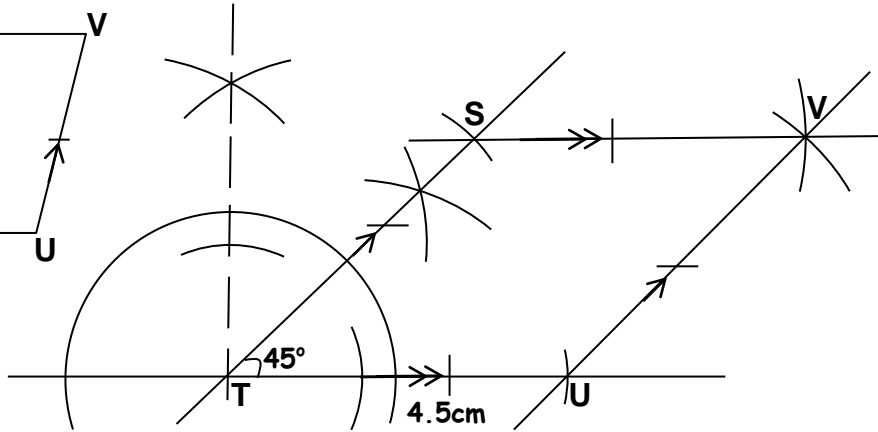
## Example 3

Construct a rhombus STUV where angle STU =  $45^\circ$  and line TU = 4.5cm.

### Sketch



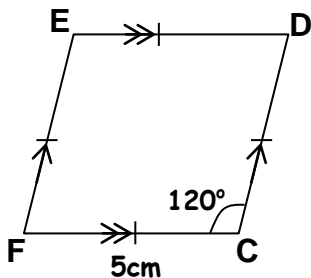
### Accurate diagram



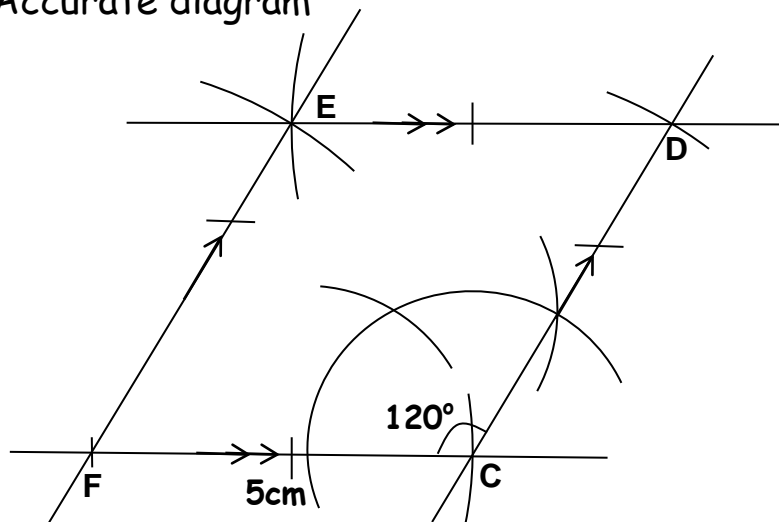
## Example 4

Construct a rhombus CDEF such that FC = 5cm and angle FCD =  $120^\circ$  and  $\overline{FC} = 5\text{cm}$ .

### Sketch



### Accurate diagram



## Exercise

1. Construct a rhombus;

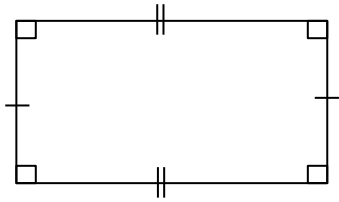
- ABCD in which diagonal AD = 4cm and diagonal AC = 7cm.
- JKLM where diagonal MK = 6.5cm and line ML = 4.5cm.
- EFGH such that HG = 5cm and EG = 6cm.
- PQRS where diagonal PR = 7cm and SQ = 8cm.
- TUVW such that VT = 10cm and UW = 6cm.
- WXYZ where XZ = 8cm and YW = 6cm.
- DMTQ where DT = 12cm and MQ = 7cm.



2. Using a ruler a pencil and a pair of compasses only, construct a rhombus;
  - a) PQRS where  $RQ = 5\text{cm}$  and angle  $SRQ = 30^\circ$ .
  - b) WYSK such that  $\angle Y = 60^\circ$  and line  $SY = 4.5\text{cm}$ .
  - d) MNTV where  $MN = 4.5\text{cm}$  and  $\angle V = 75^\circ$ .
  - e) WTSB where  $\angle S = 105^\circ$  and line  $TS = 4\text{cm}$ .
3. a) Construct a rhombus CBXV in which  $\angle CBX = 135^\circ$  and line  $CB = 5.5\text{cm}$ .
  - b) Measure;
    - i) angle BXV.
    - ii) diagonal BV.
4. a) Construct rhombus YMCA such that  $AC = 4.8\text{cm}$  and  $\angle ACM = 150^\circ$ .
  - b) Drop a perpendicular from Y to meet AC at K.
  - c) Measure;
    - i) line YK.
    - ii) angle AYK.
    - iii) diagonal AM.
5. a) Construct a rhombus CSVM such that  $MV = 4\text{cm}$ ,  $\angle CSV = 120^\circ$ . Drop perpendicular from point V to meet line CS at P.
  - b) Measure;
    - i) line VP.
    - ii) diagonal MS.
    - iii) diagonal CV.
    - iv) angle SVP.
6. a) Construct a rhombus ABCD where ABD is an equilateral triangle of side 6cm.
  - b) Drop a perpendicular from D to meet AB at M.
  - c) Measure;
    - i) line MD.
    - ii) diagonal AC.
    - iii) angle MDC.
7. a) Construct a rhombus ABCD such that  $\angle DAB = 120^\circ$  and diagonal  $AC = 6\text{cm}$ . Diagonal AC bisects angle BAD.
  - b) Drop a perpendicular from C to meet line AB at N.
  - c) Measure
    - i) Length AB.
    - ii) diagonal BD.
    - iii) angle ADC.
8. The diagonals of a rhombus KPLE intersect at point Y such that line  $LY = 7\text{cm}$  and diagonal  $EP = 9\text{cm}$ . With the help of a ruler, a pencil and a pair of compasses only, construct rhombus KPLE then measure line KP and angle LEK.



## RECTANGLES



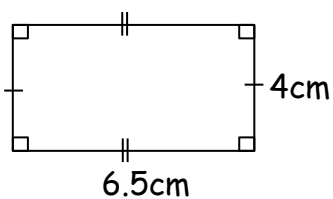
### Properties of a rectangle

- Opposite sides are equal and parallel.
- Diagonals are equal.
- Has 4 right angles.
- Has 2 lines of folding symmetry.

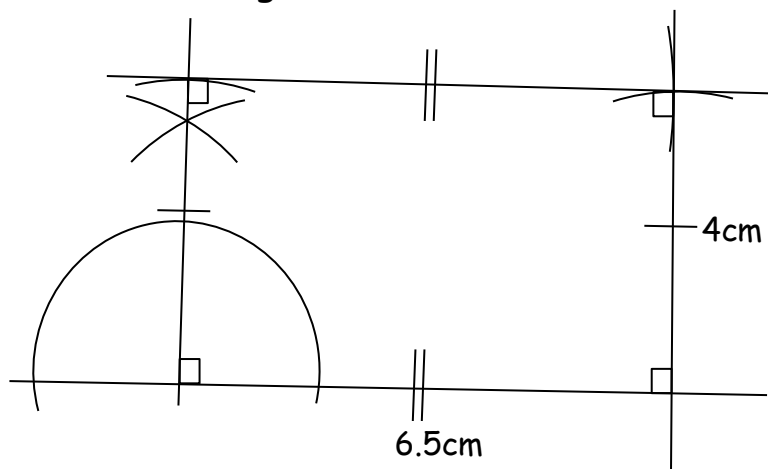
### Example 1

Construct rectangle of length 6.5cm and width 4cm.

#### Sketch



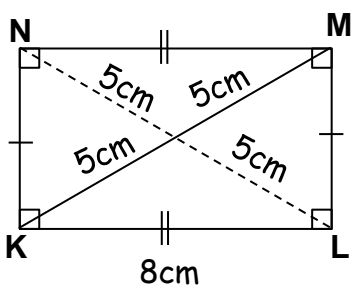
#### Accurate diagram



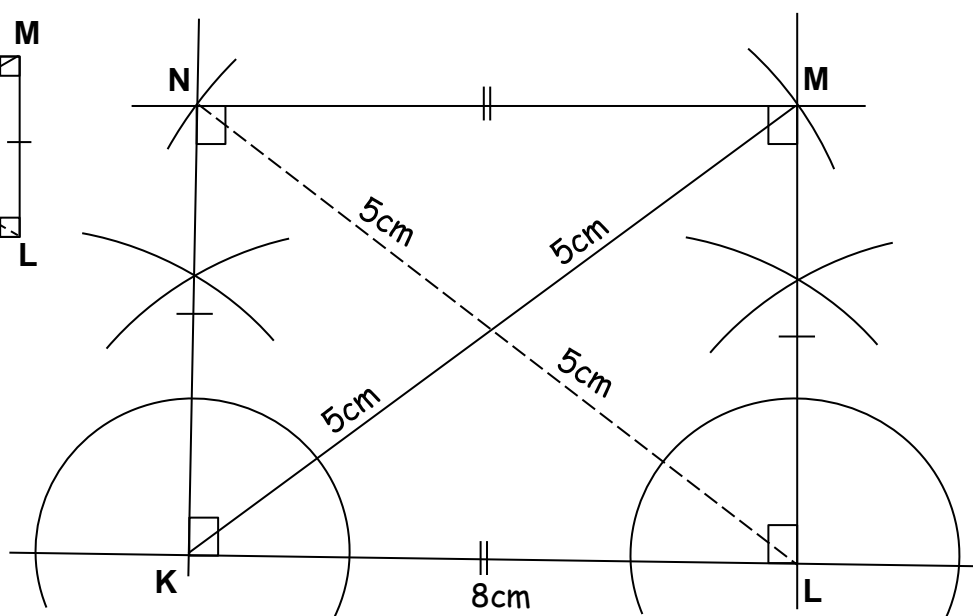
### Example 2

Construct a rectangle KLMN where  $KL = 8\text{cm}$  and diagonal  $KM = 10\text{cm}$ .

#### Sketch



#### Accurate diagram



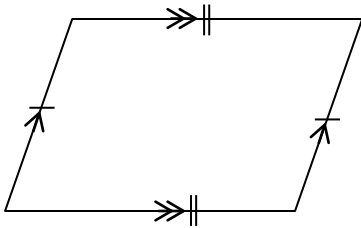


## Exercise

1. Construct a rectangle of
  - a) length 4cm and width 3cm.
  - b) length 7cm and width 4.5cm.
  - c) length 8cm and width 6cm.
  - d) length 6.2cm and width 3.5cm.
2. Construct a rectangle
  - a) ABCD in which  $AB = 5\text{cm}$  and  $BC = 4\text{cm}$
  - b) PQRS where  $QR = 7\text{cm}$  and  $PQ = 5.5\text{cm}$
  - c) MNPT such that  $MT = 4.5\text{cm}$  and  $MN = 6\text{cm}$
  - d) EFGH in which  $EF = 10\text{cm}$  and  $FG = 6.4\text{cm}$
3.
  - a) Construct a rectangle DSTV in which length  $DS = 7.4\text{cm}$  and width  $ST = 5\text{cm}$ .
  - b) Measure
    - i) diagonal DT
    - ii) angle VDT
4.
  - a) Construct a rectangle MSBK such that  $MS = 4\text{cm}$  and diagonal  $MB = 5\text{cm}$ .
  - b) Measure
    - i) line SB
    - ii) angle KBM
  - c) Find the area of the rectangle.
5.
  - a) Construct a rectangle whose length is 6.5cm and diagonal 8cm.
  - b) Measure its width.
6.
  - a) Construct a rectangle in which width  $KL = 3.5\text{cm}$  and diagonal  $MK = 7\text{cm}$ .
  - b) Measure length ML.
7.
  - a) Construct a rectangle ADKQ such that diagonal  $AK = 8.2\text{cm}$  and angle  $KAD = 30^\circ$
  - b) Measure:
    - i) AD
    - ii) DK
8.
  - a) With the help of a protractor, a ruler and sharp pencil only, draw a rectangle PRST such that  $PT = 7\text{cm}$  and angle  $TPS = 40^\circ$ .
  - b) Measure
    - i) diagonal PS.
    - ii) line ST.
9.
  - a) Using a ruler, a pencil and a pair of compasses only, construct a quadrilateral WPQR whose diagonal intersect at O such that diagonal such that angle  $WOP = 120^\circ$  and diagonal  $WQ = RP = 8\text{cm}$ .
  - b) Measure
    - (i) line RQ
    - (ii) line PQ



## PARALLELOGRAMS



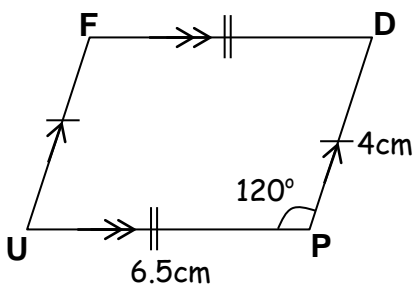
### Properties of a parallelogram

- Opposite sides are equal and parallel.
- Opposite angles are equal.
- Diagonals are not equal.
- Has no line of folding symmetry.

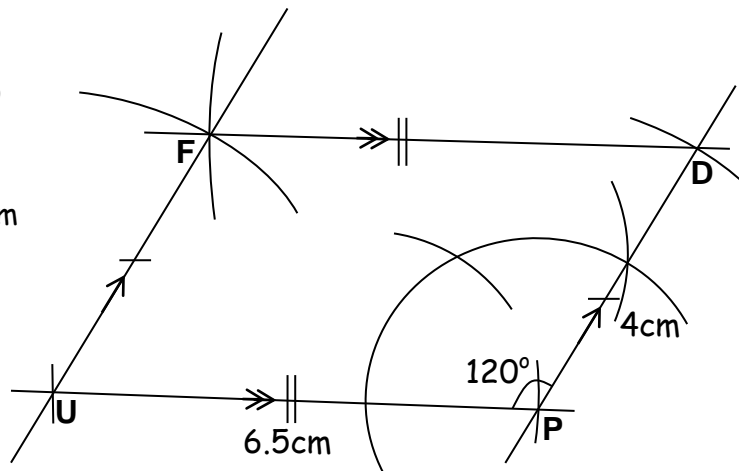
### Example 1

Construct a parallelogram FUPD where angle UPD =  $120^\circ$ . UP = 6.5cm and PD = 4cm.

#### Sketch



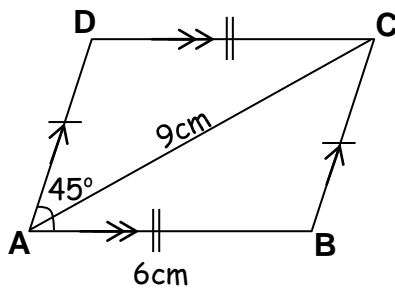
#### Accurate diagram



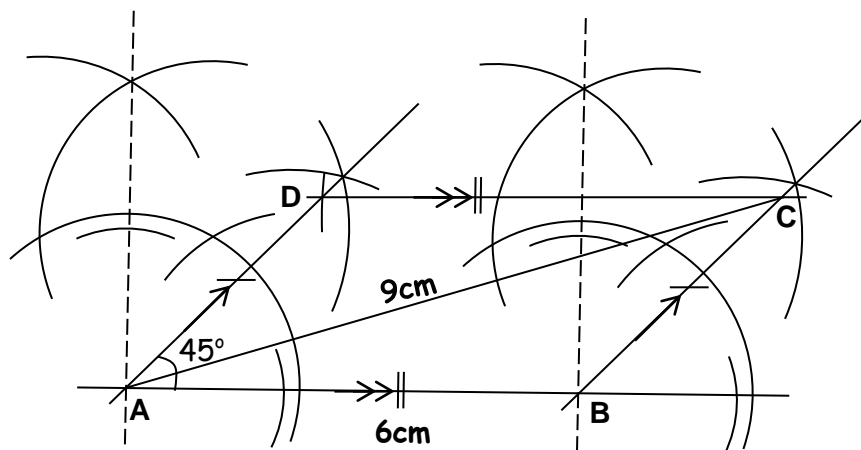
### Example 2

Construct a parallelogram ABCD in which AB = 6cm, angle DAB =  $45^\circ$  and diagonal AC = 9cm.

#### Sketch



#### Accurate diagram

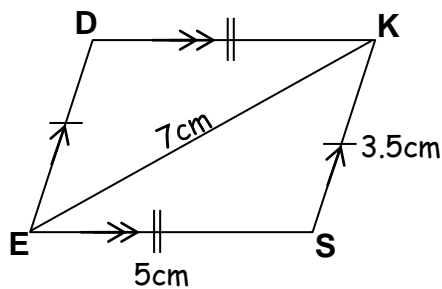




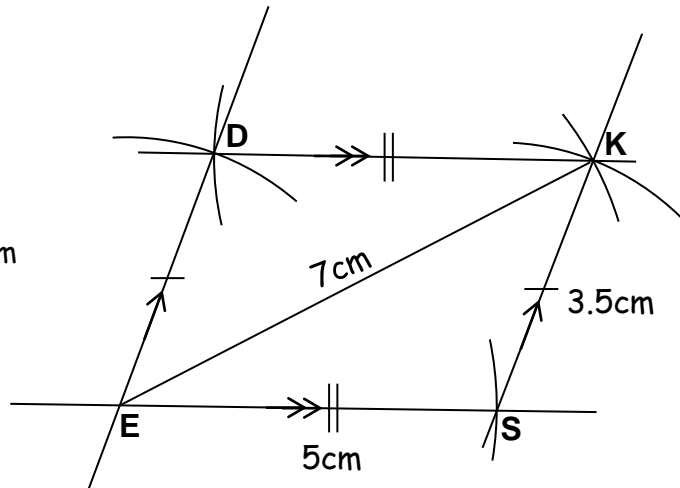
## Example 3

Construct a parallelogram DESK where  $ES = 5\text{cm}$ ,  $SK = 3.5\text{cm}$  and  $EK = 7\text{cm}$ .

### Sketch



### Accurate diagram



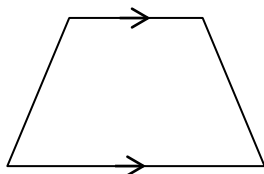
## Exercise

- Construct a parallelogram ABCD where  $AB = 8\text{cm}$ , angle A =  $60^\circ$  and line AD =  $4.5\text{cm}$ .
- Construct a parallelogram
  - WPSM such that  $WP = 7\text{cm}$ ,  $PS = 5.5\text{cm}$  and  $MWP = 30^\circ$ .
  - IJKL where angle L =  $45^\circ$ ,  $LK = 6.5\text{cm}$  and  $KJ = 4.2\text{cm}$
  - LMNP such that  $ML = 5\text{cm}$ ,  $PNM = 75^\circ$  and  $NM = 7.5\text{cm}$
  - PQRS where  $SR = 6\text{cm}$ ,  $RQ = 4\text{cm}$  and  $SRQ = 120^\circ$ .
  - SQRT where  $TR = 5.4\text{cm}$ ,  $RQ = 4.5\text{cm}$  and  $TRQ = 105^\circ$ .
  - EFGH in which  $GF = 5\text{cm}$ ,  $HG = 6.5\text{cm}$  and  $HGF = 135^\circ$ .
  - ABCD where  $AB = 6.8\text{cm}$ ,  $BC = 5\text{cm}$  and  $ABC = 150^\circ$ .
- Construct a parallelogram
  - ABCD where  $AB = 7.5\text{cm}$ ,  $CB = 4.5\text{cm}$  and diagonal AC =  $6\text{cm}$ .
  - GOAT where  $OG = 5\text{cm}$ ,  $OA = 7.5\text{cm}$  and  $GA = 7.5\text{cm}$ .
  - RUDE such that  $RU = 5.6\text{cm}$ ,  $UE = 4\text{cm}$  and  $UD = 5.5\text{cm}$ .
  - GHJK where  $KG = 7.5\text{cm}$ ,  $GH = 4.5\text{cm}$  and  $KH = 5\text{cm}$ .
- Construct a parallelogram KLMN where  $KN = 7\text{cm}$ ,  $KL = 5\text{cm}$  and  $NL = 10\text{cm}$ .
  - Measure
    - angle MNK
    - angle NKL
    - diagonal KM.
- Construct parallelogram RSTU where  $UR = 5.5\text{cm}$ ,  $RS = 4\text{cm}$  and diagonal  $US = 8\text{cm}$ . Drop a perpendicular from point T to meet line UR at Y.
  - Measure
    - angle URS
    - angle TUS
    - line TY



6. Construct a parallelogram
  - a) STUV in which  $ST = 4\text{cm}$ ,  $SU = 6\text{cm}$  and angle  $T = 120^\circ$ .
  - b) VWXY where  $VW = 6\text{cm}$ ,  $WY = 8.5\text{cm}$  and  $VWX = 75^\circ$ .
7. a) Construct a parallelogram BEST where  $ES = 7.5\text{cm}$ ,  $BES = 45^\circ$  and diagonal  $BS = 4.5\text{cm}$ . Drop a perpendicular from B to meet ES at K.
  - b) Measure
    - i) line BK
    - ii) line ST
8. a) Construct a parallelogram BCDE in which  $BC = 7\text{cm}$ , diagonal  $BD = 10\text{cm}$  and diagonal  $CE = 6\text{cm}$ .
  - b) Measure
    - i) line CD
    - ii) angle EDC
9. a) Construct a parallelogram KLMN where  $NK = 5.5\text{cm}$ ,  $KM = 5\text{cm}$  and  $NL = 9\text{cm}$ . Drop a perpendicular from M to meet line NK at P.
  - b) Measure
    - i) line MP
    - ii) angle NML
10. a) Construct a parallelogram ABCD such that  $AD = BC = 9\text{cm}$ . Bisect line AD and let the bisector meet line AD at point M. Mark point B on the bisector such that line  $MB = 4\text{cm}$ . Join point A to B and complete the construction of the parallelogram.
  - b) Measure
    - i) line AB
    - ii) angle ABC

## TRAPEZIUM



### Properties

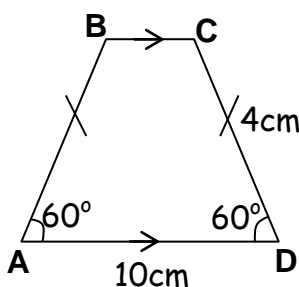
Has two sides parallel but not equal.

Base angles of an isosceles trapezium are equal

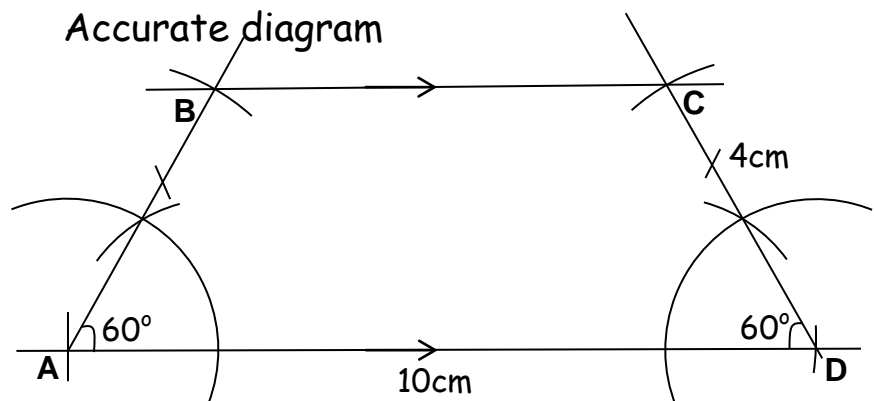
### Example 1

Construct a trapezium ABCD such that angle  $BAD = ADC = 60^\circ$ ,  $AB = CD = 4\text{cm}$  and line  $AD = 10\text{cm}$ .

#### Sketch



#### Accurate diagram

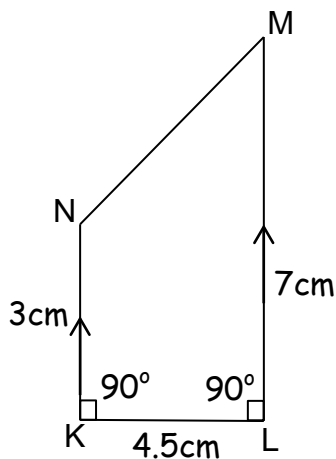




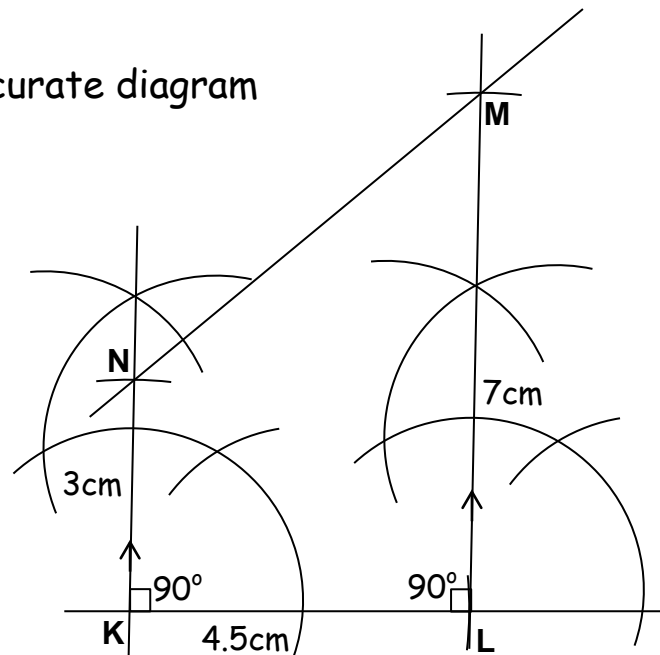
## Example 2

Construct a trapezium KLMN such that  $LM = 7\text{cm}$ ,  $\angle KLM = \angle NKL = 90^\circ$ ,  $KL = 4.5\text{cm}$  and  $KN = 3\text{cm}$ .

Sketch



Accurate diagram

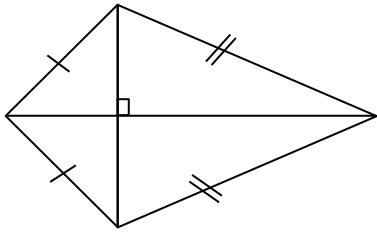


## Exercise

- Construct a trapezium ABCD in which  $AB = 6\text{cm}$ , angle  $ABC = BAD = 60^\circ$  and line  $AD = BC = 35\text{cm}$ .
  - Measure line CD.
- Construct a trapezium
  - ADEF such that  $FE = 8\text{cm}$ ,  $DE = AF = 3\text{cm}$  and  $\angle AFE = \angle FED = 30^\circ$
  - CDEF where  $\angle DEF = \angle CFE = 45^\circ$ ,  $FE = 8.5\text{cm}$  and  $CF = DE = 4\text{cm}$ .
  - BCDA in which  $AD = 6\text{cm}$ ,  $AB = CD = 45\text{cm}$  and  $\angle A = \angle D = 75^\circ$ .
  - PMNX such that  $\angle PXN = \angle XNM = 105^\circ$ ,  $PX = NM = 4\text{cm}$  and  $XN = 2.5\text{cm}$
  - KEVO where  $KE = EV = OV = 4.5\text{cm}$  and  $\angle LV = \angle LE = 120^\circ$ .
  - PQRS such that  $SR = 3\text{cm}$ ,  $PS = QR = 5.5\text{cm}$  and angle  $\angle PSR = \angle SRQ = 150^\circ$ .
  - WXYZ where line WZ is parallel to line XY,  $\angle WXY = 90^\circ$ , line  $WX = 4\text{cm}$ ,  $XY = 6.5\text{cm}$  and  $WZ = 3.5\text{cm}$ .
- Construct a quadrilateral ABCD such that BA is parallel to CD, angle  $\angle BCD = 60^\circ$ , line  $CD = 4\text{cm}$  and  $CB = 4.5\text{cm}$ .
  - Name the Quadrilateral
  - Measure i) line BA      ii) angle BAD.
- Construct a trapezium JKLM in which line  $JM = 3.5\text{cm}$ ,  $JK = 6.5\text{cm}$  and  $ML = 5\text{cm}$ . KJ is perpendicular to JM and JK parallel to ML.
  - Bisect angle KLM and let the bisector meet line KJ at X.
  - Measure;    i) angle KLX    ii) line KL    iii) line LX.



## KITES



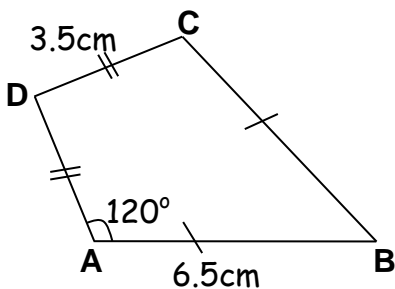
### Properties

- Two of the opposite angles are equal
- Adjacent sides are equal
- Diagonals are not equal
- Diagonals intersect at right angles
- Has one line of folding symmetry

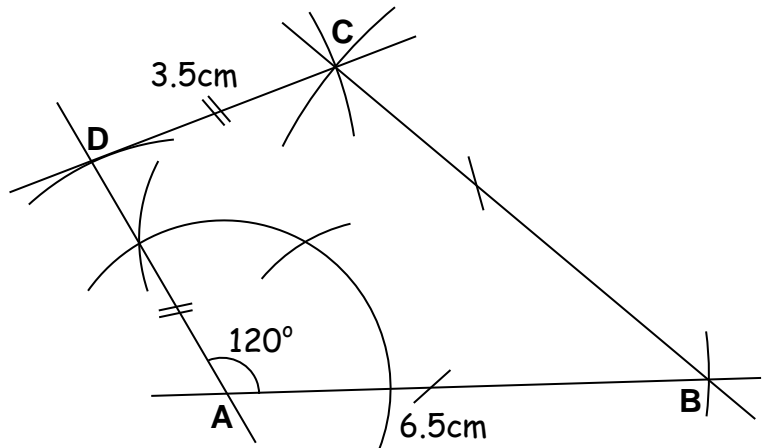
### Example 1

Construct a kite ABCD where line  $AB = BC = 6.5\text{cm}$ ,  $CD = DA = 3.5\text{cm}$  and angle  $BAD = 120^\circ$ .

#### Sketch



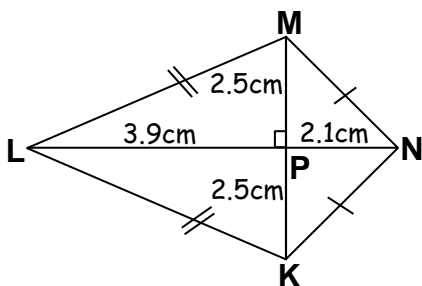
#### Accurate diagram



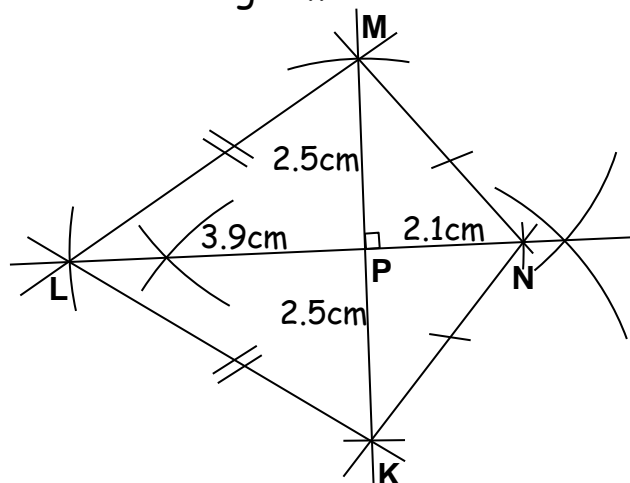
### Example 2

Construct a kite KLMN where diagonal  $KM = 5\text{cm}$ . Diagonal LN bisects KM at point P such that  $NP = 2.1\text{cm}$  and  $LP = 3.9\text{cm}$ .

#### Sketch



#### Accurate diagram





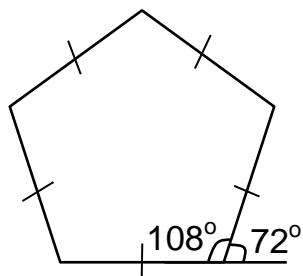
## Exercise

1. a) Construct a kite PQRS where  $PQ = QR = 7\text{cm}$ ,  $RS = SR = 4\text{cm}$  and angle  $SRQ = 105^\circ$ .  
b) Measure
  - i) angle RQP
  - ii) diagonal SQ
2. a) Construct a kite TDPO where line  $TD = TQ = 3.5\text{cm}$ , angle  $QPD = 45^\circ$  and  $QP = PD = 8\text{cm}$ .  
b) Bisect angle TDP and let the bisector meet line QP at N.  
c) Measure
  - i) line DN
  - ii) diagonal TP.
3. a) Construct a kite NWSC such that line  $CS = 6.5\text{cm}$ , angle  $CSW = 105^\circ$  and angle  $SCW = 30^\circ$ .  
b) Measure
  - i) line WS
  - ii) line CW
  - iii) angle CWN
4. a) Construct a kite PQRS such that shorter diagonal  $PR = 6\text{cm}$  and the longer diagonal  $SQ = 12\text{cm}$ . Let the diagonals intersect at point O such that  $OQ = OR = OP$ .  
b) Measure the size of angle PQR.
5. a) Construct a kite NEAT whose diagonal intersect at point R such that  $RT = 3.5\text{cm}$ ,  $TN = TA = 4\text{cm}$  and diagonal  $TE = 9.4\text{cm}$   
b) Measure
  - i) angle AEN.
  - ii) line NE.
6. a) Construct a kite JKLM such that line  $KL = 7.5\text{cm}$ ,  $JK = 4\text{cm}$  and angle  $JKL = 135^\circ$ .  
b) Measure
  - i) diagonal KM
  - ii) angle MLK
  - iii) angle KJM
7. Construct a kite EFGH in which angle  $GFE = 60^\circ$ , line  $FG = 4.5\text{cm}$  and its longer diagonal  $FH = 10\text{cm}$ . Measure angle EHG, line HE and diagonal GE.
8. Construct a kite TUVW where angle  $WTU = 105^\circ$ , diagonal  $TV = 10\text{cm}$  and line  $UV = 8.5\text{cm}$ . Measure line UT and diagonal UW.

# TOPIC 7: GEOMETRIC CONSTRUCTION



## REGULAR PENTAGON

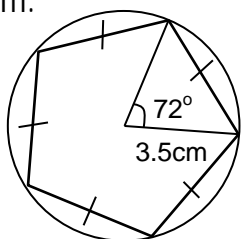


### Properties of a regular pentagon

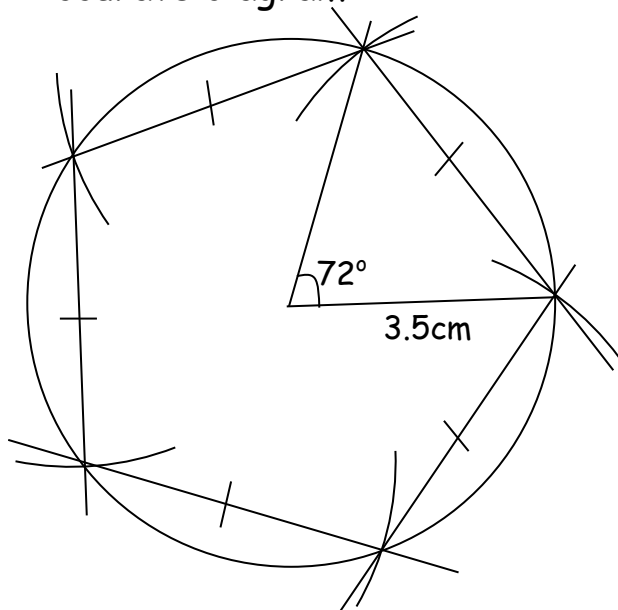
- Has 5 equal sides
- Has 5 equal angles  
(Each exterior angle is  $72^\circ$  and each interior angle is  $108^\circ$ )
- Has 5 lines of folding symmetry.

### Example 1

Construct a regular pentagon in a circle of radius 3.5cm.

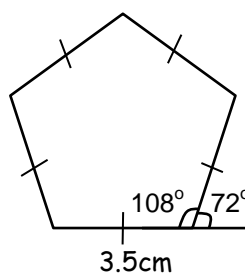


### Accurate diagram

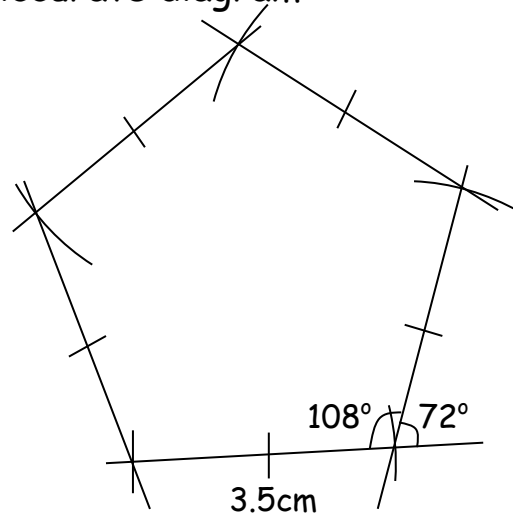


### Example 2

Construct a regular pentagon of sides 3.5cm.



### Accurate diagram



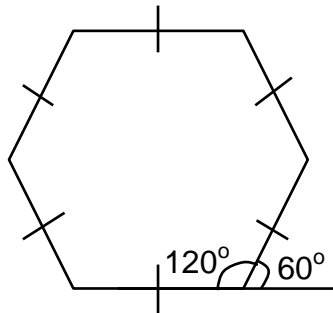
### Exercise

- Construct a regular pentagon in a circle of radius:
  - 4cm
  - 3cm
  - 3.5 cm
  - 3.8 cm
  - 2.9cm
  - 4.2cm
- Construct a regular pentagon in a circle of radius 2.5cm.
  - Measure its side.
  - Find its perimeter.
- Construct a regular pentagon in a circle whose diameter is 6cm.
  - Find its perimeter.
- Construct a regular pentagon of sides:
 

a) 3cm	c) 2.8cm	e) 4.0cm
b) 3.5cm	d) 3.8cm	f) 4.2cm



## REGULAR HEXAGON .



### Properties of a regular hexagon

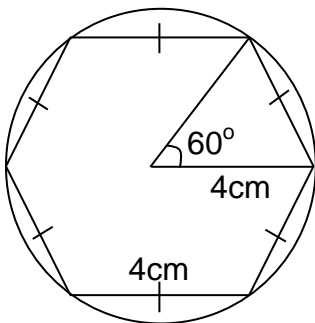
- Has six equal sides.
- Has six line of folding symmetry.
- Has six equal angles.

(Each exterior angle is  $60^\circ$  and each interior angle is  $120^\circ$ )

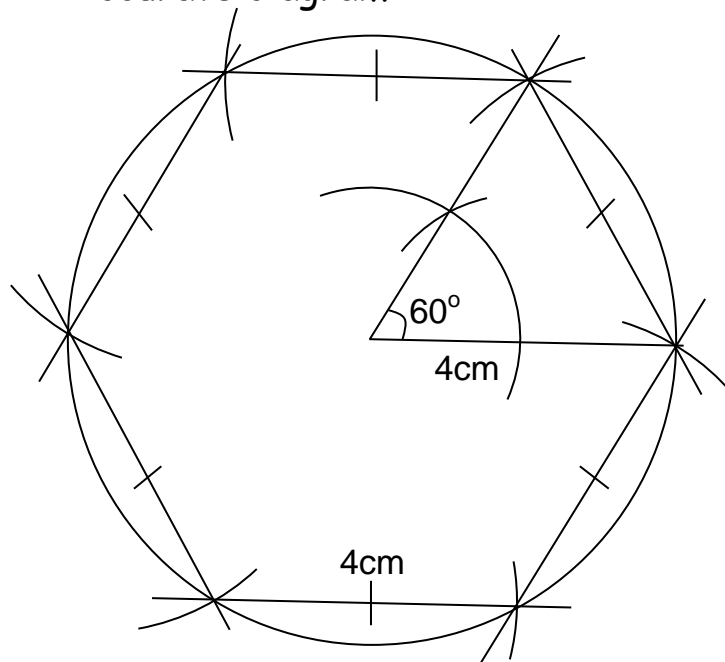
### Example

Construct a regular hexagon of sides 4cm.

### Sketch



### Accurate diagram

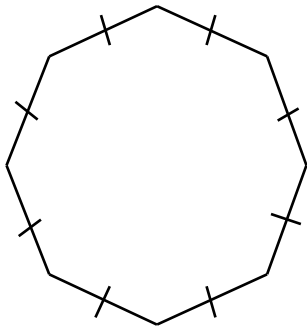


### Exercise

- Construct a regular hexagon of sides.
  - 3cm
  - 3.5cm
  - 2.8 cm
  - 3.4cm
  - 4cm
  - 4.5cm
- Construct a regular hexagon in a circle of radius;
  - 3.5cm
  - 4cm
  - 4.5cm
  - 3.5cm
  - 5cm
  - 4.1cm
- Construct a regular hexagon in a circle whose diameter is 7cm.
  - Find its perimeter.
- Construct a regular hexagon whose perimeter is 24cm.
- Construct a polygon whose interior angle is  $120^\circ$  with side 3.5cm



## REGULAR OCTAGON



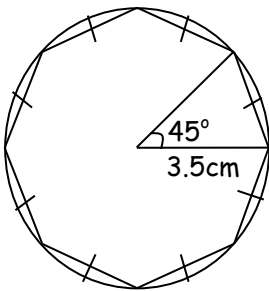
### Properties of a regular octagon

- Has 8 equal sides
- Has 8 lines of folding symmetry
- Each centre angle is  $45^\circ$ .
- Each interior angle is  $135^\circ$ .

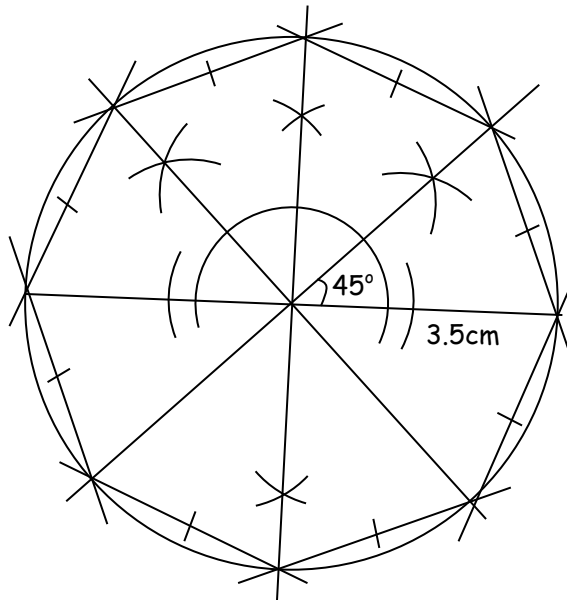
### Example

Construct a regular octagon in a circle of radius 3.5cm

### Sketch



### Accurate diagram



### Exercise

- Construct a regular octagon in a circle of radius
  - 3cm
  - 3.5cm
  - 2.5cm
  - 4.5cm
  - 4cm
  - 5cm
- Construct a regular octagon in a circle of diameter 6cm.
- Construct a regular octagon in a circle of radius 3.8cm.

### Group activity.

- Construct a regular octagon of sides 3cm.
- The exterior angle of a regular polygon is  $90^\circ$  less than its interior angle.
  - Name the polygon.
  - Construct the polygon if its perimeter is 28cm.
- In a circle of radius 4cm, construct a regular polygon whose interior angle is 2 times more than the exterior angle.



## POLYGONS

A polygon is a plane figure formed by three or more straight lines that do not cross over each other.

A polygon having all its sides equal and all its interior angles equal is called a **regular polygon**.

**Note:** Polygons are named according to the number of sides they have as shown in the table below.

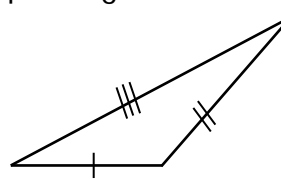
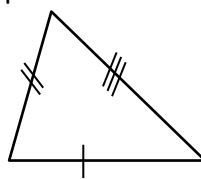
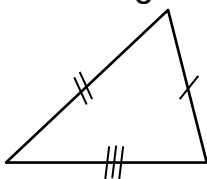
Number of sides	Name of polygon
3	Triangle
4	Quadrilateral
5	Pentagon
6	Hexagon
7	Heptagon
8	Octagon
9	Nonagon
10	Decagon
11	Hendecagon
12	Dodecagon

## Types of triangles

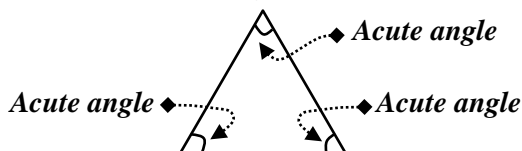
A triangle is a three sided polygon.

*There are different kinds of triangle;*

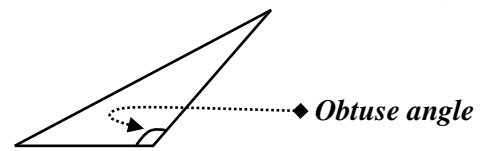
1. A scalene triangle has no equal sides and no equal angles as shown below:



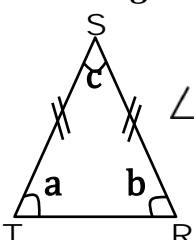
2. An acute angled triangle is a triangle whose interior angles are acute.



3. An obtuse angled triangle is a triangle that contains an obtuse interior angle.

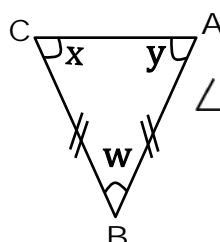


4. An isosceles triangle has two sides equal. *The base angles of an isosceles triangle are equal.*



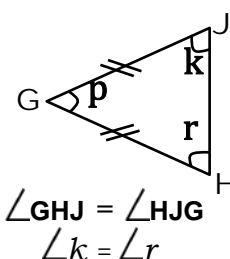
$$\angle STR = \angle TRS$$

$$\angle a = \angle b$$



$$\angle BCA = \angle BAC$$

$$\angle x = \angle y$$

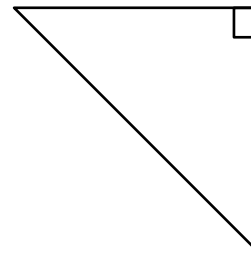
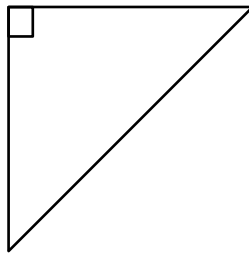
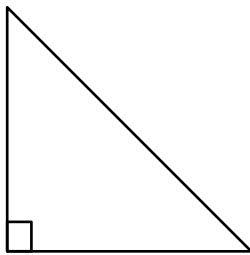


$$\angle GHJ = \angle HJG$$

$$\angle k = \angle r$$



5. A right angled triangle has one right angle. The side opposite to the right angle is called the **hypotenuse**.

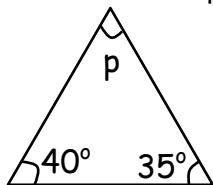


## Interior angle sum of a triangle

**Note:** *The interior angle sum of a triangle is  $180^\circ$ .*

### Example 1

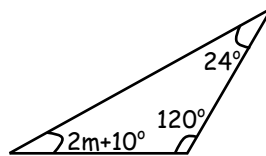
Find the value of  $p$



$$\begin{aligned} p + 40^\circ + 35^\circ &= 180^\circ \\ p + 75^\circ &= 180^\circ \\ p + 75^\circ - 75^\circ &= 180^\circ - 75^\circ \\ p &= 105^\circ \end{aligned}$$

### Example 2

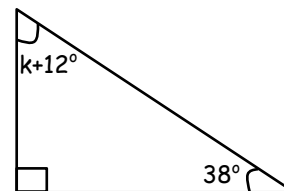
Find the value of  $m$



$$\begin{aligned} 2m + 10^\circ + 120^\circ + 24^\circ &= 180^\circ \\ 2m + 154^\circ &= 180^\circ \\ 2m + 154^\circ - 154^\circ &= 180^\circ - 154^\circ \\ \frac{2m}{2} &= \frac{26^\circ}{2} \\ m &= 13^\circ \end{aligned}$$

### Example 3

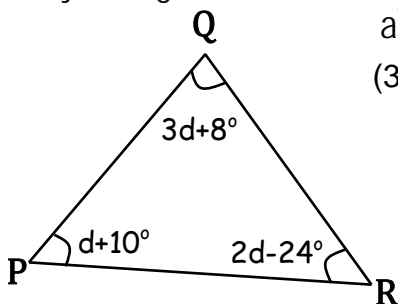
Find the value of  $k$



$$\begin{aligned} k + 12^\circ + 38^\circ + 90^\circ &= 180^\circ \\ k + 140^\circ &= 180^\circ \\ k + 140^\circ - 140^\circ &= 180^\circ - 140^\circ \\ k &= 40^\circ \end{aligned}$$

### Example 4

Study the figure below and use it to answer questions that follow.



a) Find the value of  $d$ .

$$\begin{aligned} (3d + 8^\circ) + (2d - 24^\circ) + (d + 10^\circ) &= 180^\circ \\ 3d + 8^\circ + 2d - 24^\circ + d + 10^\circ &= 180^\circ \\ 3d + 2d + d + 8^\circ + 10^\circ - 24^\circ &= 180^\circ \\ 6d - 6^\circ &= 180^\circ \\ 6d - 6^\circ + 6^\circ &= 180^\circ + 6^\circ \\ \frac{6d}{6} &= \frac{186^\circ}{6} \\ d &= 31^\circ \end{aligned}$$

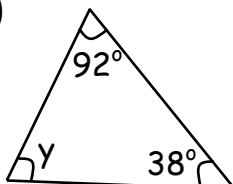
b) Find the size of angle PRQ.

$$\begin{aligned} 2d - 24^\circ \\ 2 \times 31^\circ - 24^\circ \\ 62^\circ - 24^\circ \\ 38^\circ \\ \angle PRQ &= 38^\circ \end{aligned}$$

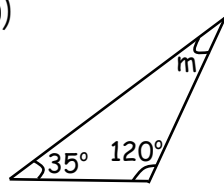
## Exercise

1. Find the value of the unknown angles.

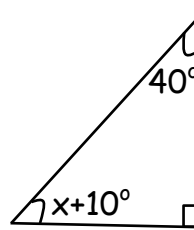
a)



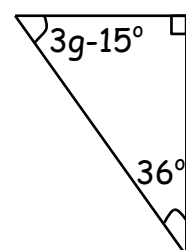
b)



c)

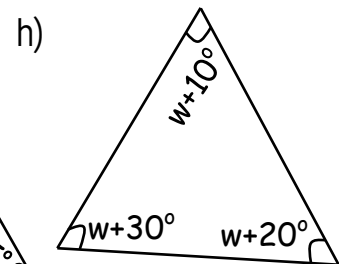
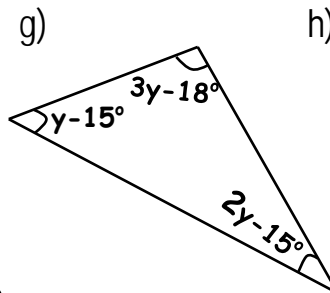
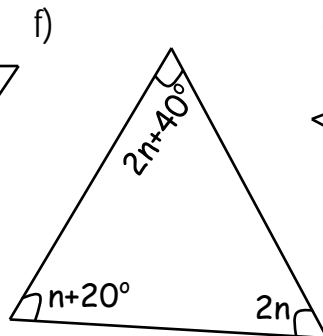
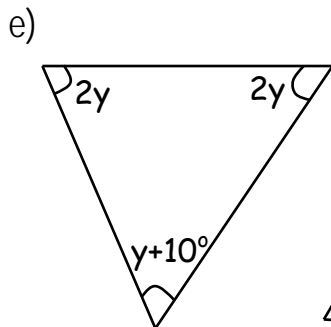
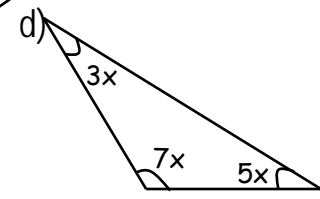
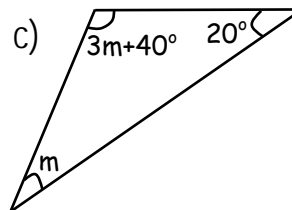
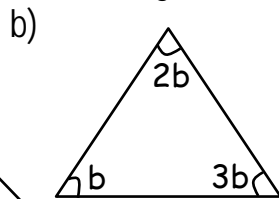
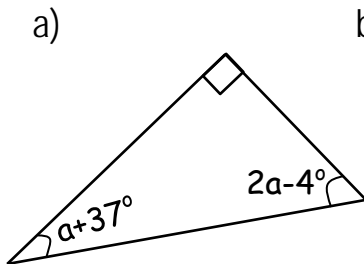


d)

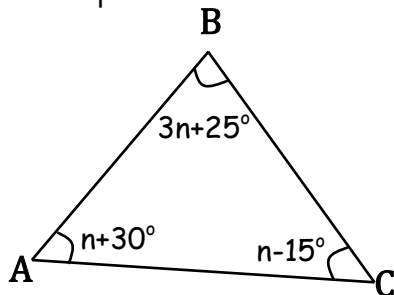




2. Find the value of the unknown angles.

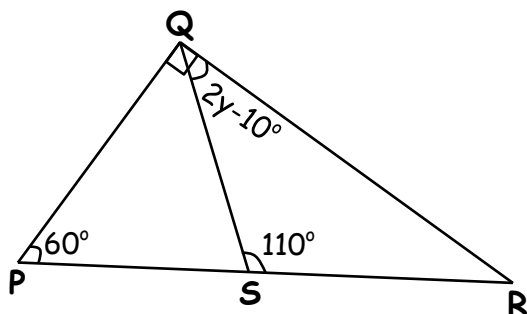


3. Study the figure below and use it to answer questions that follow.



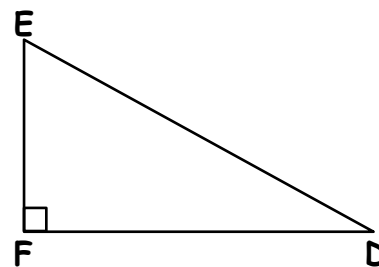
- Find the value of  $n$  in degrees.
- Find the size of angle  $CBA$ .

4. In the figure below,  $PQR$  is a right angled triangle,  $\angle SPQ = 60^\circ$ ,  $\angle SQR = 2y - 10^\circ$ ,  $\angle PQR = 90^\circ$  and  $\angle QSR = 110^\circ$



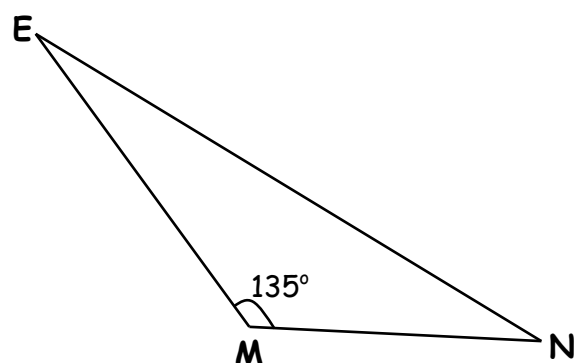
- Find the size of angle  $PRQ$
- Find the value of  $y$  in degrees.

5. In the figure below, angles  $FED$  and  $FDE$  are in the ratio of 3:2 respectively.



Find the size of angle  $FDE$  in degrees.

6. In the figure below, angle  $MEN$  is  $13^\circ$  less than angle  $MNE$ .

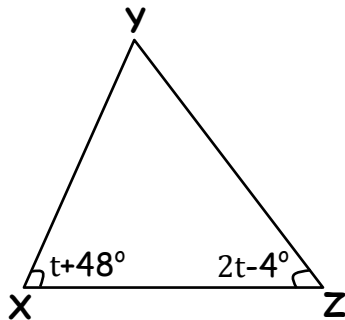


Find the size of angle:

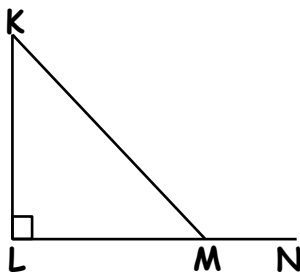
- $MNE$
- $MEN$



7. In the drawing below;  $\angle YXZ$  is 3 times  $\angle XZY$ .



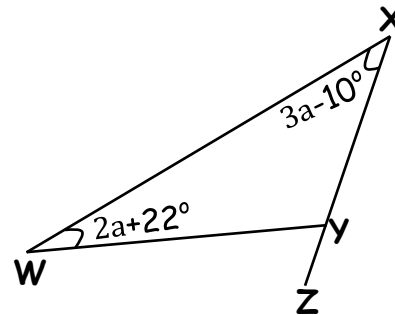
- Find the value of  $t$  in degrees.
  - Find the size of angle  $XYZ$ .
8. In the figure below,  $KL$  is perpendicular to  $LN$ ,  $KLM$  is a triangle and  $\angle LKM$  is four fifths of  $\angle LMN$ .



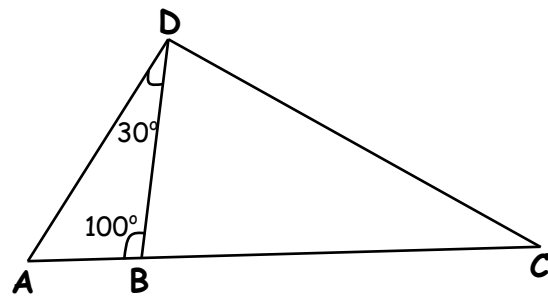
Find the size of angle.

- $\angle LKM$
- $\angle KMN$

9. Study the figure below carefully and use it to answer questions that follow.



- If  $\angle YWX$  is  $40^\circ$  larger than  $\angle WXY$ , find the value of  $a$  in degrees.
  - Find the size of angle.
    - $\angle WYX$
    - $\angle WYZ$
10. In the figure below, line  $AD$  is perpendicular to line  $DC$ .  $\angle ABD = 100^\circ$  and  $\angle ADB = 30^\circ$ .

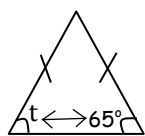
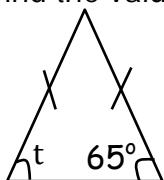


Find in degrees, the size of angle  $ACD$

## Solving problems related to base angles of an isosceles triangle.

### Example 1

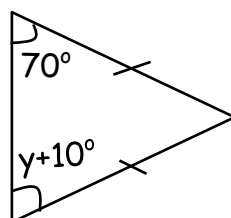
Find the value of  $t$



$$t = 65^\circ$$

### Example 2

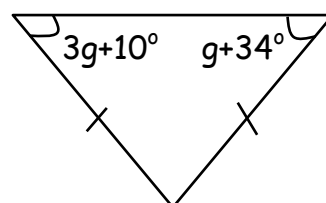
Find the value of  $y$



$$\begin{aligned} y+10^\circ &= 70^\circ \\ y+10^\circ-10^\circ &= 70^\circ-10^\circ \\ y &= 60^\circ \end{aligned}$$

### Example 3

Find the value of  $g$



$$\begin{aligned} 3g+10^\circ &= g+34^\circ \\ 3g-g+10^\circ &= g-g+34^\circ \\ 2g+10^\circ &= 34^\circ \\ 2g+10^\circ-10^\circ &= 34^\circ-10^\circ \\ \frac{2g}{2} &= \frac{24^\circ}{2} \\ g &= 12^\circ \end{aligned}$$

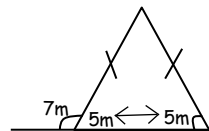
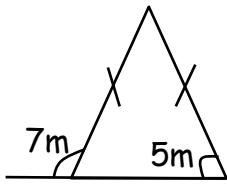
**Remember:**

► Base angles of an isosceles triangle are equal.



### Example 4

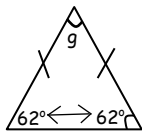
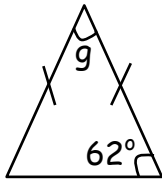
Find the value of  $m$



$$\begin{aligned} 7m + 5m &= 180^\circ \\ 12m &= 180^\circ \\ \frac{12m}{12} &= \frac{180^\circ}{12} \\ m &= 15^\circ \end{aligned}$$

### Example 5

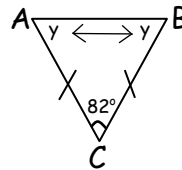
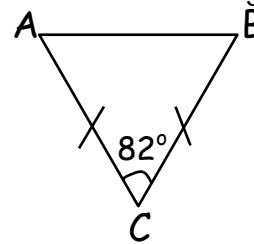
Find the value of  $g$



$$\begin{aligned} g + 62^\circ + 62^\circ &= 180^\circ \\ g + 124^\circ &= 180^\circ \\ g + 124^\circ - 124^\circ &= 180^\circ - 124^\circ \\ g &= 56^\circ \end{aligned}$$

### Example 6

Find the size of angle CAB



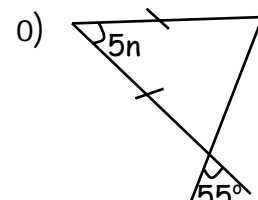
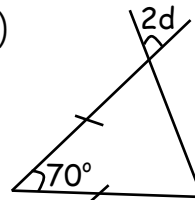
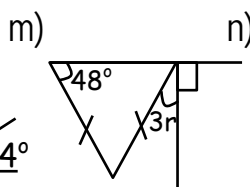
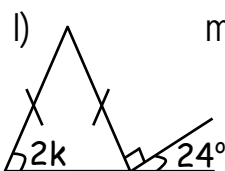
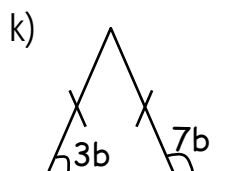
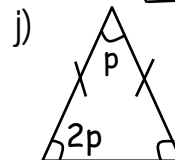
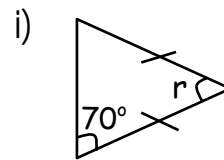
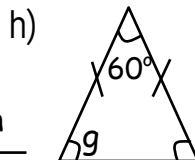
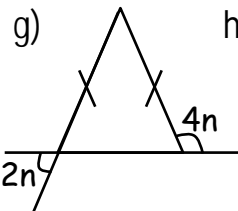
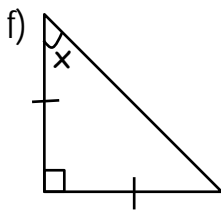
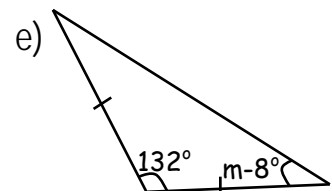
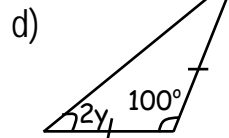
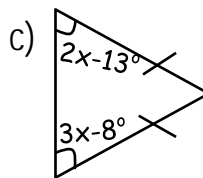
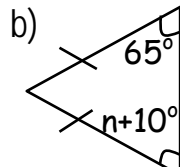
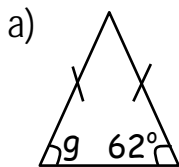
Let angle CAB be  $y$

$$\begin{aligned} y + y + 82^\circ &= 180^\circ \\ 2y + 82^\circ &= 180^\circ \\ 2y + 82^\circ - 82^\circ &= 180^\circ - 82^\circ \\ \frac{2y}{2} &= \frac{98^\circ}{2} \\ y &= 49^\circ \end{aligned}$$

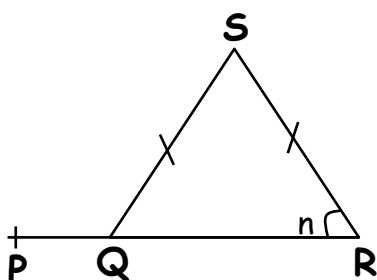
Angle CAB =  $49^\circ$

### Exercise

1. Find the value of the unknown.



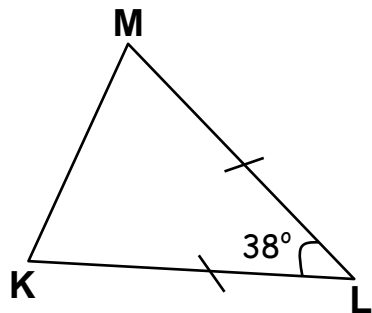
2. In the figure below,  $QS = RS$ ,  $\angle PQS$  is 5 times  $\angle QRS$ .



- Find the value of  $n$ .
- Find the size of angle.
  - PQS
  - PSR

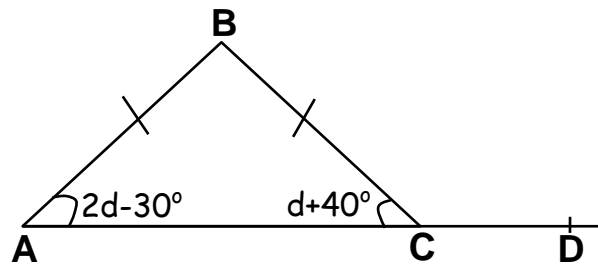


3. Study the figure below and use it to answer the question that follows.



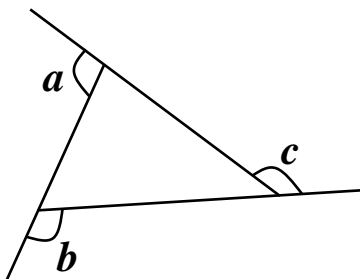
Find the size of angle KML.

4. Study the figure below and use it to answer questions that follow.



- Find the value of  $d$  in degrees.
- Find the size of angle BCD.

## Exterior angles of a triangle

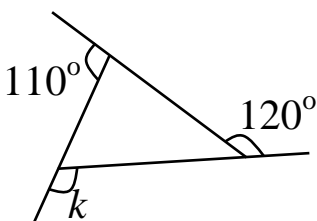


$$\angle a + \angle b + \angle c = 360^\circ$$

*The interior angle sum of a triangle add up to  $360^\circ$*

### Example 1

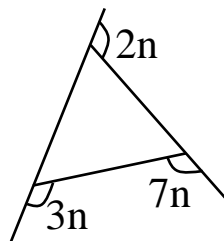
Find the value of  $k$ .



$$\begin{aligned} k + 110^\circ + 120^\circ &= 360^\circ \\ k + 230^\circ &= 360^\circ \\ k + 230^\circ - 230^\circ &= 360^\circ - 230^\circ \\ k &= 130^\circ \end{aligned}$$

### Example 2

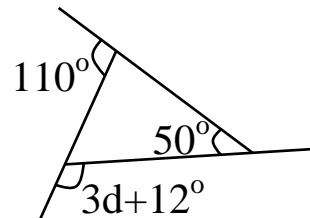
Find the value of  $n$



$$\begin{aligned} 7n + 3n + 2n &= 360^\circ \\ 12n &= 360^\circ \\ \frac{12n}{12} &= \frac{360^\circ}{12} \\ n &= 30^\circ \end{aligned}$$

### Example 3

Find the value of  $d$

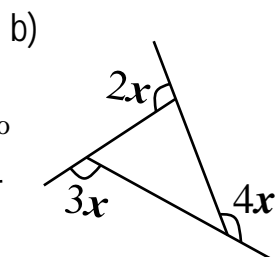
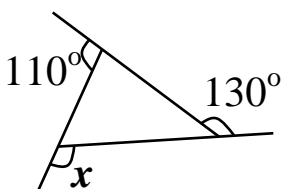


$$\begin{aligned} 180^\circ - 50^\circ &= 130^\circ \\ 3d + 12^\circ + 110^\circ + 130^\circ &= 360^\circ \\ 3d + 252^\circ &= 360^\circ \\ 3d + 252^\circ - 252^\circ &= 360^\circ - 252^\circ \\ \frac{3d}{3} &= \frac{108^\circ}{3} \\ d &= 36^\circ \end{aligned}$$

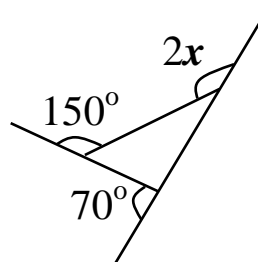
## Exercise

1. Find the value of  $x$ .

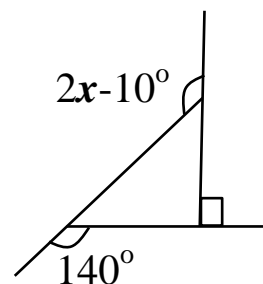
a) b)



c)



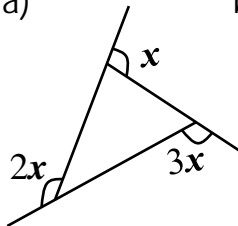
d)



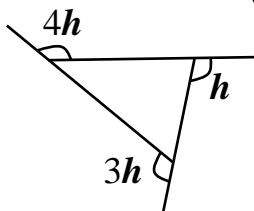


2. Find the value of the unknown angles.

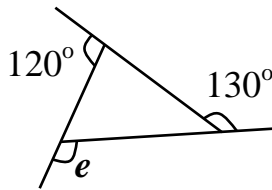
a)



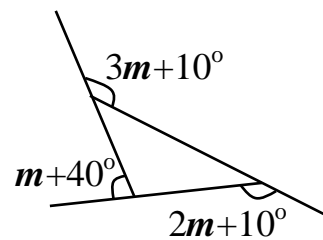
b)



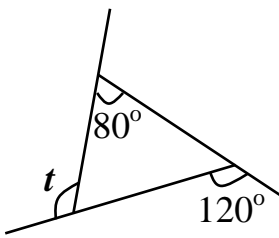
c)



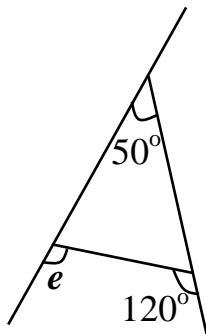
d)



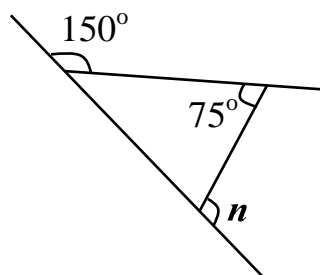
e)



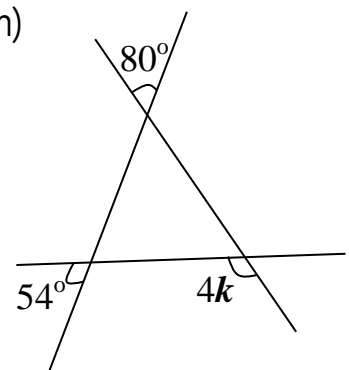
f)



g)

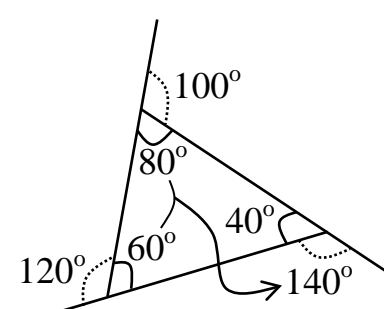
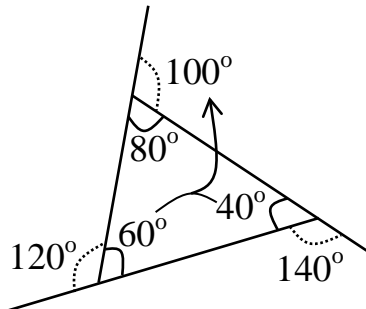
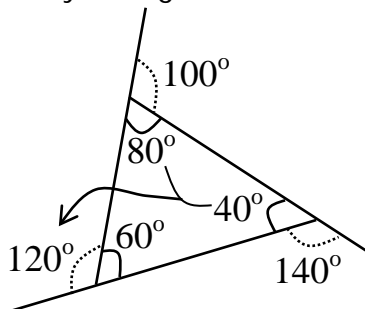


h)



## Relationship between interior angles and exterior angles of a triangle

Study the figures below.

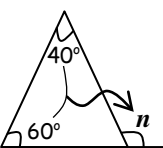
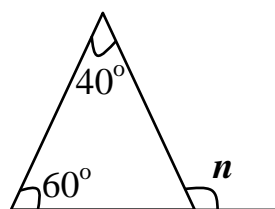


**Note:**

*The sum of two interior angles of a triangle equals to one opposite exterior angle.*

### Example 1

Find the value of  $n$

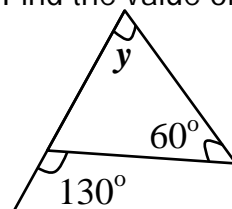


$$n = 40^\circ + 60^\circ$$

$$n = 100^\circ$$

### Example 2

Find the value of  $y$



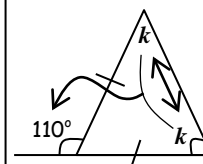
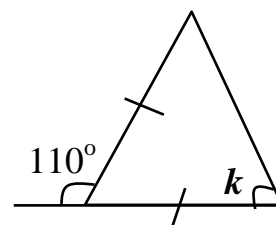
$$y + 60^\circ = 130^\circ$$

$$y + 60^\circ - 60^\circ = 130^\circ - 60^\circ$$

$$y = 70^\circ$$

### Example 3

Find the value of  $k$



$$k + k = 110^\circ$$

$$2k = 110^\circ$$

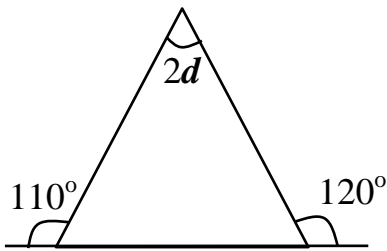
$$\frac{2k}{2} = \frac{110^\circ}{2}$$

$$k = 55^\circ$$

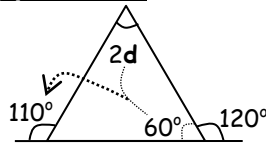


## Example 4

Find the value of  $d$



## Approach 1



$$180^\circ - 120^\circ = 60^\circ$$

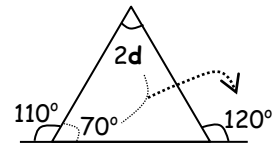
$$2d + 60^\circ = 110^\circ$$

$$2d + 60^\circ - 60^\circ = 110^\circ - 60^\circ$$

$$\frac{2d}{2} = \frac{50^\circ}{2}$$

$$d = 25^\circ$$

## Approach 2



$$180^\circ - 110^\circ = 70^\circ$$

$$2d + 70^\circ = 120^\circ$$

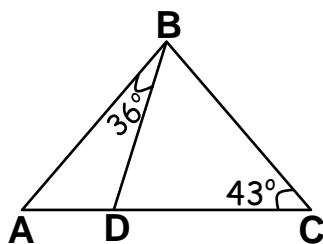
$$2d + 70^\circ - 70^\circ = 120^\circ - 70^\circ$$

$$\frac{2d}{2} = \frac{50^\circ}{2}$$

$$d = 25^\circ$$

## Example 5

In triangle ABC, angle ABC =  $91^\circ$ , angle ACB =  $43^\circ$  and angle ABD =  $36^\circ$ . Find the size of angle ADB.



$$\angle DBC = 91^\circ - 36^\circ$$

$$\angle DBC = 55^\circ$$

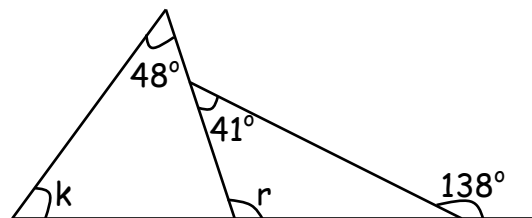
$$\angle ADB = \angle ACB + \angle DBC$$

$$\angle ADB = 55^\circ + 43^\circ$$

$$\angle ADB = 98^\circ$$

## Example 6

Find the value of  $r$  and  $k$



Value of  $r$

$$r + 41^\circ = 138^\circ$$

$$r + 41^\circ - 41^\circ = 138^\circ - 41^\circ$$

$$r = 97^\circ$$

Value of  $k$

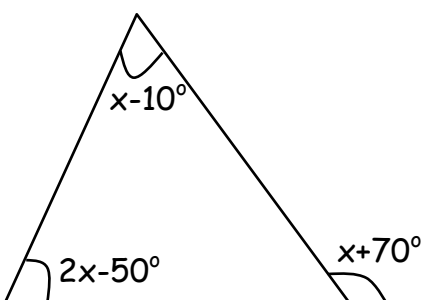
$$k + 48^\circ = 97^\circ$$

$$k + 48^\circ - 48^\circ = 97^\circ - 48^\circ$$

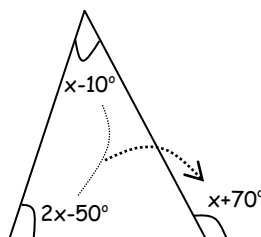
$$k = 49^\circ$$

## Example 7

Find the value of  $x$



## Solution



$$2x - 50^\circ + x - 10^\circ = x + 70^\circ$$

$$2x + x - 50^\circ - 10^\circ = x + 70^\circ$$

$$3x - 60^\circ = x + 70^\circ$$

$$3x - x - 60^\circ = x - x + 70^\circ$$

$$2x - 60^\circ = 70^\circ$$

$$2x - 60^\circ + 60^\circ = 70^\circ + 60^\circ$$

$$\frac{2x}{2} = \frac{130^\circ}{2}$$

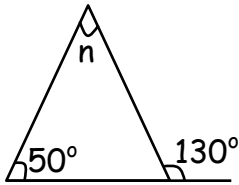
$$x = 65^\circ$$



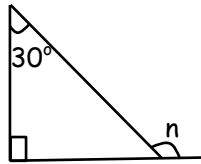
## Exercise

1. Find the value of the unknown angles.

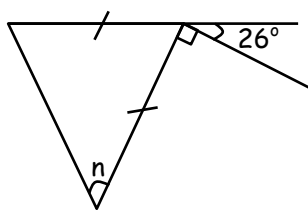
a)



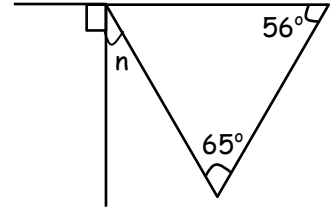
b)



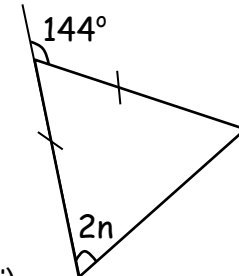
c)



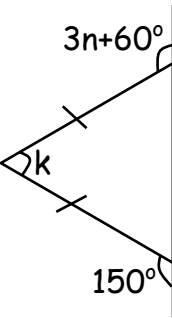
d)



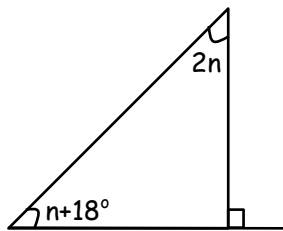
e)



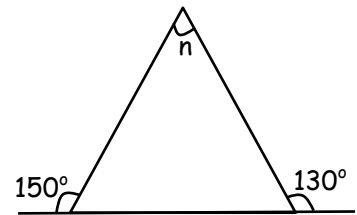
f)



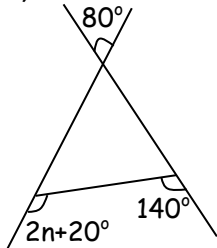
g)



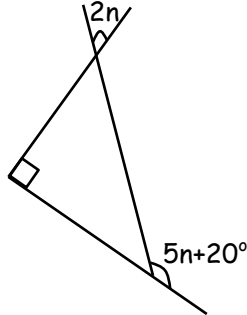
h)



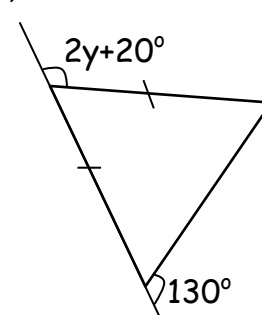
i)



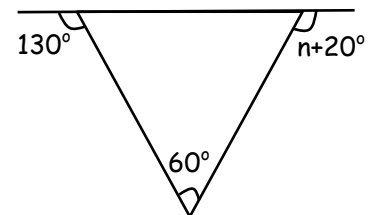
j)



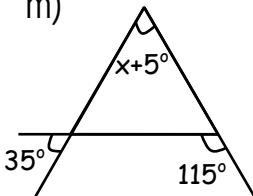
k)



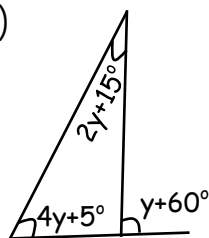
l)



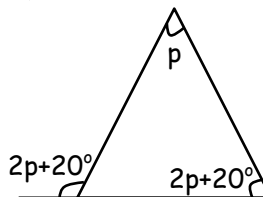
m)



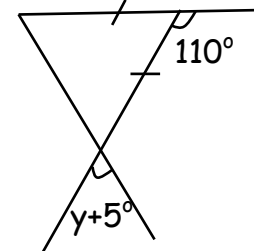
n)



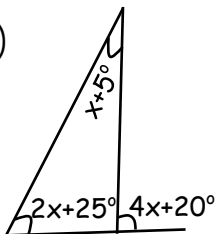
o)



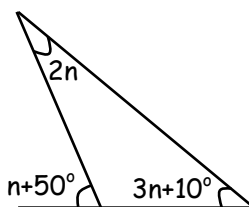
p)



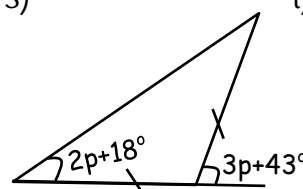
q)



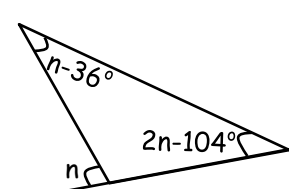
r)



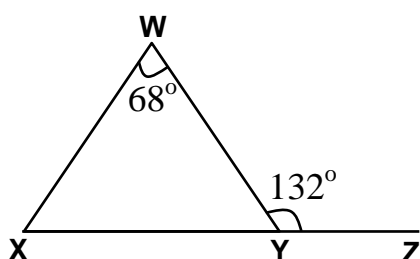
s)



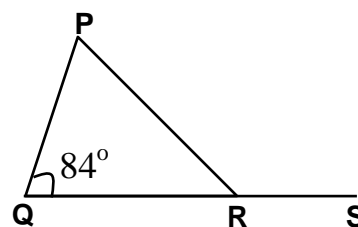
t)



2. Find the size of angle WXY.



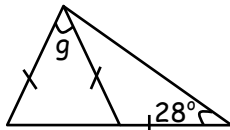
3. In the figure below,  $\angle PRS$  is thrice  $\angle QPR$ . Find the size of  $\angle PRS$



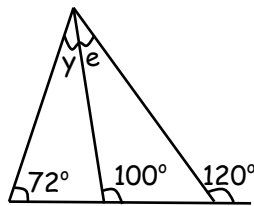


4. Find the value of the unknown angles.

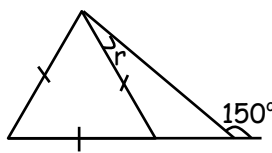
a)



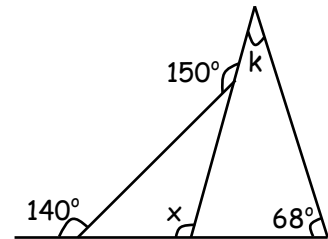
b)



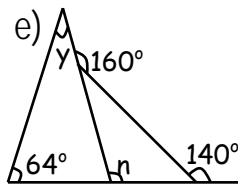
c)



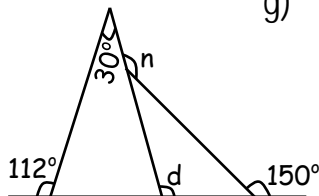
d)



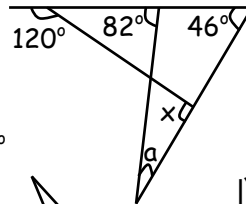
e)



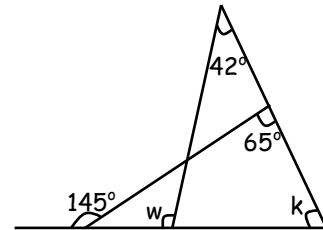
f)



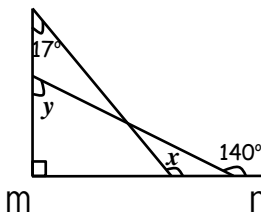
g)



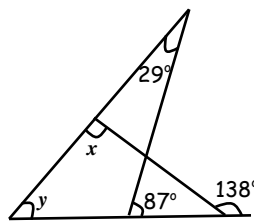
h)



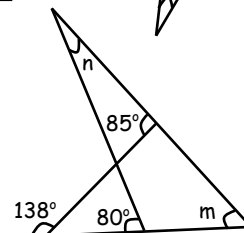
i)



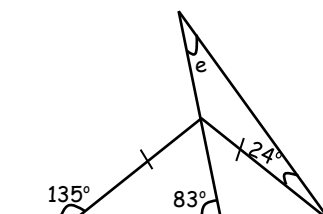
j)



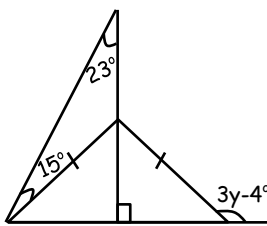
k)



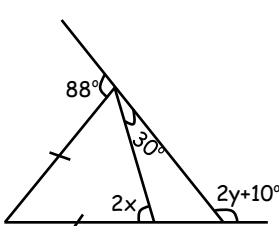
l)



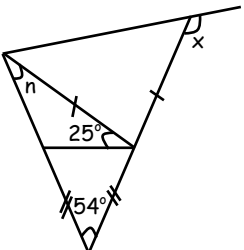
m)



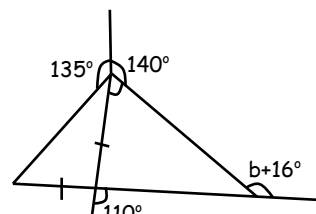
n)



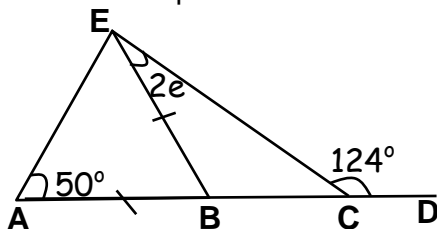
o)



p)

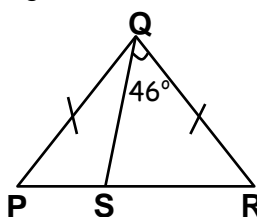


5. Study the figure below and use it to answer questions that follow.



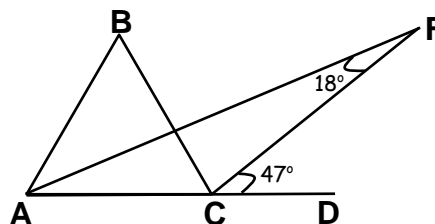
- Find the value of  $e$ .
- Find the size of angle AEC.

6. In triangle PQR,  $PQ = QR$ , angle PQS =  $38^\circ$  and angle SQR =  $46^\circ$



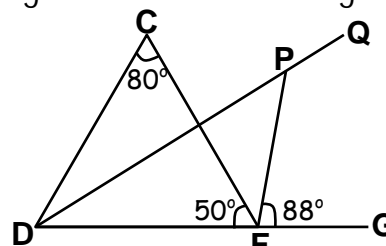
Find the size of angle QSP

7. In the figure below, ABC is an equilateral triangle. Angle AFC =  $18^\circ$  and FCD =  $47^\circ$



Find the size of angle BAF in degrees.

8. In the figure below, DFG is a straight line. Line DQ bisects angle CDF, angle DCF =  $80^\circ$ , angle PFG =  $88^\circ$  and angle DFC =  $50^\circ$



Find the size of angle FPQ.

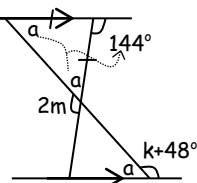
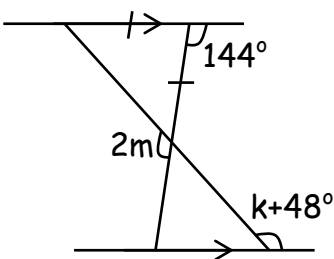
# TOPIC 7: GEOMETRIC CONSTRUCTION



## Angles in a triangle and on parallel lines

### Example 1

Find the value of  $m$  and  $k$ .



$$\begin{aligned} \text{Value of } a \\ a + a &= 144^\circ \\ 2a &= 144^\circ \\ \frac{2a}{2} &= \frac{144^\circ}{2} \\ a &= 72^\circ \end{aligned}$$

#### Value of $m$

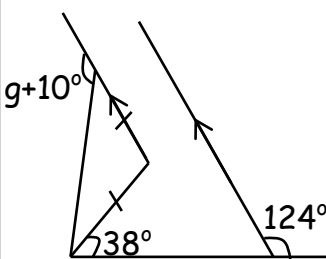
$$\begin{aligned} 2m + a &= 180^\circ \\ 2m + 72^\circ &= 180^\circ \\ 2m + 72^\circ - 72^\circ &= 180^\circ - 72^\circ \\ 2m &= 108^\circ \\ \frac{2m}{2} &= \frac{108^\circ}{2} \\ m &= 54^\circ \end{aligned}$$

#### Value of $k$

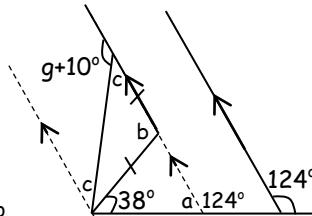
$$\begin{aligned} k + 48^\circ + a &= 180^\circ \\ k + 48^\circ + 72^\circ &= 180^\circ \\ k + 120^\circ &= 180^\circ \\ k + 120^\circ - 120^\circ &= 180^\circ - 120^\circ \\ k &= 60^\circ \end{aligned}$$

### Example 2

Find the value of  $g$  in degrees.



$$\begin{aligned} \text{Value of } a \\ a + 124^\circ &= 180^\circ \\ a + 124^\circ - 124^\circ &= 180^\circ - 124^\circ \\ a &= 56^\circ \end{aligned}$$



#### Value of $b$

$$\begin{aligned} b &= a + 38^\circ \\ b &= 56^\circ + 38^\circ \\ b &= 94^\circ \end{aligned}$$

#### Value of $c$

$$\begin{aligned} c + c + b &= 180^\circ \\ 2c + 94^\circ &= 180^\circ \\ 2c + 94^\circ - 94^\circ &= 180^\circ - 94^\circ \\ 2c &= 86^\circ \\ \frac{2c}{2} &= \frac{86^\circ}{2} \\ c &= 43^\circ \end{aligned}$$

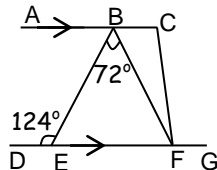
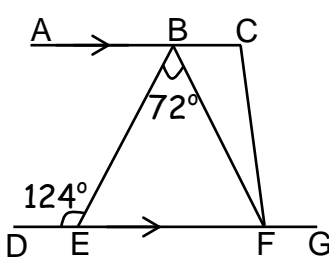
#### Value of $g$

$$\begin{aligned} g + 10^\circ + c &= 180^\circ \\ g + 10^\circ + 43^\circ &= 180^\circ \\ g + 53^\circ &= 180^\circ \\ g + 53^\circ - 53^\circ &= 180^\circ - 53^\circ \\ g &= 127^\circ \end{aligned}$$

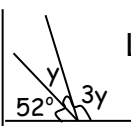
### Example 3

In the figure below, line  $AC$  is parallel to  $DG$ . Angle  $DEB = 124^\circ$ ,  $EBF = 72^\circ$  and angle  $GFC$  is thrice angle  $CFB$ .

Find the size of angle  $BCF$ .



$$\begin{aligned} \text{Angle BFE} \\ \angle BFE &= 124^\circ - 72^\circ \\ \angle BFE &= 52^\circ \end{aligned}$$



Let angle  $CFB$  be  $y$

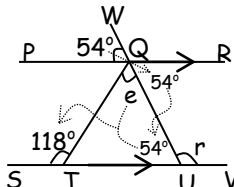
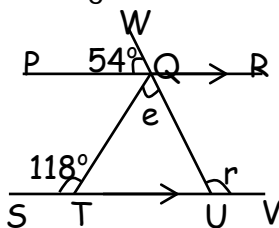
$$\begin{aligned} 3y + y + 52^\circ &= 180^\circ \\ 4y + 52^\circ &= 180^\circ \\ 4y + 52^\circ - 52^\circ &= 180^\circ - 52^\circ \\ 4y &= 128^\circ \\ \frac{4y}{4} &= \frac{128^\circ}{4} \\ y &= 32^\circ \end{aligned}$$

$$\begin{aligned} \angle BCF &= \angle GFC \\ \angle BCF &= 3y \\ \angle BCF &= 3 \times 32^\circ \\ \angle BCF &= 96^\circ \end{aligned}$$

### Example 4

In the figure below, line  $PR$  is parallel to line  $SV$ . Angle  $PQW = 54^\circ$  and  $STQ = 118^\circ$

Find the value of  $e$  and  $r$



#### Value of $e$

$$\begin{aligned} e + 54^\circ &= 118^\circ \\ e + 54^\circ - 54^\circ &= 118^\circ - 54^\circ \\ e &= 64^\circ \end{aligned}$$

#### Value of $r$

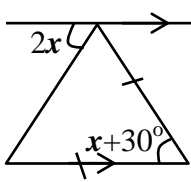
$$\begin{aligned} r + 54^\circ &= 180^\circ \\ r + 54^\circ - 54^\circ &= 180^\circ - 54^\circ \\ r &= 126^\circ \end{aligned}$$



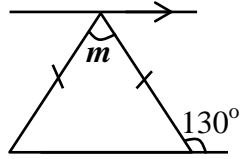
## Exercise

1. Find the value of the unknown angles.

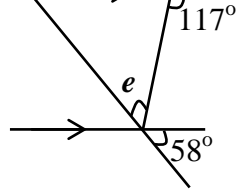
a)



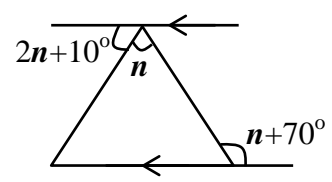
b)



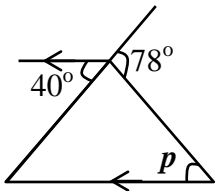
c)



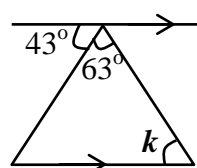
d)



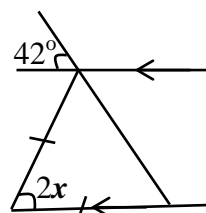
e)



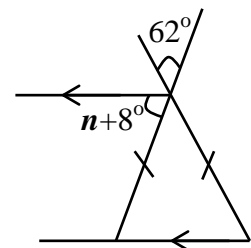
f)



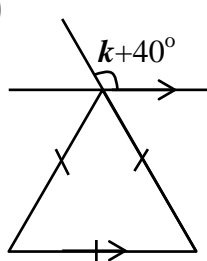
g)



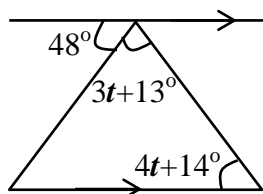
h)



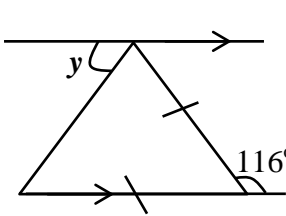
i)



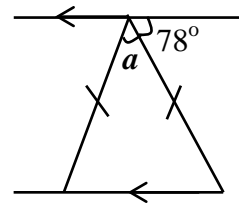
j)



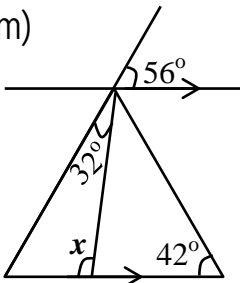
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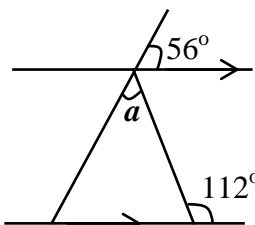
l)



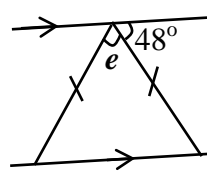
m)



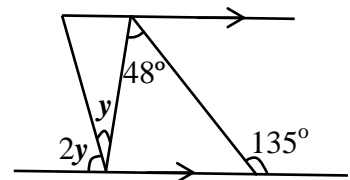
n)



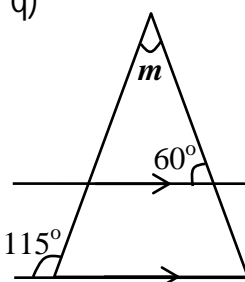
o)



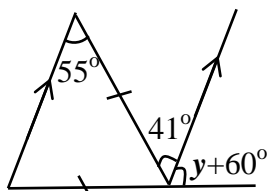
p)



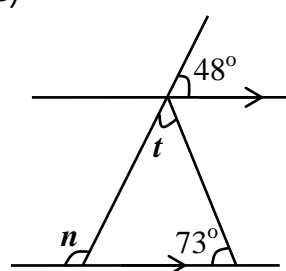
q)



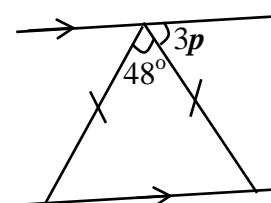
r)



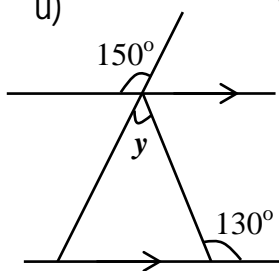
s)



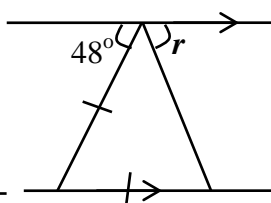
t)



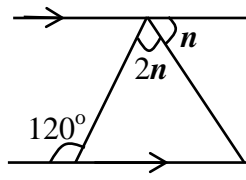
u)



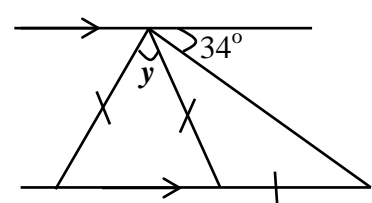
v)



w)

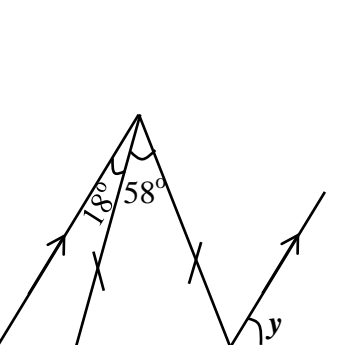
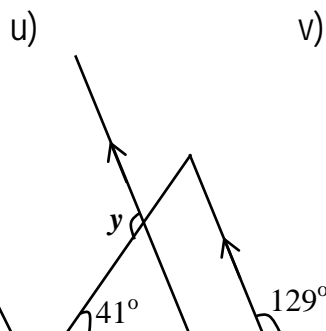
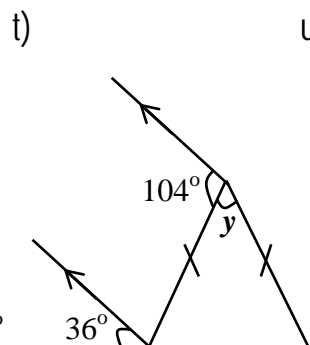
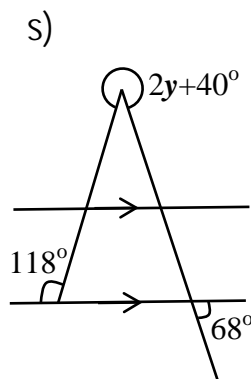
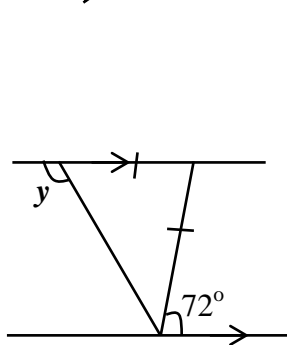
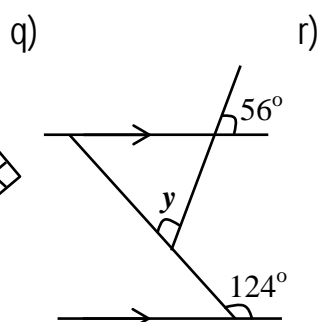
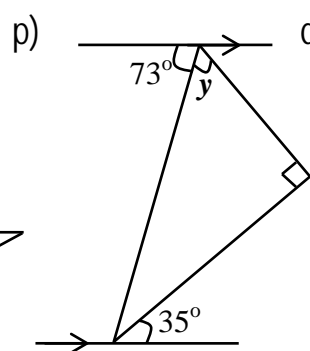
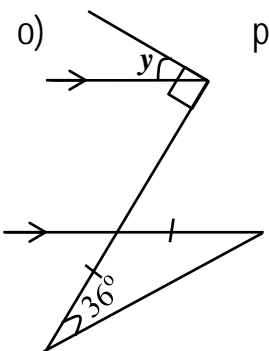
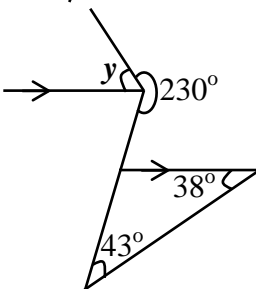
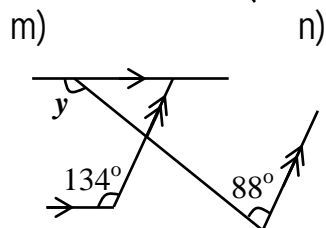
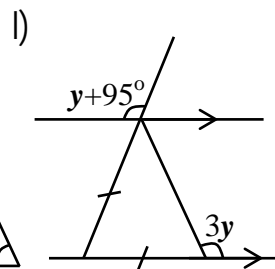
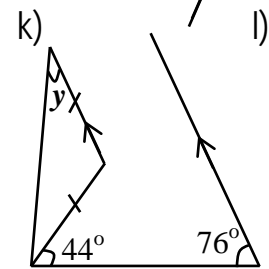
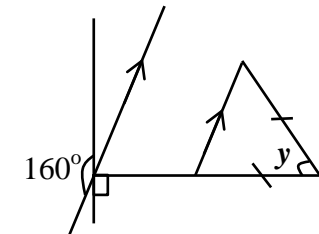
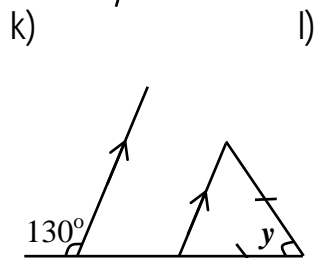
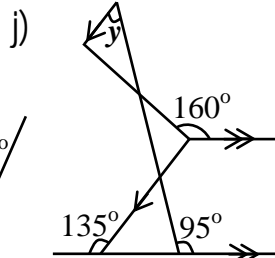
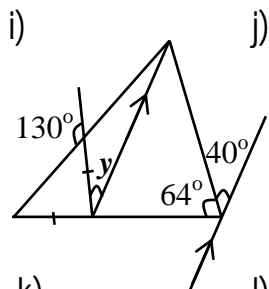
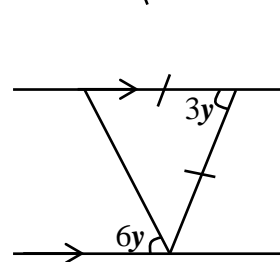
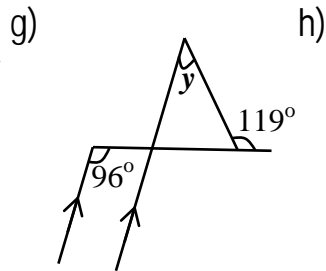
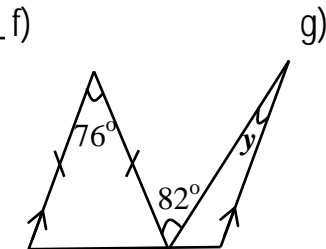
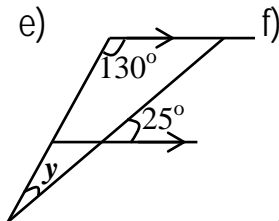
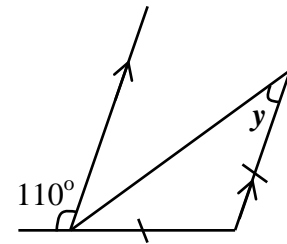
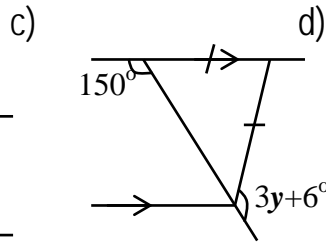
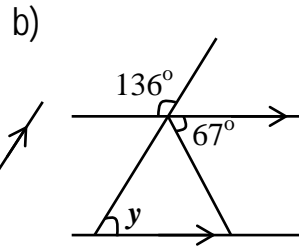
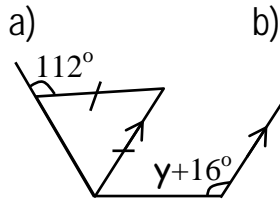


x)



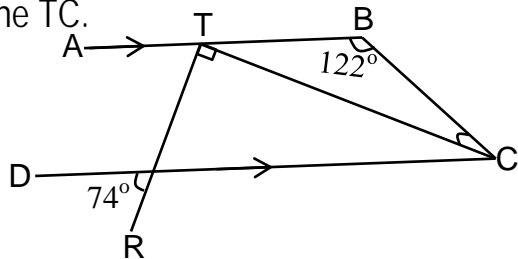


2. Find the value of  $y$



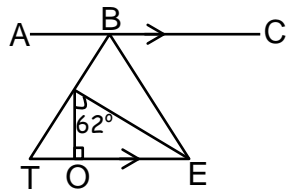


3. In the figure below, line AB is parallel to DC and line RT is perpendicular to line TC.



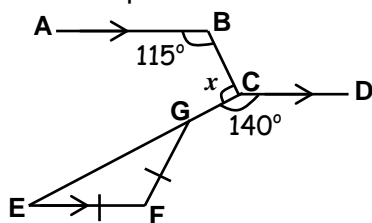
Find the size of angle TCB

4. In the figure below, AC is parallel to TE, TBE is an equilateral triangle and angle OKE =  $62^\circ$ . Study it carefully and answer the question that follows.



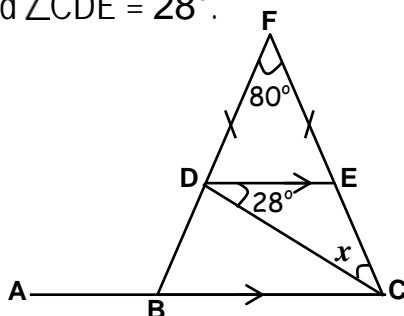
Find the size of angle KEB

5. Study the figure below and use it to answer the questions that follow.



- a) Find the value of  $x$  in degrees.  
b) Find the size of angle EFG.

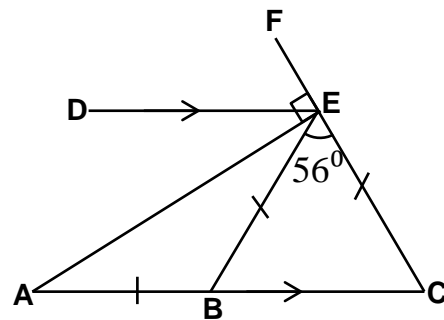
6. In the figure below DE is parallel to AC, DFE is an isosceles triangle,  $\angle BFC = 80^\circ$  and  $\angle CDE = 28^\circ$ .



Find the value of  $x$

Find the size of angle ABF

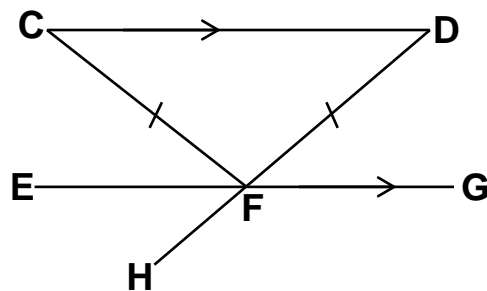
7. In the figure below line FC is perpendicular to line AE, line DE is parallel to line AC, line AB = BE = EC.



Find the size of angle

- i) ABE  
ii) DEC

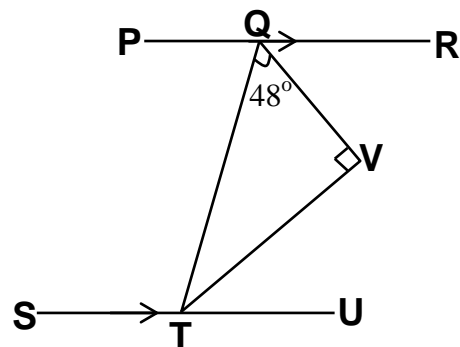
8. In the figure below, CFD is an isosceles triangle, line CD is parallel to line EG and  $\angle CFD$  is 7 times more than  $\angle EFH$ .



Find the size of angle

- i) CDF  
ii) CFG

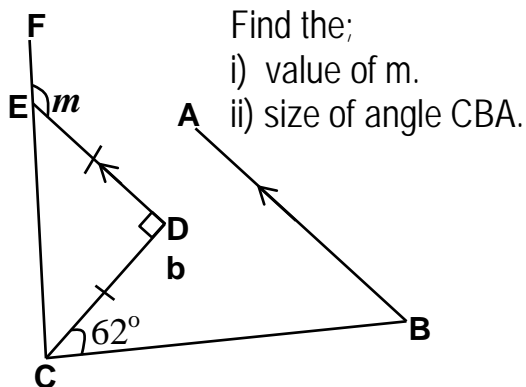
9. In the figure below PR is parallel to SU,  $\angle TQV = 48^\circ$  and angle PQT is thrice angle VTU.



Find the size of angle STQ



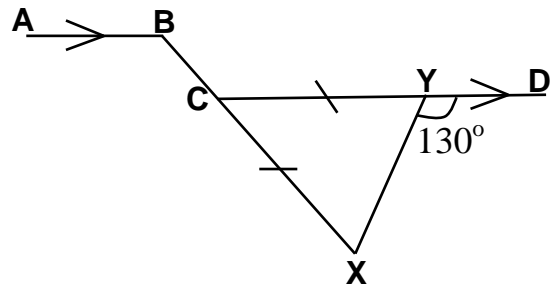
10. Study the figure below and use it to answer questions that follow.



Find the;

- value of m.
- size of angle CBA.

11. Study the figure below.



Find the size of angle ABX.

## Angles in quadrilaterals

- A quadrilateral is a 4 sided shape.
- All the 4 angles inside any quadrilateral add up to  $360^\circ$ .
- Opposite angles of a parallelogram are equal.

### Example 1

$123^\circ$ ,  $78^\circ$  and  $100^\circ$  are angles in a quadrilateral. Find the size of the missing angle.

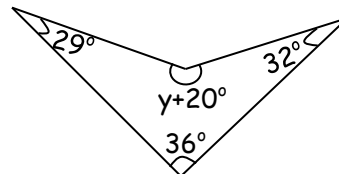
$$360^\circ - (123^\circ + 78^\circ + 100^\circ)$$

$$360^\circ - 301^\circ$$

$$59^\circ$$

### Example 3

Find the value of y.



$$y + 20^\circ + 32^\circ + 36^\circ + 29^\circ = 360^\circ$$

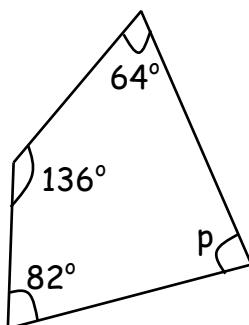
$$y + 117^\circ = 360^\circ$$

$$y + 117^\circ - 117^\circ = 360^\circ - 117^\circ$$

$$y = 243^\circ$$

### Example 2

Find the value of p.



$$p + 82^\circ + 136^\circ + 64^\circ = 360^\circ$$

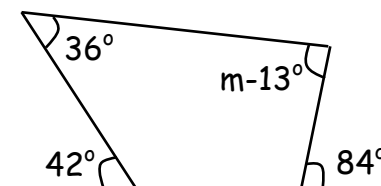
$$p + 282^\circ = 360^\circ$$

$$p + 282^\circ - 282^\circ = 360^\circ - 282^\circ$$

$$p = 78^\circ$$

### Example 4

Find the value of m



$$180^\circ - 42^\circ = 138^\circ$$

$$180^\circ - 84^\circ = 96^\circ$$

$$m - 13^\circ + 36^\circ + 138^\circ + 96^\circ = 360^\circ$$

$$m + 257^\circ = 360^\circ$$

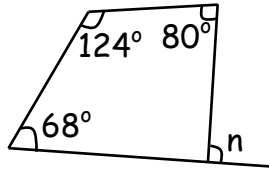
$$m + 257^\circ - 257^\circ = 360^\circ - 257^\circ$$

$$m = 103^\circ$$



## Example 5

Find the value of  $n$



$$360^\circ - (68^\circ + 124^\circ + 80^\circ)$$

$$360^\circ - 272^\circ$$

$$88^\circ$$

Value of  $n$

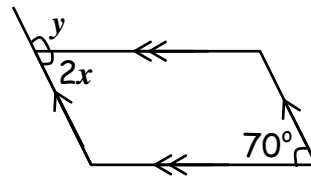
$$n + 88^\circ = 180^\circ$$

$$n + 88^\circ - 88^\circ = 180^\circ - 88^\circ$$

$$n = 92^\circ$$

## Example 6

Find the value of  $x$  and  $y$



Value of  $x$

$$2x = 70^\circ$$

$$\frac{2x}{2} = \frac{70^\circ}{2}$$

$$x = 35^\circ$$

Value of  $y$

$$y + 70^\circ = 180^\circ$$

$$y + 70^\circ - 70^\circ = 180^\circ - 70^\circ$$

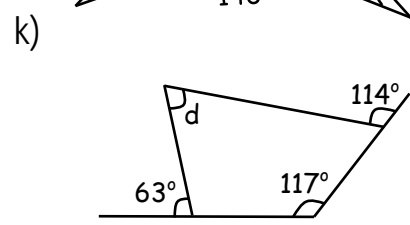
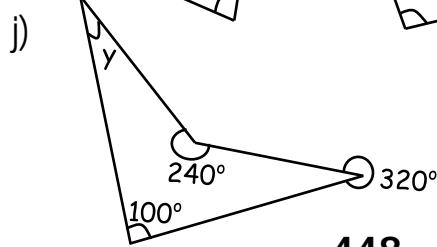
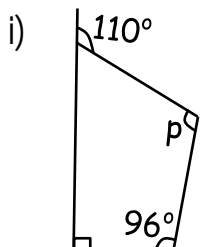
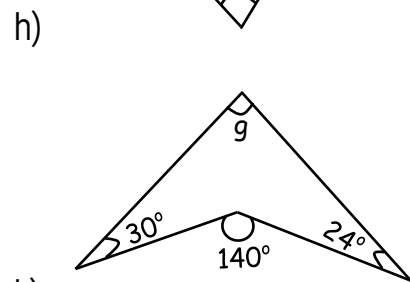
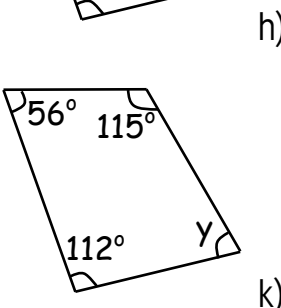
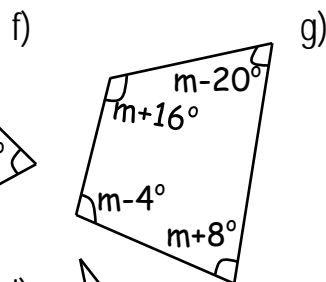
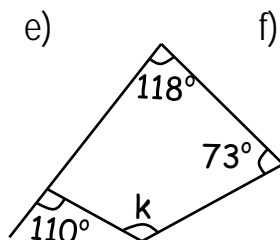
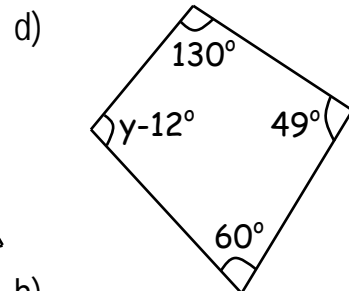
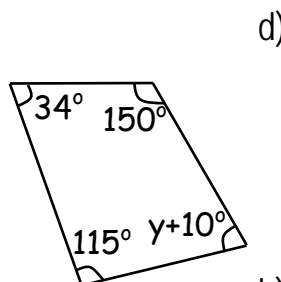
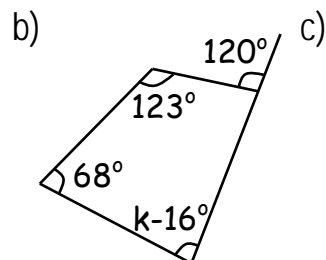
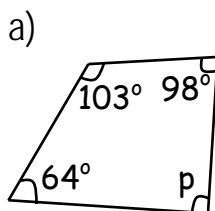
$$y = 110^\circ$$

## Exercise

1. Given below are angles in a quadrilateral. Find the size of the fourth angle.

- $83^\circ, 160^\circ, 43^\circ$
- $11^\circ, 93^\circ, 18^\circ$
- $90^\circ, 123^\circ, 69^\circ$
- $163^\circ, 48^\circ, 71^\circ$
- $24^\circ, 26^\circ, 30^\circ$

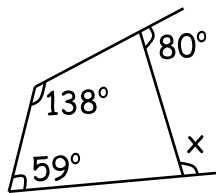
2. Find the value of the unknown.



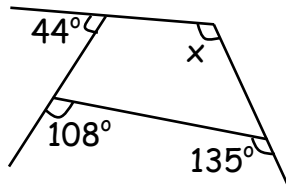


3. Find the value of  $x$

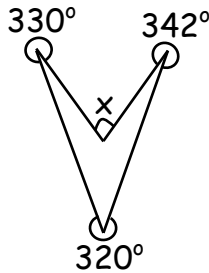
a)



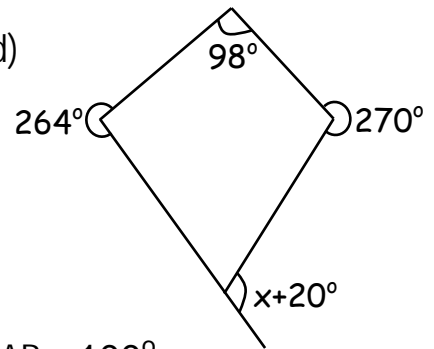
b)



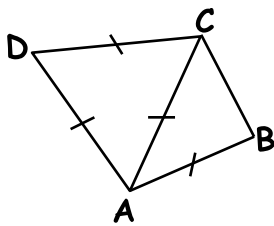
c)



d)



4. In the figure below, ABCD is a quadrilateral where angle  $DAB = 100^\circ$ .

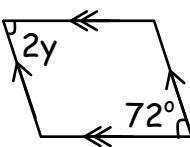


Find the size of angle BCD

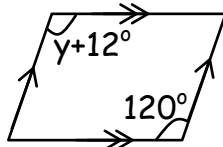
5. The four angles of a quadrilateral  $x$ ,  $2x$ ,  $4x$  and  $5x$ . Find the value of  $x$  in degrees.

6. Find the value of  $y$ .

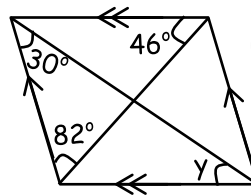
a)



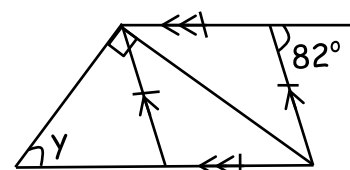
b)



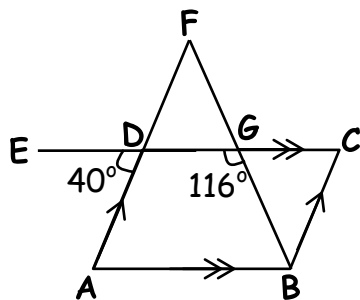
c)



d)



7. In the figure below, ABCD is a parallelogram, angle  $EDA = 40^\circ$  and angle  $DGB = 116^\circ$

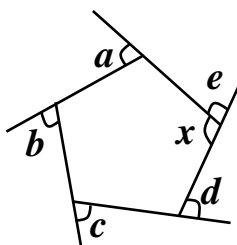


Find the size of angle FBC.

### Exterior angles of regular polygons

- Exterior angles are formed outside of the polygon.
- The sum of the exterior angles of a polygon is  $360^\circ$ .
- The sum of the interior angle and the exterior angle at a vertex is  $180^\circ$ , they lie on the same straight line.

Study the figure below.



From the figure,

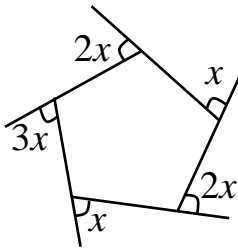
$$a + b + c + d + e = 360^\circ$$

$$e + x = 180^\circ$$



## Example 1

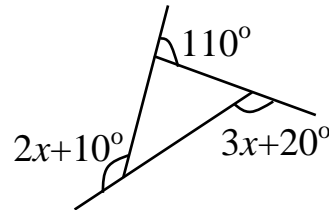
Find the value of  $x$



$$\begin{aligned}
 2x + 3x + x + 2x + x &= 360^\circ \\
 9x &= 360^\circ \\
 \frac{9x}{9} &= \frac{360^\circ}{9} \\
 x &= 40^\circ
 \end{aligned}$$

## Example 2

Find the value of  $x$

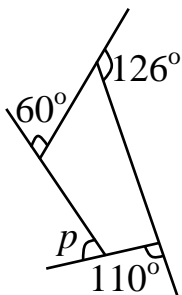


$$\begin{aligned}
 2x + 10^\circ + 3x + 20^\circ + 110^\circ &= 360^\circ \\
 2x + 3x + 10^\circ + 20^\circ + 110^\circ &= 360^\circ \\
 5x + 140^\circ &= 360^\circ \\
 5x + 140^\circ - 140^\circ &= 360^\circ - 140^\circ \\
 \frac{5x}{5} &= \frac{220^\circ}{5} \\
 x &= 44^\circ
 \end{aligned}$$

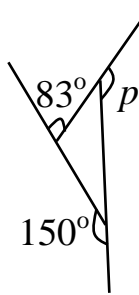
## Exercise

Find the value of  $p$  in each of the following.

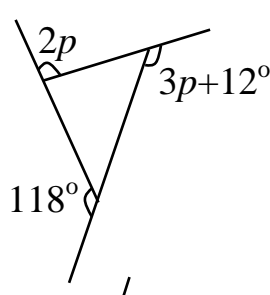
a)



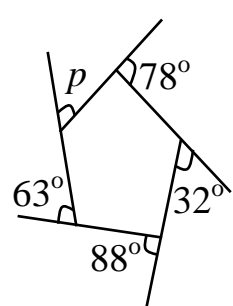
b)



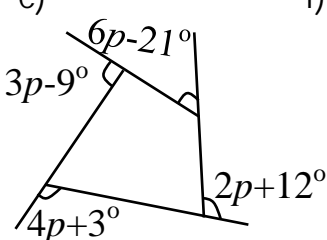
c)



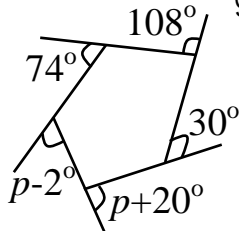
d)



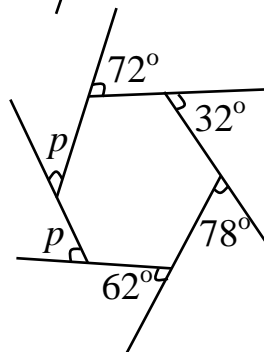
e)



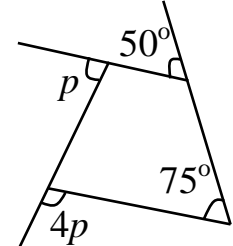
f)



g)



h)



## Finding exterior angles (Centre angles) of regular polygons.

- Since the interior angle of a regular polygon are all the same, the exterior angles must be equal to one another.
- To find the size of one exterior angle, we simply have to divide  $360^\circ$  by the number of sides in the polygon.

$$\text{Each exterior angle} = 360^\circ \div \text{number of sides}$$



## Example

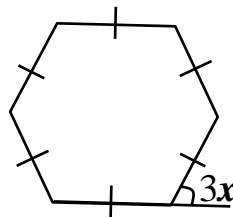
Calculate the size of each exterior angle of a regular octagon.

*An octagon has 8 sides*

$$\begin{aligned}\text{Each exterior angle} &= 360^\circ \div \text{number of side} \\ &= 360^\circ \div 8 \\ &= 45^\circ\end{aligned}$$

## Exercise

- Calculate the size of each exterior angle of a polygon with
  - 3 sides
  - 6 sides
  - 15 sides
  - 12 sides
  - 4 sides
  - 9 sides
  - 5 sides
  - 8 sides
- If a polygon has 12 sides, find the size of each exterior angle.
- Find the size of each exterior angle of;
  - a regular octagon.
  - a regular decagon.
  - a regular nonagon.
  - a regular pentagon.
  - a regular hexagon.
  - an equilateral triangle.
- Find the value of  $x$  in the figure below:



## Finding the number of sides of a regular polygon whose exterior angle is given.

$$\text{Number of sides} = 360^\circ \div \text{Each exterior angle}$$

## Example

Each exterior angle of a regular polygon is  $24^\circ$ . Find the number of sides.

$$\begin{aligned}\text{Number of sides} &= \frac{360^\circ}{\text{Ext. } \angle} \\ &= \frac{360^\circ}{24^\circ} \\ &= 15 \text{ sides}\end{aligned}$$

## Exercise

- Calculate the number of sides of a polygon whose centre angle is
  - $120^\circ$
  - $60^\circ$
  - $72^\circ$
  - $40^\circ$
  - $45^\circ$
  - $18^\circ$
- The size of each exterior angle of a regular polygon is  $30^\circ$ . Find the number of sides.
- Each exterior angle of a regular polygon is  $90^\circ$ . Find the number of sides.
- The sum of four exterior angles of a polygon is  $180^\circ$ . Name the polygon.



## Exterior angles and interior angles of a polygon .

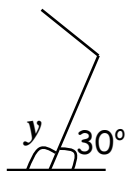
*Note that, for any polygon, the interior angle and exterior angle at a vertex, they add up to **180°**. This means that we can work out the interior angle from the exterior angle and vice versa.*

- ▶ **Interior angle + Exterior angle = 180°**
- ▶ **Interior angle = 180° – Exterior angle**
- ▶ **Exterior angle = 180° – Interior angle**

### Example 1

The exterior angle of a regular polygon is 30°. Find the size of each interior angle.

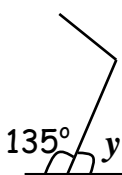
*Let the interior angle be y*



$$\begin{aligned} y + 30^\circ &= 180^\circ \\ y + 30^\circ - 30^\circ &= 180^\circ - 30^\circ \\ y &= 150^\circ \end{aligned}$$

### Example 3

Name the polygon whose interior angle is 135°  
*Let the exterior angle be y*



$$\begin{aligned} y + 135^\circ &= 180^\circ \\ y + 135^\circ - 135^\circ &= 180^\circ - 135^\circ \\ y &= 45^\circ \end{aligned}$$

$$\text{Number of sides} = \frac{360^\circ}{45^\circ}$$

$$= 8 \text{ sides}$$

The polygon is an octagon

### Example 2

The interior angle and exterior angle of a regular polygon are in the ratio of 7:2 respectively.

a) Find the size of each interior angle.

$$\begin{aligned} \text{Total ratio} &= 7+2 \\ &= 9 \end{aligned}$$

$$\begin{aligned} \text{Interior angle} &= \frac{7}{9} \times 180^\circ \\ &= 7 \times 20^\circ \\ &= 140^\circ \end{aligned}$$

b) Name the polygon.

$$\begin{aligned} \text{Exterior angle} &= \frac{2}{9} \times 180^\circ \\ &= 2 \times 20^\circ \\ &= 40^\circ \end{aligned}$$

$$\text{Number of sides} = \frac{360^\circ}{40^\circ}$$

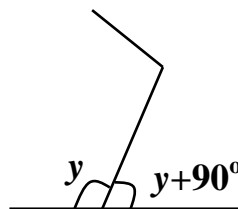
$$= 9 \text{ sides}$$

The polygon is a nonagon

### Example 4

The interior angle of a regular polygon is 90° more than the centre angle. Find the size of each centre angle.

*Let the centre angle be y*



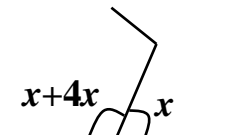
$$\begin{aligned} y + y + 90^\circ &= 180^\circ \\ 2y + 90^\circ &= 180^\circ \\ 2y + 90^\circ - 90^\circ &= 180^\circ - 90^\circ \\ \frac{2y}{2} &= \frac{90^\circ}{2} \\ y &= 45^\circ \end{aligned}$$



**Example 5**

The interior angle of a polygon is 4 times more than the exterior angle.  
Find the size of each interior angle.

Let the centre angle be  $x$



$$x + x + 4x = 180^\circ$$

$$6x = 180^\circ$$

$$\frac{6x}{6} = \frac{180^\circ}{6}$$

$$x = 30^\circ$$

Interior angle

$$x + 4x$$

$$30^\circ + (4 \times 30^\circ)$$

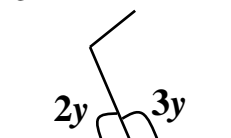
$$30^\circ + 120^\circ$$

$$150^\circ$$

**Example 6**

The exterior angle of a polygon is  $\frac{2}{3}$  of its interior angle. Name the polygon.

$$\frac{2}{3} = 2:3$$



$$3y + 2y = 180^\circ$$

$$5y = 180^\circ$$

$$\frac{5y}{5} = \frac{180^\circ}{5}$$

$$y = 36^\circ$$

$$\text{Exterior angle} = 2y$$

$$= 2 \times 36^\circ$$

$$= 72^\circ$$

$$\text{Number of sides} = \frac{360^\circ}{72^\circ}$$

$$= 5 \text{ sides}$$

The polygon is a pentagon

**Exercise**

- Find the size of each interior angle of a polygon whose centre angle is;
  - $36^\circ$
  - $18^\circ$
  - $30^\circ$
  - $45^\circ$
  - $15^\circ$
  - $12^\circ$
  - $72^\circ$
  - $20^\circ$
- The interior angle of a regular polygon is  $140^\circ$ .
  - Find the size of each exterior angle.
  - Name the polygon.
- Name the polygon whose interior angle is  $135^\circ$ .
- Find the number of sides of a polygon whose interior angle is  $108^\circ$ .
- The interior angle of a polygon is 4 times the centre angle.
  - Find the size of each centre angle.
  - Name the polygon.
- Calculate the number of sides of a polygon whose interior angle is equal to the exterior angle.
- The interior angle of a polygon is twice the exterior angle.
  - Find the size of each interior angle.
  - Name the polygon.



8. The interior angle is 5 times the exterior angle of a polygon.
  - a) Calculate the number of sides of a polygon.
  - b) Name the polygon.
9. The interior angle and exterior angle of a polygon are in the ratio of 3:1 respectively.
  - a) Find the size of each interior angle.
  - b) Calculate the number of sides of a polygon.
10. The ratio of the exterior angle to interior angle of a polygon is 1:5 respectively. Calculate the number of sides of a polygon.
11. The centre angle and interior angle of a polygon are in the ratio of 2:3 respectively.
  - a) Find the size of one interior angle.
  - b) Name the polygon.
12. Find the number of sides of a polygon whose exterior angle and interior angle are in the ratio of 2:13 respectively.
13. The centre angle of a polygon is half the interior angle.
  - a) Calculate the size of each interior angle.
  - b) Find the number of sides of the polygon.
14. The exterior angle is a quarter of the interior angle of a polygon.
  - a) Find the size of each exterior angle.
  - b) Name the polygon
15. The exterior angle of a regular polygon is two sevenths the interior angle. Name the polygon.
16. Name the regular polygon whose exterior angle is two thirds of its interior angle.
17. Calculate the number of sides of a polygon whose exterior angle is a ninth of its interior angle.
18. The exterior angle of a polygon is twice the interior angle. Name the polygon.
19. The interior angle of a polygon is  $100^\circ$  more than the exterior angle.
  - a) Find the size of one exterior angle.
  - b) Calculate the number of sides of the polygon.
20. The interior angle of a regular polygon is  $108^\circ$  more than the exterior angle.
  - a) Find the size of one interior angle.
  - b) Name the polygon.
21. The exterior angle of a polygon is  $60^\circ$  more than the exterior angle.
  - a) Find the size of each interior angle.
  - b) Name the polygon.
22. The exterior angle of a polygon is  $90^\circ$  less than the interior angle.
  - a) Find the size of each exterior angle.
  - b) Calculate the number of sides.
  - c) Name the polygon.
23. The exterior angle of a polygon is  $120^\circ$  less than the interior angle.
  - a) Find the interior angle.
  - b) Name the polygon.



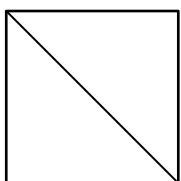
24. Find the number of sides of a polygon whose exterior angle is  $150^\circ$  less than its interior angle.
25. Name the polygon whose interior angle is  $60^\circ$  less than the exterior angle.
26. Given that the interior angle and exterior angle are  $7x$  and  $2x$  respectively.
  - a) Find the value of  $x$
  - b) Calculate the number of sides of the polygon.
27. The interior angle of a polygon is 10 times more than the exterior angle. Calculate the number of sides of the polygon.
28. The interior angle of a polygon is 3 times more than the centre angle.
  - a) Find the size of each centre angle
  - b) Name the polygon.
29. The interior angle of a polygon is 7 times more than the exterior angle.
  - a) Find the size of each interior angle.
  - b) Find the number of sides of the polygon.
30. Calculate the number of sides of a polygon whose interior angle is 8 times more than the exterior angle.
31. Name the polygon whose interior angle is 4 times more than its exterior angle.
32. The interior angle of a polygon is 2 times more than the centre angle.
  - a) Calculate the size of each interior angle.
  - b) Name the polygon.

## Forming triangles from polygons

***The division of a surface or plane polygon into a set of triangles is called triangulation***

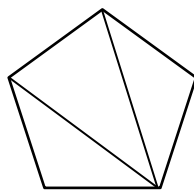
Study the figures below.

Quadrilateral



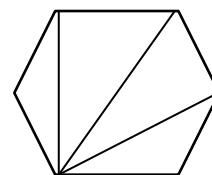
4 sides  
2 triangles

Pentagon



5 sides  
3 triangles

Hexagon



6 sides  
4 triangles

► From the figures above, we take away 2 from the number of sides of a polygon to get the number of triangles.

Let " $n$ " represent the number of sides of a polygon.

So, Number of triangles = *number of sides*  $- 2$   
 $= n - 2$



### Example 1

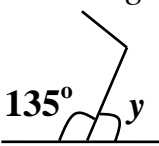
Find the number of triangles that can be formed from a regular pentagon.

$$\begin{aligned}\text{Number of triangles} &= n - 2 \\ &= 5 - 2 \\ &= 3 \text{ triangles}\end{aligned}$$

### Example 2

How many triangles can be formed from a polygon whose interior angle is  $135^\circ$ .

Let the interior angle be  $y$



$$\begin{aligned}y + 135^\circ &= 180^\circ \\ y + 135^\circ - 135^\circ &= 180^\circ - 135^\circ \\ y &= 45^\circ\end{aligned}$$

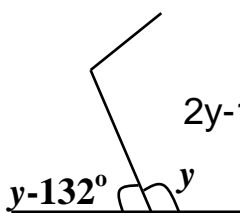
$$\begin{aligned}\text{Number of sides} &= \frac{360^\circ}{45^\circ} \\ &= 8 \text{ sides}\end{aligned}$$

$$\begin{aligned}\text{Number of triangles} &= n - 2 \\ &= 8 - 2 \\ &= 6 \text{ triangles}\end{aligned}$$

### Example 3

The exterior angle of a polygon is  $132^\circ$  less than the interior angles. Calculate the number of triangles that can be formed from that polygon.

Let the interior angle be  $y$



$$\begin{aligned}y + y - 132^\circ &= 180^\circ \\ 2y - 132^\circ &= 180^\circ \\ 2y - 132^\circ + 132^\circ &= 180^\circ + 132^\circ \\ \frac{2y}{2} &= \frac{312^\circ}{2} \\ y &= 156^\circ\end{aligned}$$

Exterior angle	Number of sides = $\frac{360^\circ}{24^\circ}$
$y - 132^\circ$	
$156^\circ - 132^\circ$	
$24^\circ$	= 15 sides

$$\begin{aligned}\text{Number of triangles} &= n - 2 \\ &= 15 - 2 \\ &= 13 \text{ triangles}\end{aligned}$$

### Example 4

Given that, 8 triangles can be formed from a polygon. Find the number of sides of the polygon.

$$\begin{aligned}n - 2 &= \text{Number of sides} \\ n - 2 &= 8 \\ n - 2 + 2 &= 8 + 2 \\ n &= 10\end{aligned}$$

The polygon has 10 sides

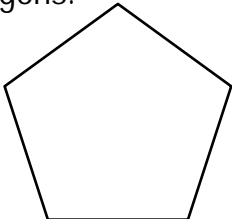
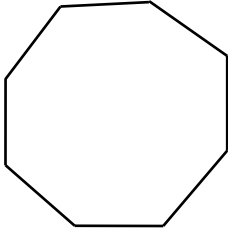
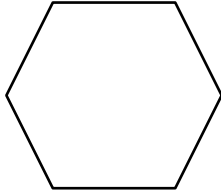
### Exercise

1. Find the number of triangles that can be formed from;
  - a) a quadrilateral.
  - b) a regular decagon.
  - c) a regular octagon.
  - d) a regular heptagon.



2. Find the number of triangles that can be formed from a polygon with.
 

a) 6 sides	f) 15 sides	k) 5 sides
b) 10 sides	g) 14 sides	l) 20 sides
c) 4 sides	h) 12 sides	m) 17 sides
d) 9 sides	i) 11 sides	n) 25 sides
e) 7 sides	j) 8 sides	o) 18 sides
3. How many triangles can be formed from a polygon whose centre angle is  $36^\circ$ ?
4. Calculate the number of triangles that can be formed from a polygon whose interior angle is  $108^\circ$ .
5. The interior angle of a regular polygon is  $100^\circ$  more than the exterior angle. How many triangles can be formed from the polygon?
6. The centre angle of a polygon is  $120^\circ$  less than the interior angle.
  - a) Name the polygon.
  - b) How many triangles can be formed from the polygon named in (a) above?
7. The exterior angle and interior angle of a polygon are in the ratio of 2:7 respectively.
  - a) Find the size of each exterior angle.
  - b) How many triangles can be formed from the polygon?
8. How many triangles can be formed from a polygon whose interior angle is 9 times its exterior angle?
9. Find the number of triangles that can be formed from a polygon whose exterior angle is two thirds the interior angle.
10. The interior angle of a polygon is 7 times more than its exterior angle.
  - a) Find the number of sides of the polygon.
  - b) How many triangles can be formed from the polygon?
11. Show and state the number of triangles that can be formed from each of the following polygons.
 

a) 	b) 	c) 
--	--	--
12. Find the number of sides of polygons whose number of triangles are;
 

a) 6 triangles	e) 5 triangles
b) 4 triangles	f) 7 triangles
c) 10 triangles	g) 11 triangles
d) 7 triangles	h) 25 triangles



13. A regular polygon has 9 triangles. Name the polygon.
14. If 6 triangles can be formed from a polygon, find the size of each exterior angle of the polygon.
15. Given that 3 triangles can be formed from a regular polygon. Calculate the size of each interior angle of the polygon.

### Finding number of right angles in a polygon.

*Since a triangle has 2 right angles, Number of right angles in a polygon is equal to the number of triangle (n-2) times 2.*

$$\text{Number of right angles} = 2(n-2) \text{ or } 2n - 4$$

### **Example 1**

Find the number of right angles in a polygon with 7 sides.

#### **Approach 1**

$$\begin{aligned} \text{Number of right angles} &= 2(n-2) \\ &= 2(7-2) \\ &= 2 \times 5 \\ &= 10 \text{ right angles} \end{aligned}$$

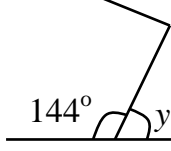
#### **Approach 2**

$$\begin{aligned} \text{Number of right angles} &= 2n - 4 \\ &= (2 \times 7) - 4 \\ &= 14 - 4 \\ &= 10 \text{ right angles} \end{aligned}$$

### **Example 2**

The interior angle of a polygon is  $144^\circ$ . Find the number of right angles in the polygon.

*Let the exterior angle be y*



$$\begin{aligned} y + 144^\circ &= 180^\circ \\ y + 144^\circ - 144^\circ &= 180^\circ - 144^\circ \\ y &= 36^\circ \end{aligned}$$

#### Number of sides

$$\begin{aligned} \frac{360^\circ}{\text{Ext. } \angle} &= \frac{360^\circ}{36^\circ} \\ &= 10 \text{ sides} \end{aligned}$$

#### Number of right angles

$$\begin{aligned} &2(n-2) \\ &2(10-2) \\ &2 \times 8 \\ &16 \text{ right angles} \end{aligned}$$

### **Example 3**

A polygon has 14 right angles. Find the size of each exterior angle.

#### **Number of sides**

$$2n - 4 = \text{Number of right angles}$$

$$2n - 4 + 4 = 14 + 4$$

$$\frac{2n}{2} = \frac{18}{2}$$

$$n = 9 \text{ sides}$$

#### Exterior angle

$$\begin{aligned} \frac{360^\circ}{\text{Sides}} &= \frac{360^\circ}{9} \\ &= 40^\circ \end{aligned}$$



## Example 4

Find the size of each interior angle of a polygon with 20 right angles.

### Number of sides

$$2n - 4 = \text{Right angles}$$

$$2n - 4 + 4 = 20 + 4$$

$$\frac{2n}{2} = \frac{24}{2}$$

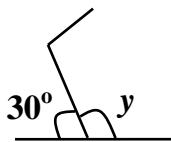
$$n = 12 \text{ sides}$$

Exterior angle

$$\frac{360^\circ}{\text{Sides}} = \frac{360^\circ}{12}$$

$$= 30^\circ$$

Let the interior angle be  $y$



$$y + 30^\circ = 180^\circ$$

$$y + 30^\circ - 30^\circ = 180^\circ - 30^\circ$$

$$y = 150^\circ$$

## Exercise

- Find the number of right angles of a polygon with
  - 6 sides
  - 11 sides
  - 7 sides
  - 10 sides
  - 4 sides
  - 9 sides
  - 14 sides
  - 15 sides
  - 24 sides
- The exterior angle of a polygon is  $72^\circ$ .
  - Name the polygon.
  - Find the number of right angles in the polygon.
- The interior angles of a polygon is  $150^\circ$ .
  - Find the size of one centre angle.
  - Find the number of right angles in a polygon.
- Find the number of right angles in a polygon whose interior angle is  $36^\circ$  more than the exterior angle.
- The exterior angles of a polygon is  $140^\circ$  less than the interior angle.
  - Find the size of each interior angle.
  - Find the number of right angles in the polygon.
- Calculate the number of right angles in a polygon whose interior angle is 4 times the exterior angle.
- The interior and exterior angle of a polygon are in the ratio of 2:1 respectively.
  - Name the polygon.
  - Find the number of right angles in the polygon.
- The exterior angle of a polygon is a third of the interior angle. Calculate the number of right angles in the polygon.
- Find the number of sides of a polygon whose right angles are;
  - 6 right angles
  - 10 right angles
  - 4 right angles
  - 20 right angles
  - 18 right angles
  - 8 right angles
  - 16 right angles
  - 32 right angles

## TOPIC 7: GEOMETRIC CONSTRUCTION



10. A polygon has 12 right angles.
  - a) Name the polygon.
  - b) Find the size of each interior angle.
11. Name the polygon with 10 right angles.
12. A polygon has 14 right angles.
  - a) Find the number of sides of the polygon.
  - b) Calculate the size of each interior angles.

### Sum of interior angles of polygons.

*Sum of interior angles = Each interior angle  $\times$  Number of sides*

#### **Example 1**

Calculate the sum of the interior angles of a nonagon whose interior angle is  $140^\circ$ .

A nonagon has 9 sides  
Each interior angle =  $140^\circ \times 9$   
=  $1260^\circ$

#### **Example 2**

Find the interior angle sum of a regular hexagon whose exterior angle is  $60^\circ$ .

A hexagon has 6 sides  
Each exterior angle is  $60^\circ$   
Each interior angle =  $180^\circ - 60^\circ$   
=  $120^\circ$   
Interior angle sum =  $120^\circ \times 6$   
=  $720^\circ$

### **Exercise**

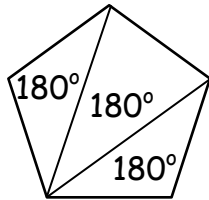
1. Each interior angle of a regular octagon is  $135^\circ$ . What is the sum of its interior angles?
2. Find the interior angle sum of a six sided polygon whose interior angle is  $120^\circ$ .
3. The size of each interior angle of a pentagon is  $108^\circ$ . Calculate the sum of its interior angles.
4. A regular nonagon has one of its exterior angle  $40^\circ$ .
  - a) Find the size of each interior angle.
  - b) Find the sum of all interior angles.
5. Akot drew a ten sided regular polygon.
  - a) Find the size of each exterior angle.
  - b) Find the size of one interior angle.
  - c) Calculate the total of all interior angles.
6. Each interior angle of a quadrilateral is  $90^\circ$ . Find the interior angle sum.
7. The interior angle sum of a regular polygon is  $180^\circ$ . If each interior angle is  $60^\circ$ .
  - a) Find the number of sides of the polygon.
  - b) Name the polygon.



## More problems involving finding the interior angle sum of polygons

### Note:

To find the sum of interior angles of a polygon, divide the polygon into triangles as shown below.



Interior angle sum

$$180^\circ + 180^\circ + 180^\circ$$

$$540^\circ$$

Or

$$180^\circ \times 3$$

$$540^\circ$$

The number of triangles in each polygon is 2 less than the number of sides( $n$ ). The formula for calculating the sum of interior angles is  **$180^\circ(n-2)$**  where  $n$  represents the number of sides of a polygon.

### Example 1

Calculate the sum of the interior angles in an octagon.

An octagon has 8 sides

$$\begin{aligned} \text{Sum of interior angles} &= 180^\circ(n-2) \\ &= 180^\circ(8-2) \\ &= 180^\circ \times 6 \\ &= 1080^\circ \end{aligned}$$

### Example 2

The interior angle of a polygon is  $108^\circ$ .

a) Find the size of each exterior angle.

Let each exterior angle be  $x$



$$\begin{aligned} x + 108^\circ &= 180^\circ \\ x + 108^\circ - 108^\circ &= 180^\circ - 108^\circ \\ x &= 72^\circ \end{aligned}$$

b) Calculate the sum of the interior angles

Number of sides

$$\begin{aligned} \frac{360^\circ}{\text{Ext. } \angle} &= \frac{360^\circ}{72^\circ} \\ &= 5 \text{ sides} \end{aligned}$$

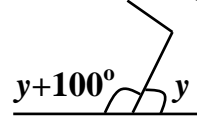
Interior angle sum

$$\begin{aligned} 180^\circ(n-2) \\ 180^\circ(5-2) \\ 180^\circ \times 3 \\ 540^\circ \end{aligned}$$

### Example 3

The interior angle of a regular polygon is  $100^\circ$  more than the exterior angle. Find the total of all the interior angles of the polygon.

Let the exterior angle be  $y$



$$\begin{aligned} y + y + 100^\circ &= 180^\circ \\ 2y + 100^\circ &= 180^\circ \\ 2y + 100^\circ - 100^\circ &= 180^\circ - 100^\circ \\ \frac{2y}{2} &= \frac{80^\circ}{2} \\ y &= 40^\circ \end{aligned}$$

Number of sides

$$\begin{aligned} \frac{360^\circ}{\text{Ext. } \angle} &= \frac{360^\circ}{40^\circ} \\ &= 9 \text{ sides} \end{aligned}$$

Interior angle sum

$$\begin{aligned} 180^\circ(n-2) \\ 180^\circ(9-2) \\ 180^\circ \times 7 \\ 1260^\circ \end{aligned}$$



## Exercise

1. Find the sum of all interior angles of a regular
 

a) pentagon	d) heptagon	g) hendecagon
b) octagon	e) quadrilateral	h) heptagon
d) decagon	f) nonagon	
  
2. Find the total of interior angles of a polygon with;
 

a) 7 sides	d) 4 sides	g) 9 sides
b) 12 sides	e) 3 sides	h) 11 sides
c) 5 sides	f) 8 sides	i) 18 sides
  
3. The exterior angle of a regular polygon is  $60^\circ$ .
  - a) Name the polygon.
  - b) Find the interior angle sum of the polygon.
  
4. The interior angle of a regular polygon is  $140^\circ$ .
  - a) Find the size of each exterior angle.
  - b) Find the sum of interior angles of the polygon.
  
5. A polygon has its interior angle as  $165^\circ$ . Calculate the total of all interior angles
  
6. The exterior angle of a regular polygon is twice the interior angle.
  - a) Calculate the size of one exterior angle.
  - b) Find the sum of interior angles of the polygon.
  
7. Find the sum of interior angles of a polygon whose interior angles is 4 times its exterior angle.
  
8. The interior angle of a polygon is 8 times the exterior angle.
  - a) Find the number of sides of the polygon.
  - b) Calculate the total of interior angles of the polygon.
  
9. The interior and exterior angles of a polygon are in the ratio of 3:2 respectively
  - a) Name the polygon.
  - b) Find the interior angle sum of the polygon.
  
10. The ratio of the size of the interior angle to the size of the exterior angle of a polygon is 13:2.
  - a) Find the number of sides of the polygon
  - b) Calculate the interior angle sum.
  
11. The exterior angle of a polygon is a fifth of the interior angle of the polygon.
  - a) Find the size of one interior angle.
  - b) Calculate the number of sides of the polygon.
  - c) Find the interior angle sum of the polygon.



12. The exterior angle of a polygon is two thirds of its interior angle.
  - a) Name the polygon.
  - b) Calculate the interior angle sum of the polygon.
13. A regular polygon has its interior angle which is  $60^\circ$  less than the exterior angle.
  - a) Find the size of each exterior angle.
  - b) Find the total of the interior angles of the polygon.
14. By measuring angles using a protractor, P.7 pupil found out that the interior angle of a polygon was  $108^\circ$  more than the exterior angle.
  - a) Name the polygon.
  - b) Calculate the interior angle sum of the polygon.
15. The exterior angle of a polygon is  $120^\circ$  less than the interior angle.
  - a) Find the size of each exterior angle.
  - b) Name the polygon.
  - c) Calculate the interior angle sum of the polygon.
16. Calculate the interior angle sum of a polygon whose exterior angle is  $140^\circ$  less as than the interior angles.
17. The interior angle of a regular polygon is 3 times more than the centre angle.
  - a) Name the polygon.
  - b) Calculate the interior angle sum of the polygon.
18. Find the sum of interior angles of a regular polygon whose interior angle is 2 times more than the exterior angle.
19. The interior angle of a polygon is 4 times more than the exterior angle.
  - a) Find the number of sides.
  - b) Calculate the sum of the interior angles of the polygon.

### Finding the number of sides when the sum of interior angles is given

#### **Example 1**

The interior angle sum of a regular polygon is  $1260^\circ$ .

- a) Find the number of triangles in the polygon.

$$\begin{aligned}
 \text{Number of triangles} &= \text{Int. } \angle \text{ sum} \div 180^\circ \\
 &= \frac{1260^\circ}{180^\circ} \\
 &= 7 \text{ triangles}
 \end{aligned}$$

- b) Find the number of sides

$$\begin{aligned}
 n - 2 &= \text{Number of sides} \\
 n - 2 &= 7 \\
 n - 2 + 2 &= 7 + 2 \\
 n &= 9 \text{ sides}
 \end{aligned}$$



**Example 2**

Find the number of sides of a regular polygon whose interior angle sum is  $1800^\circ$ .

**Approach 1**

$$\begin{aligned}
 180^\circ(n - 2) &= \text{Interior angle sum} \\
 180^\circ(n - 2) &= 1800^\circ \\
 180^\circ n - 360^\circ &= 1800^\circ \\
 180^\circ n - 360^\circ + 360^\circ &= 1800^\circ + 360^\circ \\
 180^\circ n &= 2160^\circ \\
 \frac{180^\circ n}{180^\circ} &= \frac{2160^\circ}{180^\circ} \\
 n &= 12 \\
 \text{The polygon has 12 sides}
 \end{aligned}$$

**Approach 2**

Number of triangles

$$\text{Int. } \angle \text{ sum} \div 180^\circ$$

$$1800^\circ \div 180^\circ = 10 \text{ triangles}$$

Number of sides

$$n - 2 = \text{Number of sides}$$

$$n - 2 = 10$$

$$n - 2 + 2 = 10 + 2$$

$$n = 12 \text{ sides}$$

The polygon has 12 sides

**Example 3**

The interior angle sum of a regular polygon is  $1080^\circ$ .

a) Find the number of triangles in the polygon.

$$\begin{aligned}
 \text{No. of triangles} &= \frac{\text{Int. } \angle \text{ sum}}{180^\circ} \\
 &= \frac{1080^\circ}{180^\circ} \\
 &= 6 \text{ triangles}
 \end{aligned}$$

b) Name the polygon.

$$n - 2 = \text{Number of sides}$$

$$n - 2 = 6$$

$$n - 2 + 2 = 6 + 2$$

$$n = 8 \text{ sides}$$

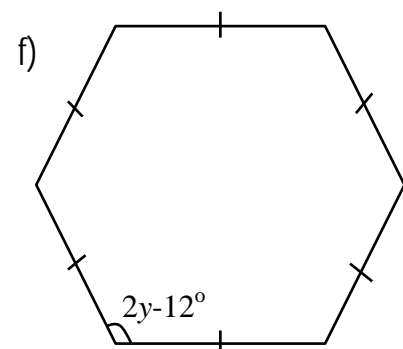
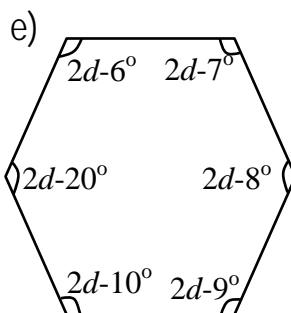
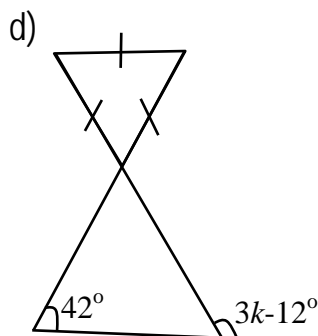
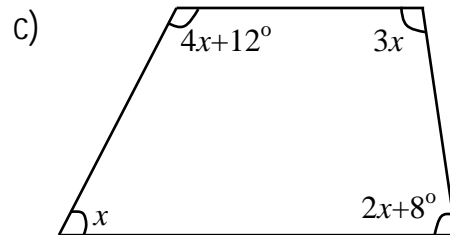
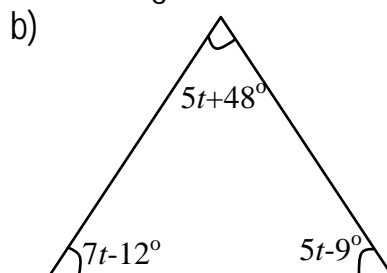
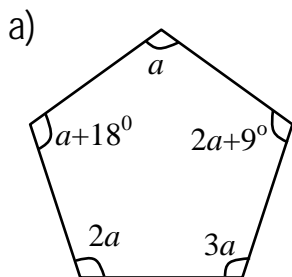
The polygon has 8 sides

**Exercise**

- How many sides has a polygon whose interior angle sum is;
  - $360^\circ$
  - $720^\circ$
  - $540^\circ$
  - $900^\circ$
  - $1080^\circ$
  - $1440^\circ$
  - $2700^\circ$
  - $5040^\circ$
  - $1260^\circ$
- Find the number of triangles in a polygon whose interior angle sum is;
  - $1080^\circ$
  - $900^\circ$
  - $360^\circ$
  - $1440^\circ$
  - $2700^\circ$
  - $2880^\circ$
  - $540^\circ$
  - $2160^\circ$
- The sum of interior angles of a polygon is  $720^\circ$ .
  - Find the number of triangles in the polygon.
  - Find the number of right angles in the polygon.
  - Calculate the size of each interior angle.
- Name the polygon whose interior angle sum is  $900^\circ$ .



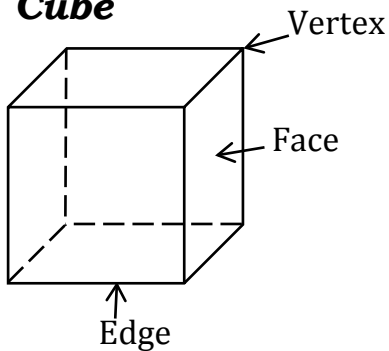
5. The sum of interior angles of a polygon is  $1620^\circ$ .
  - a) Find the number of triangles in the polygon.
  - b) Name the polygon.
6. The number of the interior angles a regular polygon is  $1800^\circ$ .
  - a) Name the polygon.
  - b) How many right angles are in the polygon?
  - c) Find the size of each exterior angle.
7. The interior angle sum of a regular polygon is  $1260^\circ$ .
  - a) Find the number of right angles in the polygon.
  - b) Calculate the size of each exterior angle of the polygon.
  - c) Find the size of each interior angle.
8. Find the size of each exterior angle of a regular polygon whose interior angle sum is  $1440^\circ$ .
9. Given that the sum of interior angles of a regular polygon is  $540^\circ$ .
  - a) Find the number of sides of the polygon.
  - b) Name the polygon.
  - c) Calculate the size of each exterior angle of the polygon.
10. Find the size of each interior angle of a regular polygon whose interior angle sum is  $2340^\circ$ .
11. Using a ruler, a pencil and a pair of compass only, construct a polygon whose interior angle is  $720^\circ$  in a circle of radius 3.5cm.
12. The sum of interior angles of a regular polygon is  $540^\circ$ . Find the ratio of size of each exterior angle to each interior angle.
13. Given that the interior angle sum of a polygon is  $1080^\circ$ . By how many times is the interior angle more than the exterior angle?
14. The sum of interior angles of a polygon is  $720^\circ$ . By how many degrees is each interior angle more than the exterior angle?
15. Find the value of the unknown angles.



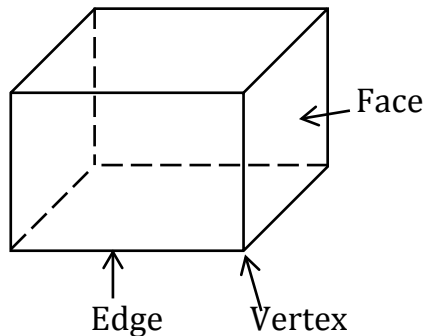


## PRISMS AND THEIR PROPERTIES

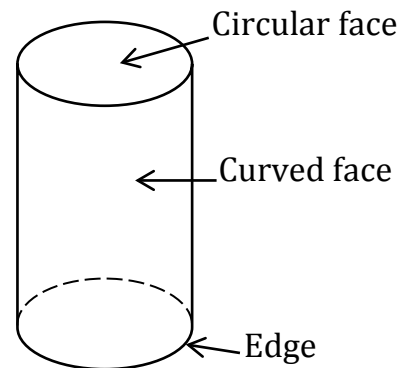
**Cube**



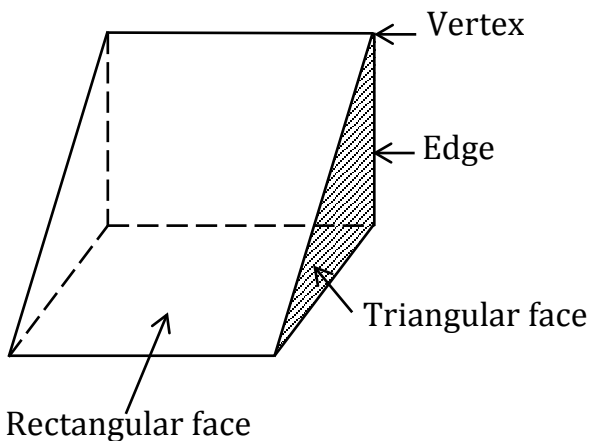
**Cuboid**



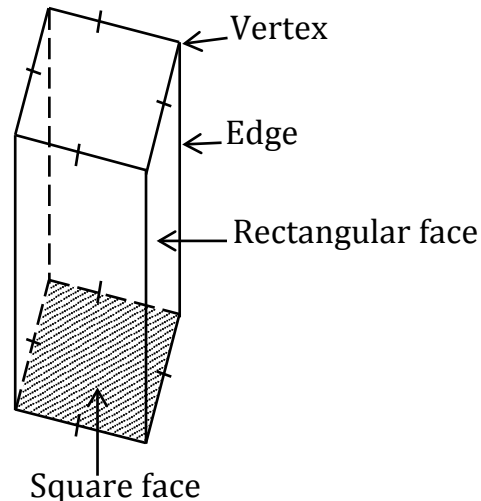
**Cylinder**



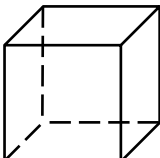
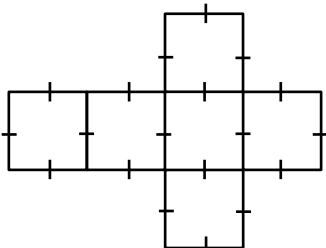
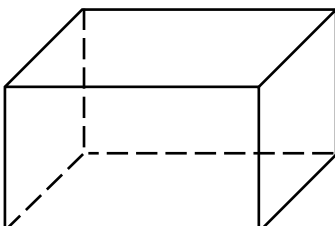
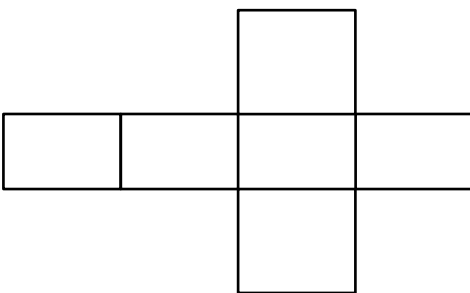
**Triangular prism**



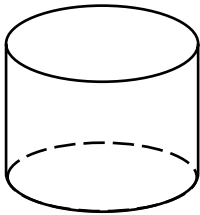
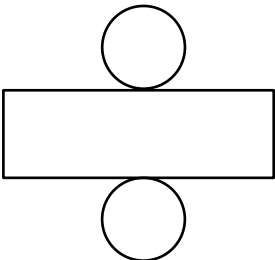
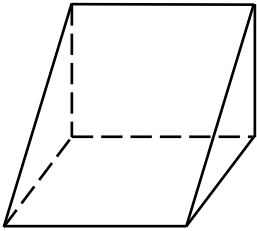
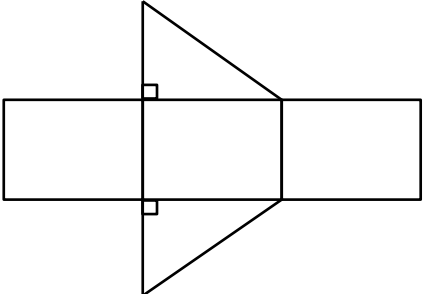
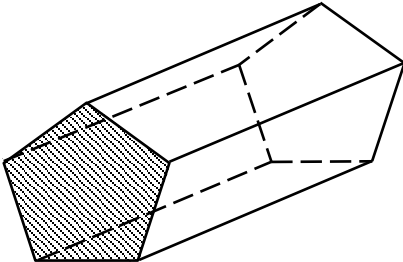
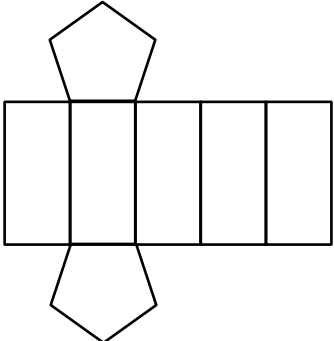
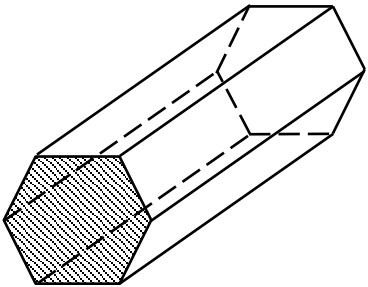
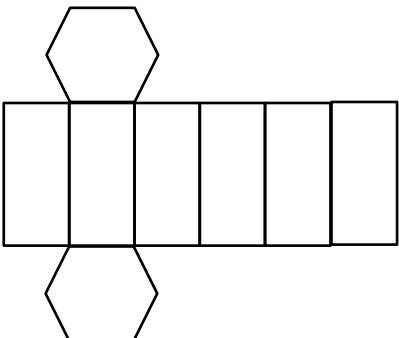
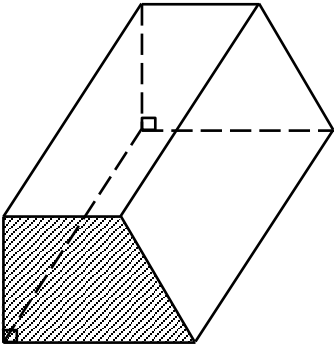
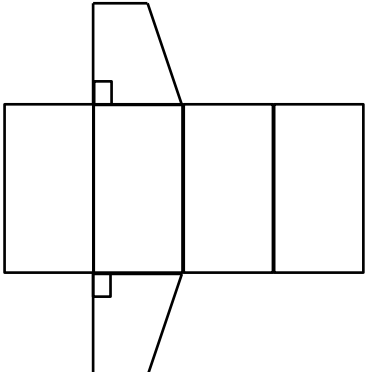
**Right prism**



Study and complete the table below.

Prism	Properties	Net
 Cube	6 square faces _____ vertices _____ edges	
 Cuboid	_____ rectangular faces _____ vertices _____ edges	



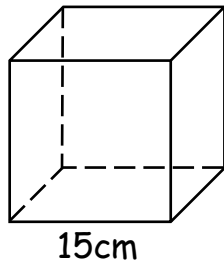
Prism	Properties	Net
	3 faces ____ circular faces ____ edges	
	5 faces ____ rectangular faces ____ triangular faces ____ vertices ____ edges	
	7 faces ____ rectangular faces ____ pentagonal faces ____ vertices ____ edges	
	____ faces ____ vertices ____ edges	
	____ faces ____ vertices ____ edges	



## Finding the sum of length of edges of prisms

### Example 1

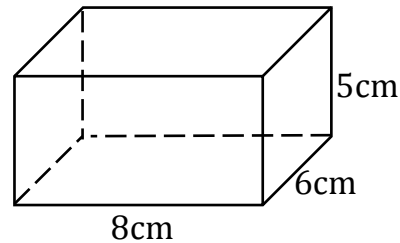
Find the length of the wire needed to make the cube below.



$$\begin{aligned} \text{Length} &= \text{Edges} \times \text{length of each edge} \\ &= 12 \times 15\text{cm} \\ &= 180\text{cm} \end{aligned}$$

### Example 2

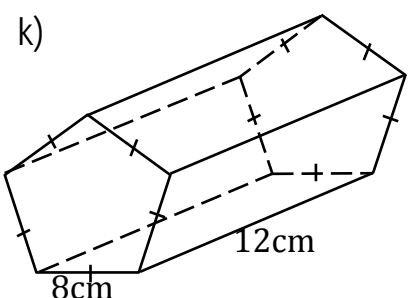
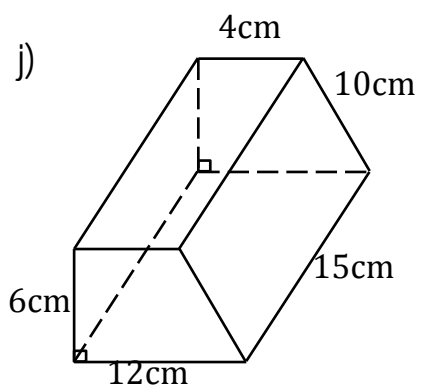
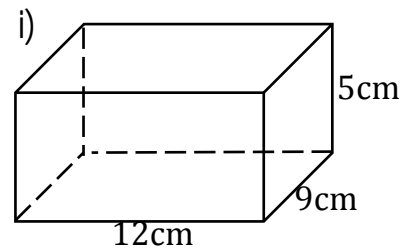
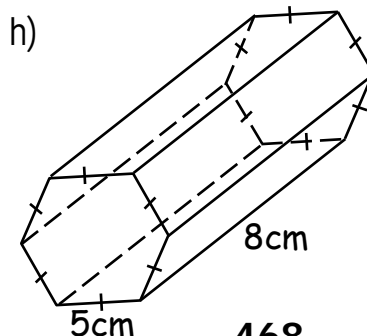
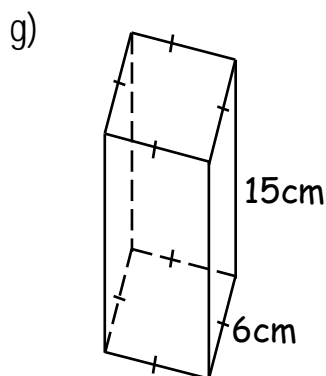
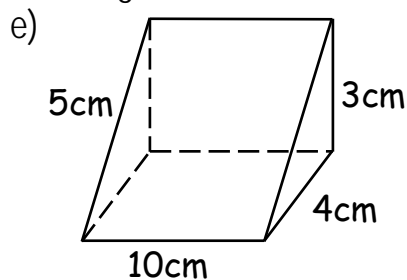
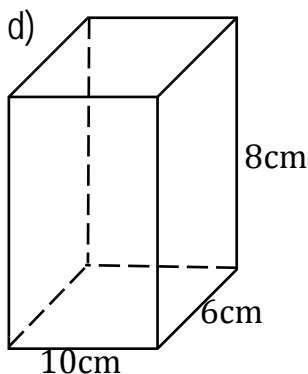
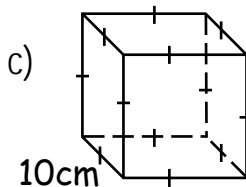
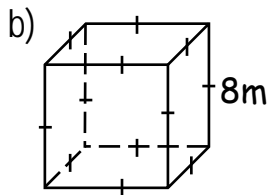
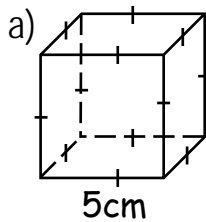
Find the sum of the length of all edges in the figure below.



$$\begin{aligned} &4l + 4w + 4h \\ &(4 \times 8\text{cm}) + (4 \times 6\text{cm}) + (4 \times 5\text{cm}) \\ &32\text{cm} + 24\text{cm} + 20\text{cm} \\ &76\text{cm} \\ &\text{The sum of length of all edges is } 76\text{cm} \end{aligned}$$

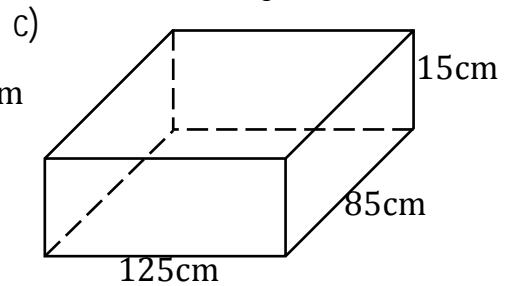
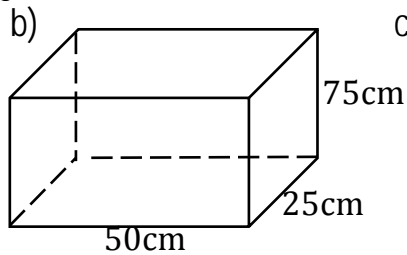
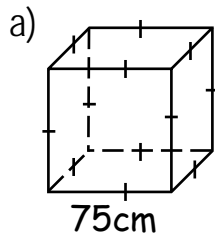
## Exercise

1. Find the sum of length of all edges of each of the solids below.

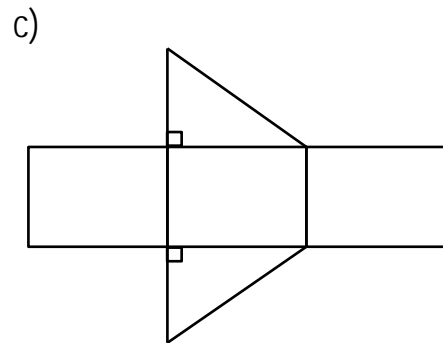
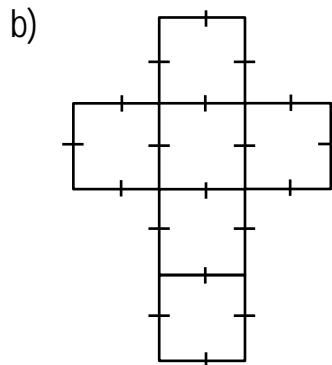
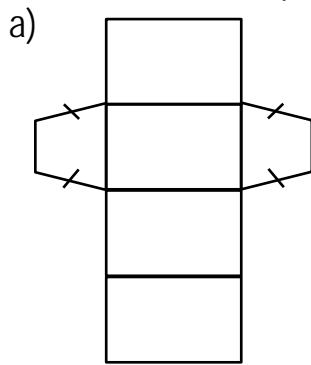




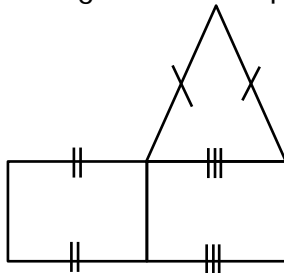
2. Find in metres, the length of wires used to make each of the following.



3. Name the solid shapes whose nets are drawn below:

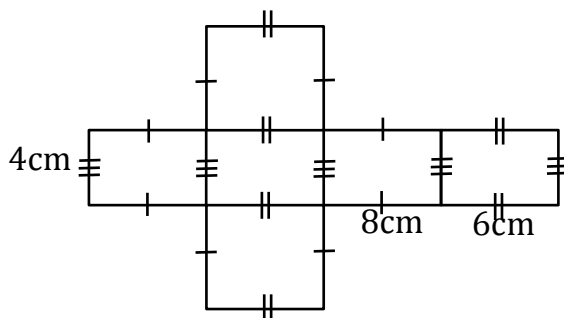


4. The figure below represents part of the net of a solid figure with 5 faces.



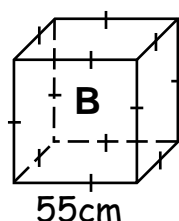
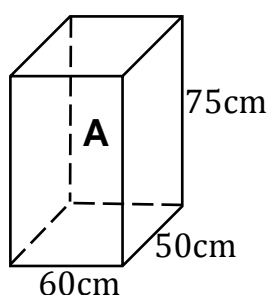
- Copy and complete the net
- Name the solid figure whose net is drawn.

5. Primary seven pupils formed a solid figure from the net shown in the drawing below.



- Name the solid figure formed.
- The solid figure has;  
\_\_\_\_\_ edges  
\_\_\_\_\_ vertices
- Calculate the total of length of all of its edges.

6. A welder buys a metallic pipe whose length was enough to make the edges of tank A. He decides to make tank B.



- Calculate the length of the metallic pipe that remained.
- Calculate the area of the metallic sheet needed to make the four walls of tank B.



More problems involving the sum of lengths of edges.

### Example 1

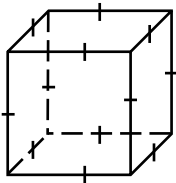
The total of length of all edges of a cube is 180cm. Find the length of each edge.

A cube has 12 edges

$$\begin{aligned}\text{Length of each edge} &= 180\text{cm} \div 12 \\ &= 15\text{cm}\end{aligned}$$

### Example 2

Mawaya used a wire of length 3 metres to make the edges of the prism below.



Find in centimetres, the length of each edge.

$$1\text{m} = 100\text{cm}$$

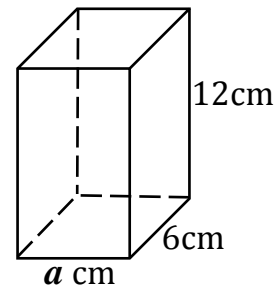
$$\begin{aligned}3\text{m} &= 3 \times 100\text{cm} \\ &= 300\text{cm}\end{aligned}$$

$$300\text{cm} \div 12 = 25\text{cm}$$

*The length of each edge is 25cm*

### Example 3

The sum of length of all edges of the prism below is 108cm. Find the value of  $a$



$$\begin{aligned}\text{Heights} &= 4 \times 12\text{cm} & \text{Widths} &= 4 \times 6\text{cm} \\ &= 48\text{cm} & &= 24\text{cm}\end{aligned}$$

$$\begin{aligned}\text{Heights} + \text{Widths} &= 48\text{cm} + 24\text{cm} \\ &= 72\text{cm}\end{aligned}$$

$$\begin{aligned}\text{Lengths} &= 108\text{cm} - 72\text{cm} \\ &= 36\text{cm}\end{aligned}$$

*Value of  $a$*

$$4 \times a\text{cm} = 36\text{cm}$$

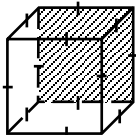
$$\frac{4a\text{cm}}{4\text{cm}} = \frac{36\text{cm}}{4\text{cm}}$$

$$a = 9$$

### Exercise

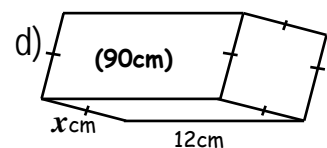
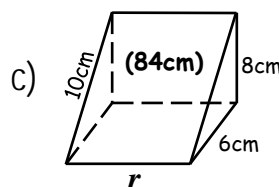
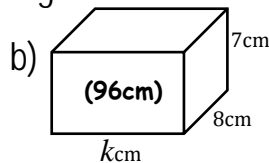
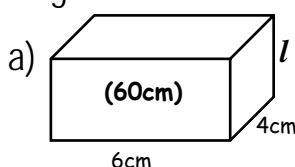
- The sum of lengths of all edges of a cube is given below. Find the length of each edge.  
a) 36cm      b) 60cm      c) 96cm      d) 48cm      e) 42cm      f) 120cm

- The sum of length of all edges of the prism below is 4.2 metres.

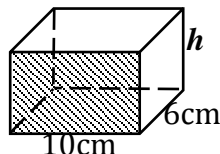
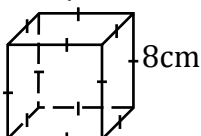


- Find in cm, the length of each edge.
- Calculate the area of the shaded part.

- The sum of lengths of edges of each of the prisms below is given in brackets. Find the length of the unknown edge.



- The prisms below have the same sum of the length of all edges.

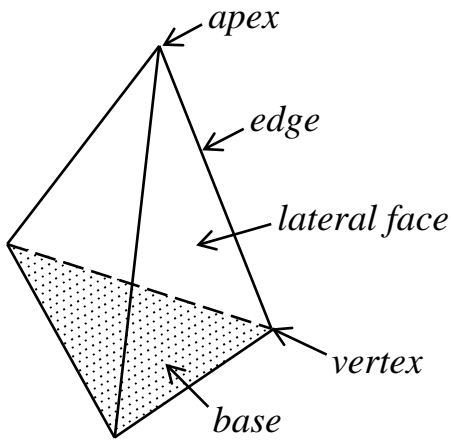


- Find the value of  $h$ .
- Calculate the perimeter of the shaded part.

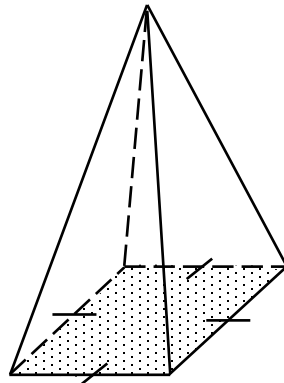


## PYRAMIDS AND THEIR PROPERTIES

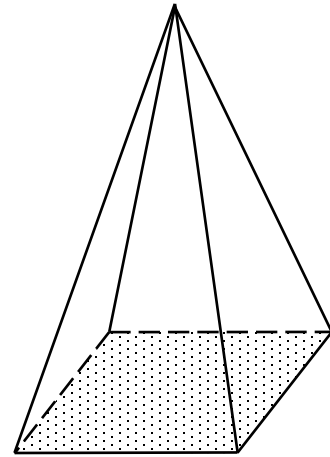
Pyramids are named after their bases. A pyramid with a triangular base is called a triangular pyramid.



Triangular pyramid  
(Tetrahedron)

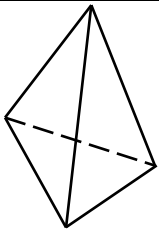
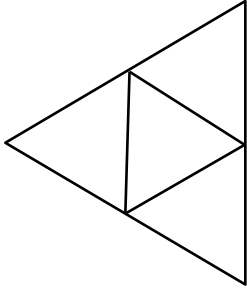
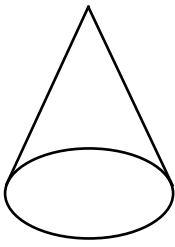
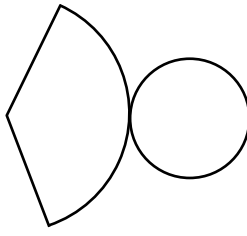
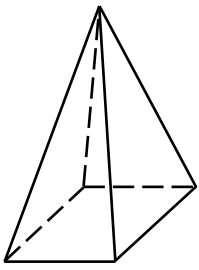
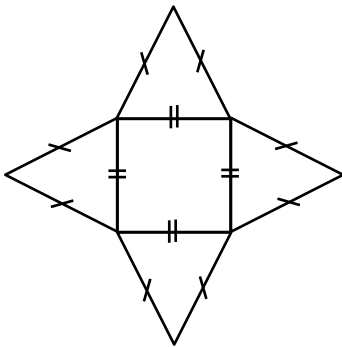


Square pyramid

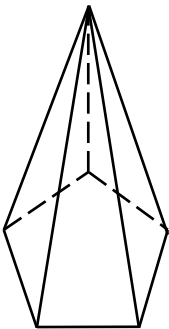
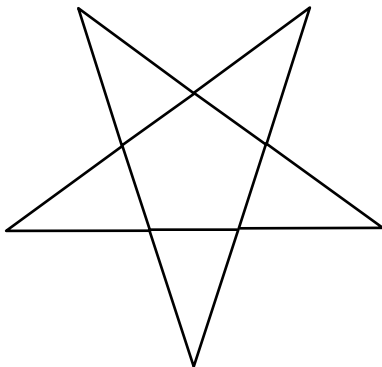
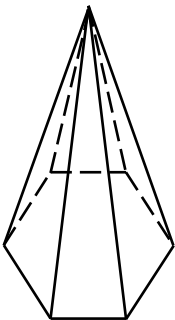
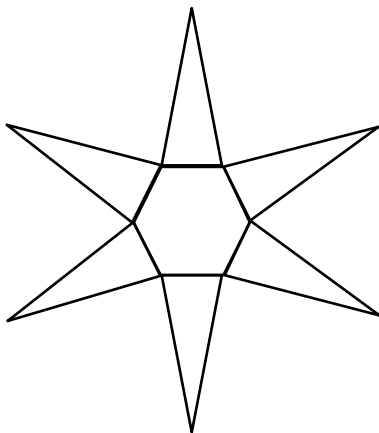
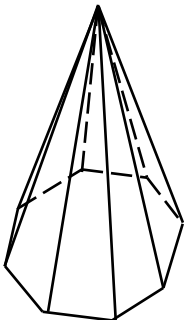
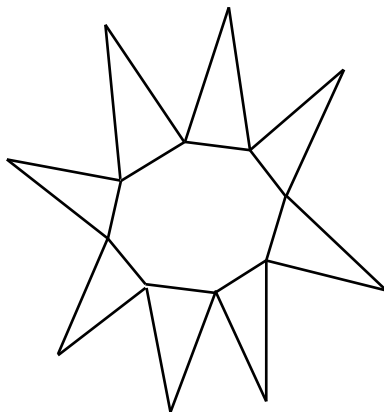
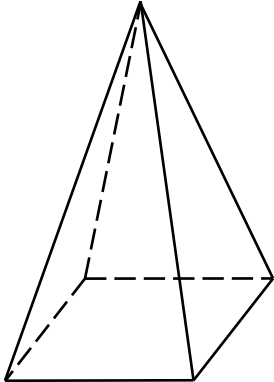
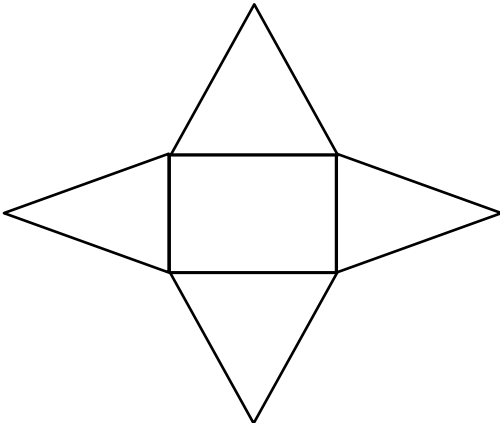


Rectangular pyramid

Study and complete the table below.

Pyramid	Properties	Net
 Triangular pyramid	4 faces 4 vertices 6 edges	
 Circular pyramid / cone	1 vertex 1 edge 2 faces	
 Square pyramid	_____ vertices _____ edges _____ faces	

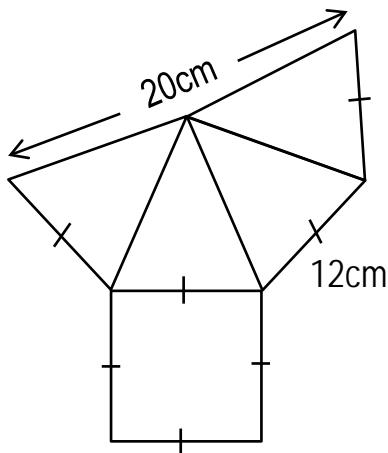


Pyramid	Properties	Net
 <p>Pentagonal pyramid</p>	<p>_____ vertices</p> <p>_____ edges</p> <p>_____ faces</p>	
 <p>Hexagonal pyramid</p>	<p>_____ vertices</p> <p>_____ edges</p> <p>_____ faces</p>	
 <p>Octagonal pyramid</p>	<p>_____ vertices</p> <p>_____ edges</p> <p>_____ faces</p>	
 <p>Rectangular pyramid</p>	<p>_____ vertices</p> <p>_____ edges</p> <p>_____ faces</p>	



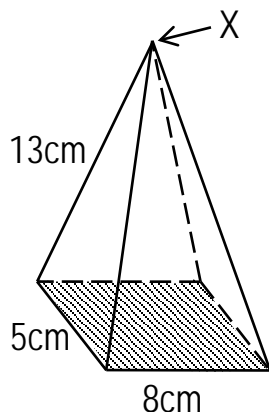
## Exercise

1. Below is a net of a pyramid. Use it to answer questions that follow.



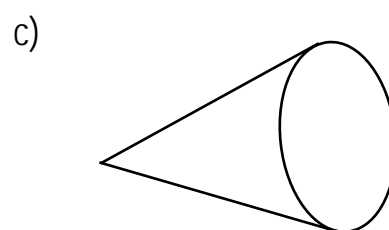
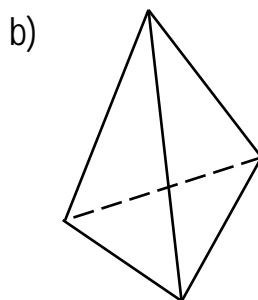
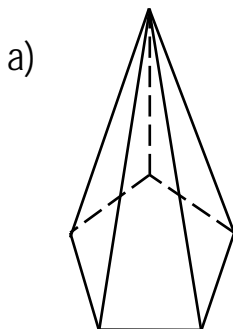
- Name the pyramid whose net is drawn above.
- State the number of edges, vertices and faces of pyramid named in (a) above.
  - edges
  - vertices
  - faces
- Find the area of the square face.
- Calculate the sum of the area of the triangular faces.

2. Study the figure below and use it to answer questions that follow.

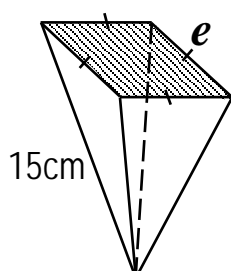


- Name the solid figure drawn above.
- Name part marked X.
- How many edges does the figure above has?
- Calculate the area of the shaded part.
- Find the sum of the length of all edges.

3. Draw nets of each of the following solid figures.



4. The sum of the length of edges of the pyramid below is 108 metres.



- Name the pyramid.
- Find the length of edge  $e$ .
- Calculate its base area.

## TOPIC 7: GEOMETRIC CONSTRUCTION



### Rotation /Revolution

#### **Note**

- One complete turn or revolution is equal to  $360^\circ$ . This is the same angle made by a minute hand of a clock to make 60 minutes.
- A half a turn or a straight angle is equal to  $180^\circ$
- A quarter a turn is equal to  $90^\circ$
- Three quarter a turn is equal to  $270^\circ$

#### **Example 1**

How many degrees are there in a quarter a turn?

$$1 \text{ complete turn} = 360^\circ$$

$$\frac{1}{4} \text{ of a turn} = \frac{1}{4} \times 360^\circ$$

$$= 90^\circ$$

#### **Example 2**

Find the number of degrees in  $\frac{3}{5}$  of a revolution.

$$1 \text{ revolution} = 360^\circ$$

$$\frac{3}{5} \text{ of a revolution} = \frac{3}{5} \times 360^\circ$$

$$= 216^\circ$$

#### **Example 3**

Through what angle does a minute hand of a clock turn in 20 minutes.

$$20 \text{ min} = \frac{20}{60}$$

$$= \frac{1}{3}$$

$$\frac{1}{3} \times 360^\circ = 120^\circ$$

#### **Example 4**

What turn is made in an angle of  $270^\circ$

$$360^\circ = 1 \text{ complete turn}$$

$$1^\circ = \frac{1}{360} \text{ turn}$$

$$270^\circ = \left(\frac{1}{360} \times 270^\circ\right) \text{ turn}$$

$$= \frac{3}{4} \text{ turn}$$

#### **Exercise**

1. How many degrees are there in:
 

a) $\frac{3}{4}$ turn	d) $\frac{2}{5}$ revolution	g) $\frac{5}{12}$ turn
b) $\frac{2}{3}$ turn	e) $\frac{1}{2}$ rotation	h) $\frac{3}{8}$ revaluation
c) $\frac{1}{6}$ turn	f) $\frac{4}{5}$ turn	i) $\frac{7}{20}$ turn
2. Through what angle does a soldier turn when he is given the order "right turn"?
3. Through what angle does a minute hand of a clock turn in
 

i) 12 minutes	iii) 45 minutes
ii) 15 minutes	iv) 24 minutes
4. How many degrees will one turn to make 3 revolutions?
5. Find the angle turned by a minute hand at 25 minutes past.

## TOPIC 7: GEOMETRIC CONSTRUCTION

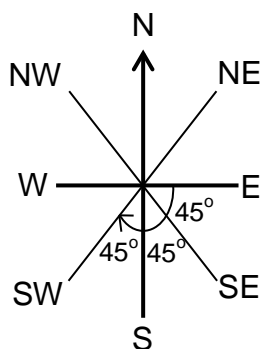


6. In 24 hours, the earth makes one complete turn about its axis. Through what angle does it turn about its axis in 18 hours?
7. A bicycle travelled 3 metres during one complete turn of each wheel. Through what angle does each wheel turn when the bicycle travels?
  - a) 3 metres      b) 1 metre      c)  $\frac{1}{2}$  metres      d) 12 metres
8. Find the fraction of a revolution representing these degrees.
  - a)  $270^\circ$       b)  $240^\circ$       c)  $90^\circ$       d)  $144^\circ$

### Angles on a compass

#### Example 1

What is the smaller angle between East and south west?

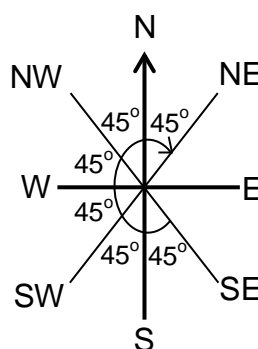


$$45^\circ + 45^\circ + 45^\circ = 135^\circ$$

*The smaller angle is  $135^\circ$*

#### Example 2

What is the larger angle between North East and South East?



$$45^\circ + 45^\circ + 45^\circ + 45^\circ + 45^\circ + 45^\circ = 270^\circ$$

*The larger angle is  $270^\circ$*

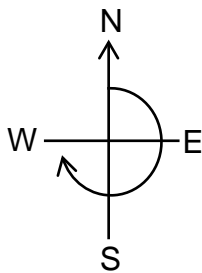
### Exercise

1. What is the smaller angle between;
  - a) North and NW
  - b) North and East
  - c) South and SE
  - d) SE and North
  - e) SW and East
  - f) NW and East
  - g) NW and SW
  - h) SW and SE
2. What is the larger angle between;
  - a) NE and SE
  - b) North and SE
  - c) North and west
  - b) South and SW
  - c) SE and West
3. What is the size of the angle between North and Southeast through West?

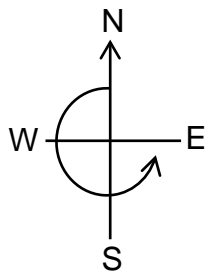


## Clockwise and anticlockwise turn

Study the figures below.



*Clockwise turn*



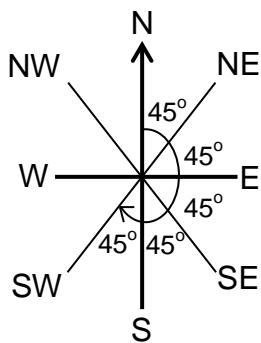
*Anti-clockwise turn*

*Opening a bottle of water*



### Example 1

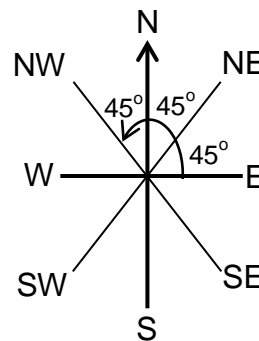
Obonyo was facing North. She turned clockwise to face Southwest. What angle did she make?



$$45^\circ + 45^\circ + 45^\circ + 45^\circ + 45^\circ = 225^\circ$$

### Example 2

Tokiya was facing west. He turned anti-clockwise through an angle of  $135^\circ$ . In which direction did he face?



*He faced in the Northwest*

## Exercise

- Hakim is facing North. What angle will be made if he turns clockwise to face Southeast?
- A boy is facing Southwest, what angle will be made if he turns anti-clockwise to face Northwest?
- What angle will I make, if I turned anti-clockwise from
  - Northeast to south.
  - South to Northwest.
  - Southeast to west.
  - North to Northeast.
  - East to Northwest.
  - North to Southwest.
- What angles will a girl make if she turned clockwise from
  - South to North
  - North to west
  - Northeast to South
  - West to North East
  - East to North west
  - North to south
- Ankunda was facing Northeast. She turned anti-clockwise through an angle of  $90^\circ$ . In which direction did she face?

## TOPIC 7: GEOMETRIC CONSTRUCTION



6. Aminah was facing North. She turned clockwise through an angle of  $225^\circ$ . In which direction did she face?
7. Medi is facing Northwest. In which direction will he face if he turned through;
  - a)  $135^\circ$  clockwise
  - b)  $90^\circ$  clockwise
  - c)  $225^\circ$  anti-clockwise
  - d)  $45^\circ$  anti-clockwise
  - e)  $315^\circ$  clockwise
  - f)  $270^\circ$  anti-clockwise

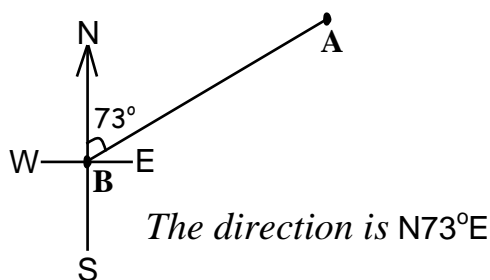
### Telling direction

#### **Note:**

The acute angle used when describing direction is measured either from North or South.

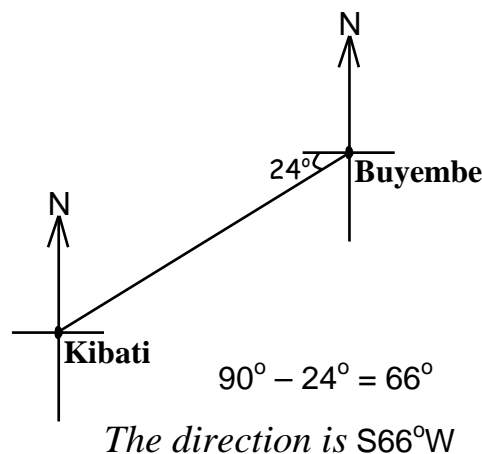
#### **Example 1**

What is the direction of A from B.



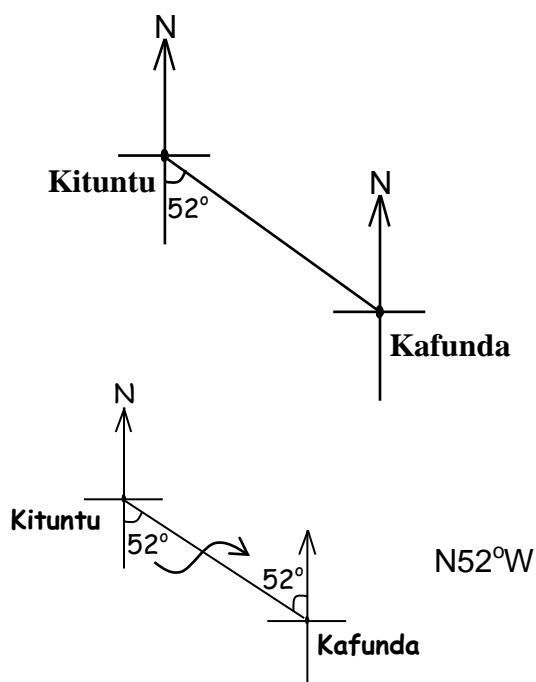
#### **Example 2**

Find the direction of Kibati from Buyembe



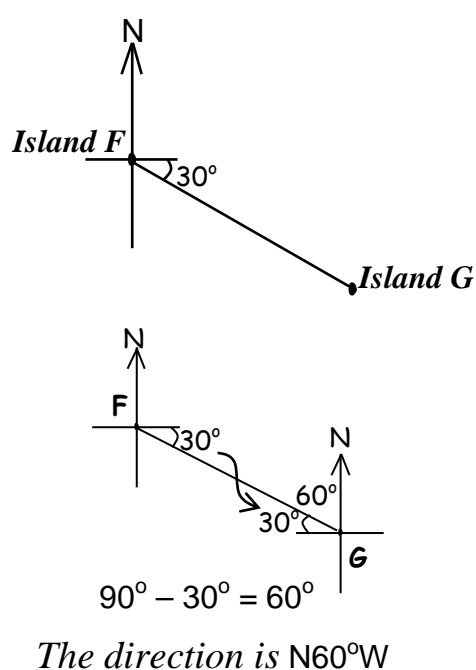
#### **Example 3**

State the direction of Kituntu from Kafunda.



#### **Example 4**

Find the direction of Island F from Island G.

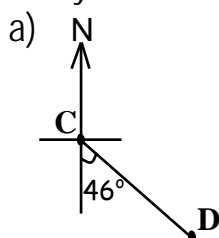


# TOPIC 7: GEOMETRIC CONSTRUCTION

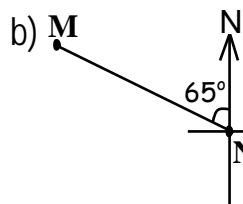


## Exercise

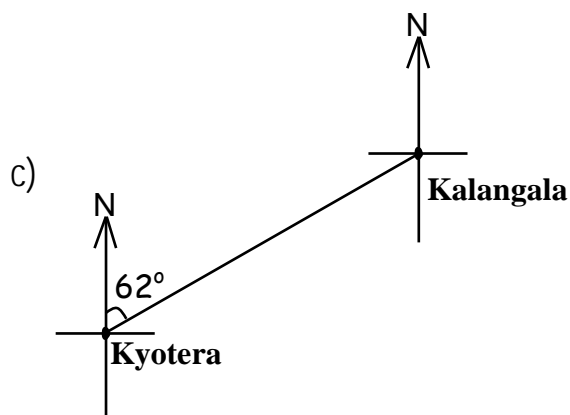
1. Study the drawing below.



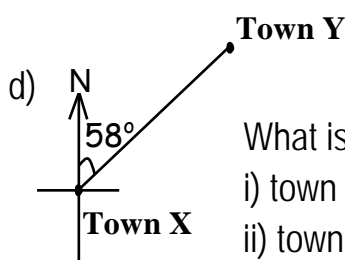
What is the direction of;  
i) D from C?  
ii) C from D?



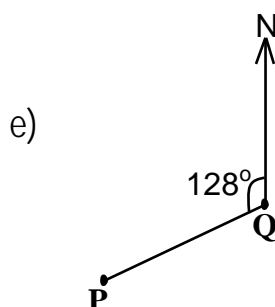
What is the direction of;  
i) M from N?  
ii) N from M?



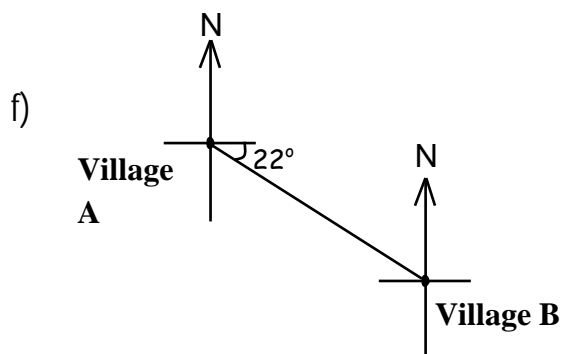
What is the direction of;  
i) Kalangala from Kyotera?  
ii) Kyotera from Kalangala?



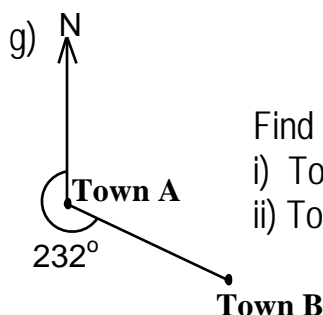
What is the direction of;  
i) town X from town Y?  
ii) town Y from town X?



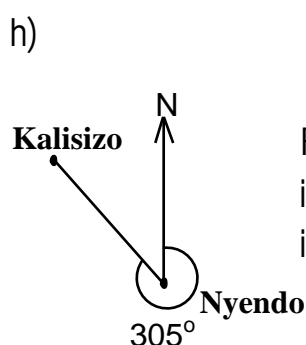
Find the direction of  
i) P from Q  
ii) Q from P



Find the direction of;  
i) Village A from village B  
ii) Village B from village A



Find the direction of;  
i) Town A from town B.  
ii) Town B from town A.

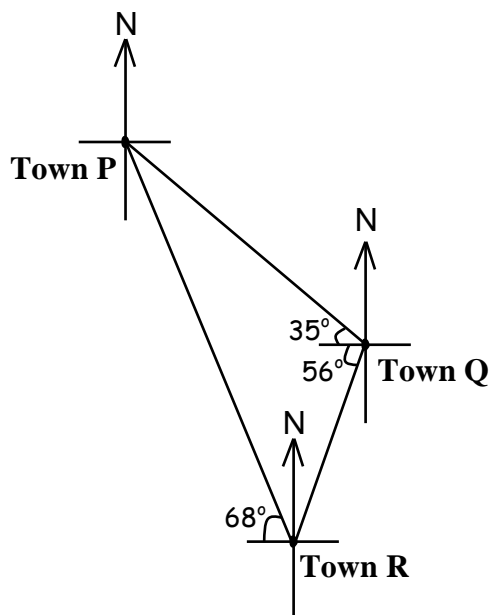


Find the direction of;  
i) Kalisizo from Nyendo  
ii) Nyendo from Kalisizo

## TOPIC 7: GEOMETRIC CONSTRUCTION



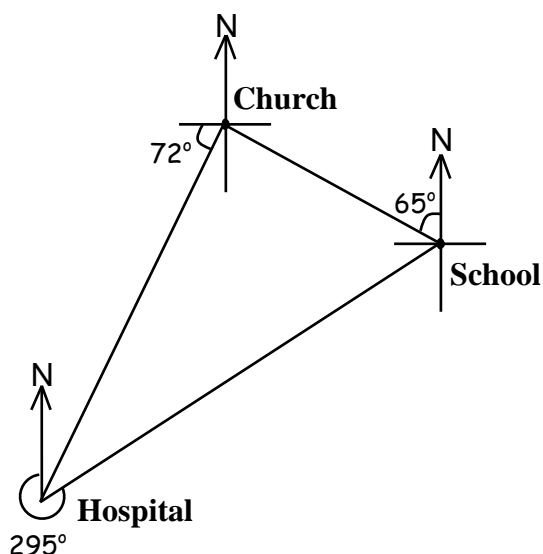
2. The drawing below shows the location of three towns.



Find the direction of

- Town P from town Q.
- Town R from town Q.
- Town P from town R.
- Town R from town P.
- Town Q from town R.
- Town Q from town P.

3. The drawing below shows the location of the church, school and hospital. Use it to answer the questions that follow.



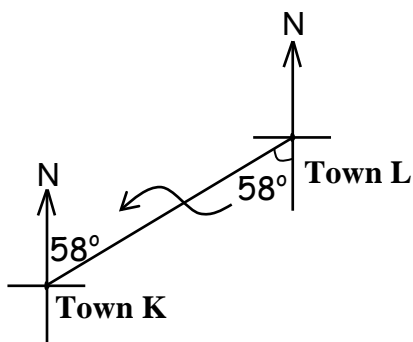
Find the direction of

- the school from the church.
- the church from the school.
- the hospital from the church.
- the church from the hospital.
- the school from the hospital.
- the hospital from the school.

### Opposite direction

#### Example

The direction of town K from town L is  $S58^\circ W$ . Find the direction of town L from town K.



*The direction of town L from town K is  $N58^\circ E$ .*

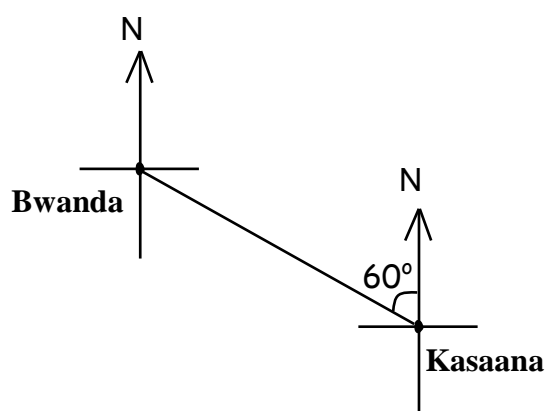
## TOPIC 7: GEOMETRIC CONSTRUCTION



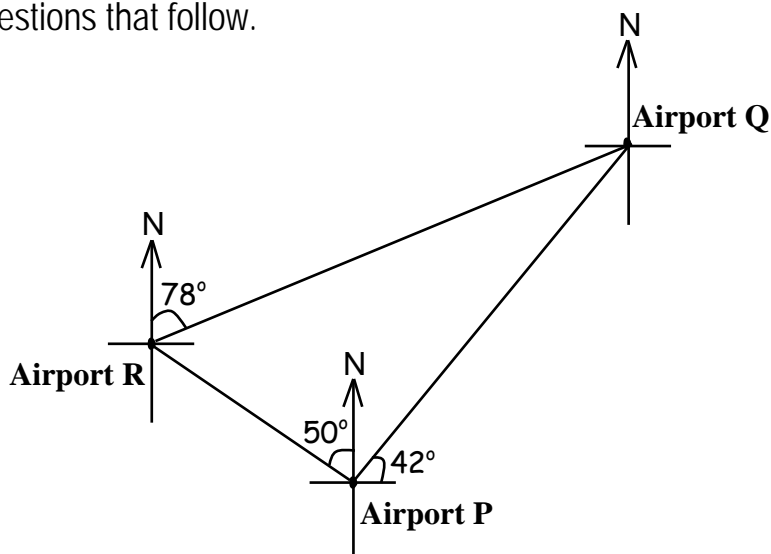
### Exercise

- Give the opposite direction for;
 

a) $S75^{\circ}E$	c) $N47^{\circ}W$	e) $S48^{\circ}W$
b) $N16^{\circ}E$	d) $S57^{\circ}E$	f) $N83^{\circ}W$
- The direction of the kitchen from the staffroom is  $S34^{\circ}W$ . State the direction of the staffroom from the kitchen.
- The direction of Gomba from Buddu is  $N55^{\circ}E$ . Find the direction of Buddu from Gomba.
- Use the figure below to state the direction of Kasaana from Bwanda.



- The direction of town C from town D is  $S14^{\circ}E$ . State the direction of town D from town C.
- The figure below shows the location of three Airports. Study it carefully and use it to answer questions that follow.



- Find the direction of Airport P from Airport R.
- Airport Q from Airport P.
- Airport R from Airport Q.



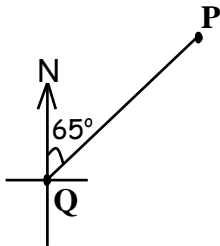
## BEARING

### Note:

- True bearing is measured from North in clockwise direction only.
- Bearing is written in three digits i.e.  $000^\circ$ ,  $025^\circ$ ,  $120^\circ$ ,  $076^\circ$ , etc.
- The bearing of North is  $000^\circ$  or  $360^\circ$ .

### Example 1

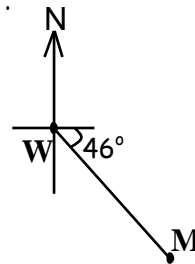
Find the bearing of town P from town Q.



The bearing of town P from town Q is  $060^\circ$

### Example 2

State the bearing of Island M from Island W.

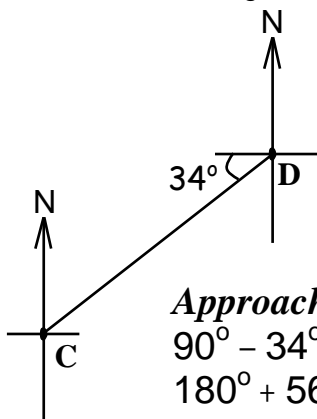


$$90^\circ + 46^\circ = 136^\circ$$

The bearing of Island M from Island W is  $136^\circ$

### Example 3

Find the bearing of C from D.



#### Approach 1

$$90^\circ - 34^\circ = 56^\circ$$

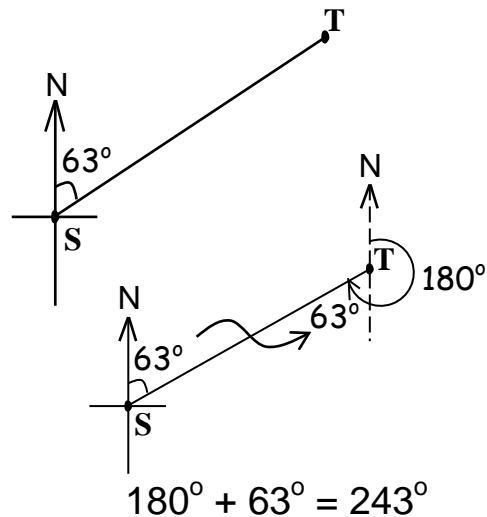
$$180^\circ + 56^\circ = 236^\circ$$

#### Approach 2

$$270^\circ - 34^\circ = 236^\circ$$

### Example 4

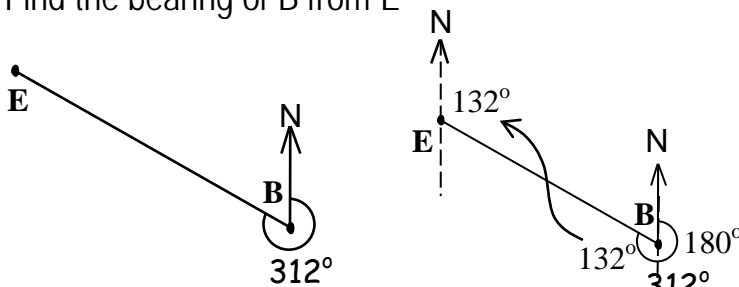
Find the bearing of S from T.



$$180^\circ + 63^\circ = 243^\circ$$

### Example 5

Find the bearing of B from E.



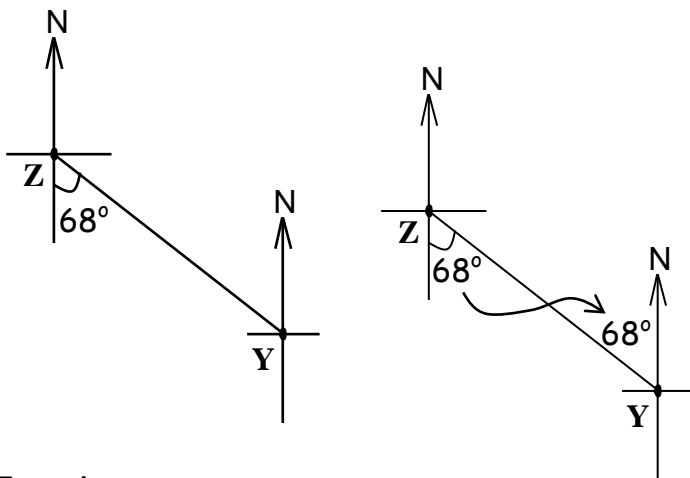
$$312^\circ - 180^\circ = 132^\circ$$

The bearing of B from E is  $132^\circ$



## Example 6

Find the bearing of Z from Y

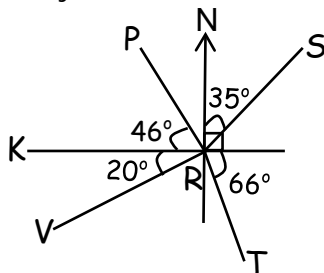


$$360^\circ - 68^\circ = 292^\circ$$

The bearing of Z from Y is  $292^\circ$

## Exercise

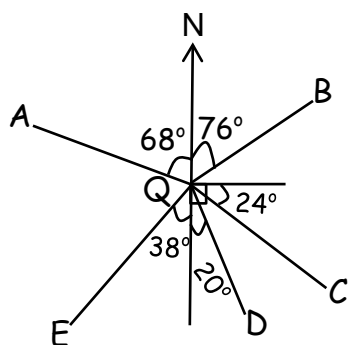
1. Study the below.



Find the bearing of

- S from R
- T from R
- P from R
- V from R
- K from R
- R from T

2. Study the drawing below.

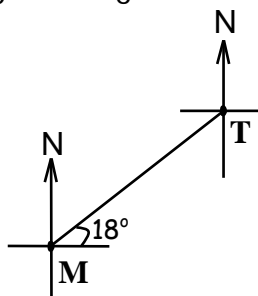


Find the bearing of

- B from Q
- C from Q
- E from Q
- A from Q
- D from Q
- Q from B
- Q and A
- Q from E
- Q from C
- Q from D

3. Study the diagrams below.

a)



Find the bearing of T from M.

b)



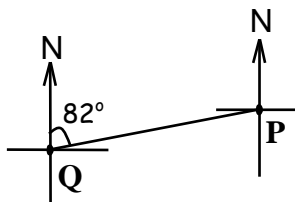
Find the bearing of P from Q.

# TOPIC 7: GEOMETRIC CONSTRUCTION

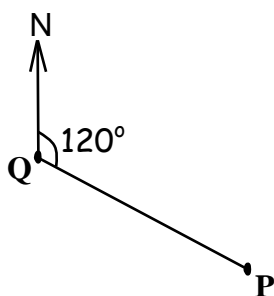


4. In the figures below, find the bearing of P from Q.

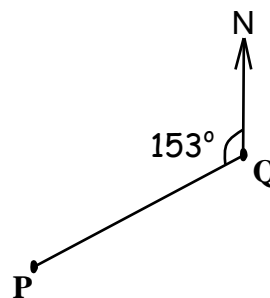
a)



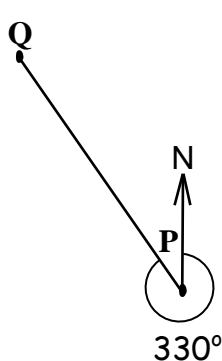
b)



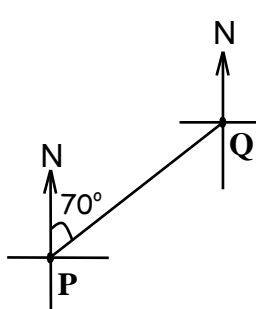
c)



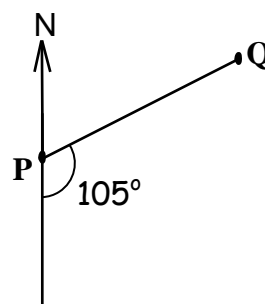
d)



e)

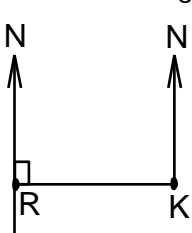


f)

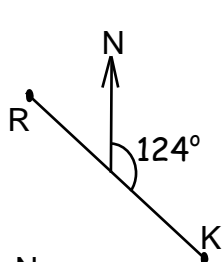


5. Find the bearing of R from K.

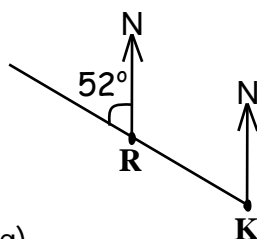
a)



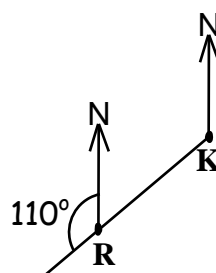
b)



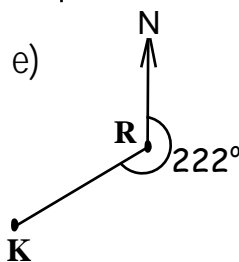
c)



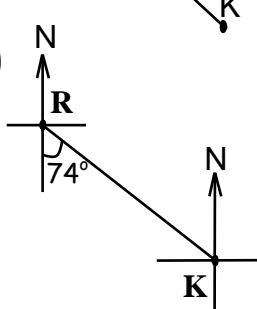
d)



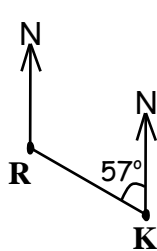
e)



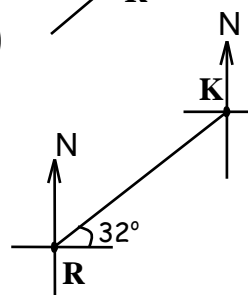
f)



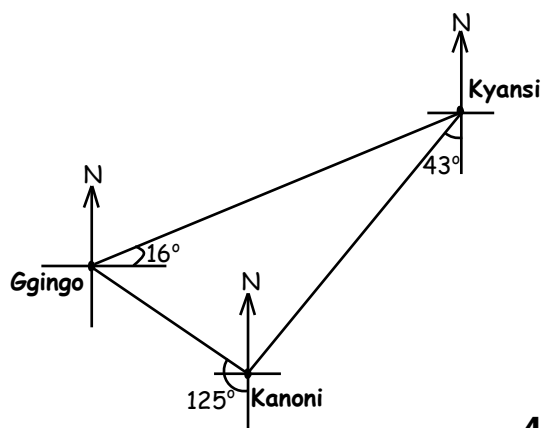
g)



h)



6. The figure below shows the location of three places. Find the bearing of;



- Kyansi from Kanoni.
- Kyansi from Ggingo.
- Ggingo from Kanoni.
- Kanoni from Kyansi.
- Ggingo from Kyansi.
- Kanoni from Ggingo.

## TOPIC 7: GEOMETRIC CONSTRUCTION



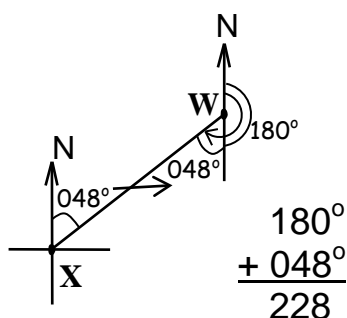
### Opposite bearing

#### Note:

- When the given bearing is less than  $180^\circ$ , add  $180^\circ$  to the given angle to get its opposite bearing.
- If the given bearing is greater than  $180^\circ$ , subtract  $180^\circ$  from it to get its opposite bearing.

#### Example 1

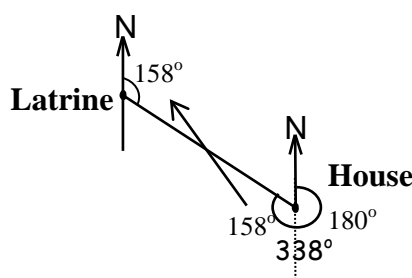
The bearing of town W from town X is  $048^\circ$ . Find the bearing of *Town X* from *Town W*.



The bearing of town X from town W is  $228^\circ$

#### Example 2

The bearing of the latrine from the house is  $338^\circ$ . Find the bearing of the house from the latrine.



$$338^\circ - 180^\circ = 158^\circ$$

The bearing is  $158^\circ$

#### Exercise.

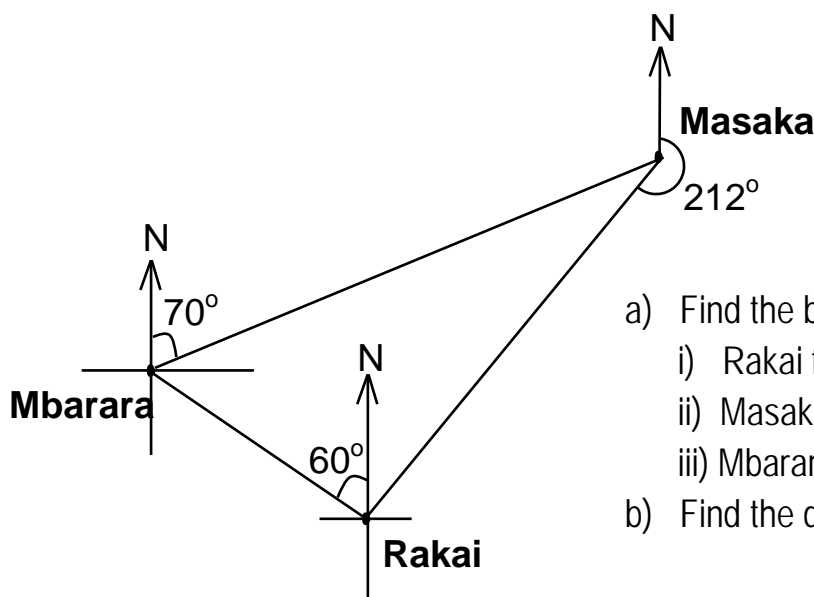
- The bearing of X from Y is  $042^\circ$ . Find the bearing of Y from X.
- The bearing of town P from town Q is  $173^\circ$ . Find the bearing of town Q from town P.
- The bearing of island M from island N is  $068^\circ$ . Find the bearing of Island N from Island M.
- The bearing of A from B is  $235^\circ$ . Find the bearing of B from A.
- The bearing of Kikajo from Seguku is  $349^\circ$ . Find the bearing of Seguku from Kikajo.
- Find the opposite bearing:
 

a) $049^\circ$	d) $091^\circ$	g) $215^\circ$	j) $197^\circ$
b) $072^\circ$	e) $105^\circ$	h) $344^\circ$	k) $358^\circ$
c) $060^\circ$	f) $157^\circ$	i) $186^\circ$	l) $300^\circ$
- The bearing of L. Victoria from L. Albert is  $126^\circ$ . Find the bearing of L. Albert from L. Victoria.
- Kedo is on a bearing of  $188^\circ$  from Fene. Find the bearing of Fene from Kedo.
- Two pupils; Kalori and Katongole stood a distance apart such that Kalori was on bearing of  $279^\circ$  from Katongole. Find the bearing of Katongole from Kalori
- Town X is East of town Y. Find the bearing of town Y from town X.
- My home is  $S45^\circ E$  of the church. Find the bearing of the church from my home.
- The direction of Somalia from Uganda is  $N68^\circ E$ . Find the bearing of Uganda from Somalia.

## TOPIC 7: GEOMETRIC CONSTRUCTION



11. Town P is North of town Q. Find the bearing of town Q from town P.  
 12. The diagram below shows the location of three districts in Uganda .

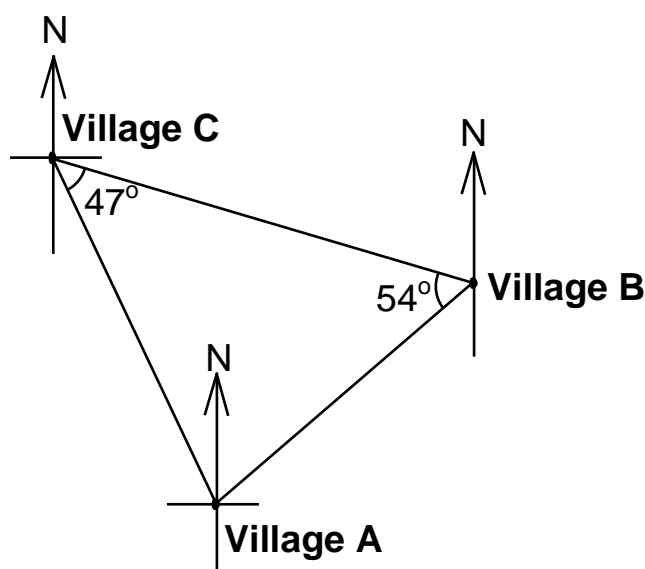


- a) Find the bearing of  
 i) Rakai from Mbarara.  
 ii) Masaka from Rakai.  
 iii) Mbarara from Rakai.  
 b) Find the direction of Rakai from Masaka.

13. Copy and complete the table below.

Direction	Opposite direction	Bearing	Opposite bearing
S40°W			
N55°W			
N48°E			
S60°E			

14. The direction of Moroto from Mpigi is N58°E. Find the true bearing of Mpigi from Moroto.  
 15. The diagram below shows the location of three villages; A, B and C. **Village A** is on a bearing of 164° from **Village C**. Use the diagram to answer questions that follow.



- a) Find the bearing of;  
 i) village B from village A.  
 ii) village A from village B.  
 iii) village B from village C.  
 iv) village C from village B.  
 v) village C from village A.  
 b) In which direction is village C from village A?



## SCALE

### Example 1

The distance between two towns is 90km, this distance is represented by 5cm on a map. Find the scale.

5cm represent 90km  
 1cm represents  $\frac{90\text{km}}{5}$   
 1cm represents 18km

### Example 2

Using a scale of 1cm to represent 10km, find the actual length of the following.

a) 5cm                      b) 3.5cm

5 x 10km                  3.5 x 10km  
 50km                       $\frac{35}{10} \times 10\text{km} = 35\text{km}$

### Example 3

Given that 1cm represents 20km. Find the distance on the map that represents the given actual distance.

a) 120km	b) 70km	c) 150km
1cm represents 20km	1cm represents 20km	1cm represents 20km
$(120 \div 20)\text{cm} = 6\text{cm}$	$(70 \div 20)\text{cm} = 3.5\text{cm}$	$(150 \div 20)\text{cm} = 7.5\text{cm}$
6cm represent 120km	3.5cm represent 70km	7.5cm represent 150km

## Exercise

- The actual distance between two islands is 200km. It is represented by 4cm on a map. Find the scale.
- A distance of 75 kilometres is represented by 5cm on a map. Find the scale.
- A square plot of land of side 160m was represented on a map by a square whose perimeter is 32cm. What scale was used.
- Find the actual ground distance represented by the following length on the map given that 1cm represents 10km.
 

a) 8cm	d) 4cm	g) 2.5cm
b) 12cm	e) 117cm	h) 8.75cm
c) 13cm	f) 708cm	i) 14.25 cm
- Calculate the distance on the map that represents the given actual distance if 1cm represents 10km.
 

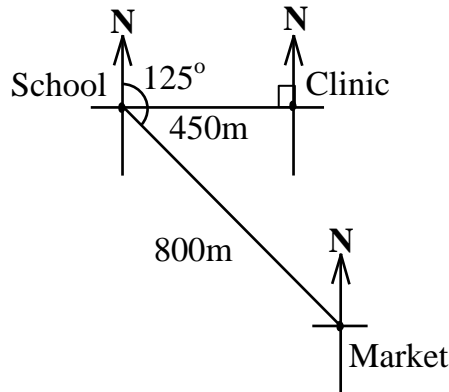
a) 80km	d) 1020km	g) 17km
b) 100km	e) 115km	h) 25.5km
c) 150km	f) 248km	i) 124.25km.
- The distance between town T and town S is 255 kilometres from Entebbe to Mutukula. Find the map distance if 1cm represents 34 kilometres.
- On a map, 1cm represents 170 metres. Two towns are 1020 metres apart. How far apart are the two towns on the map?



## SCALE DRAWING

### Example 1

The diagram below shows the location of three places in Buikwe town. Use it to answer questions that follow.



- a) Using a scale of 1cm to represent 100metres, draw an accurate diagram showing the three places.

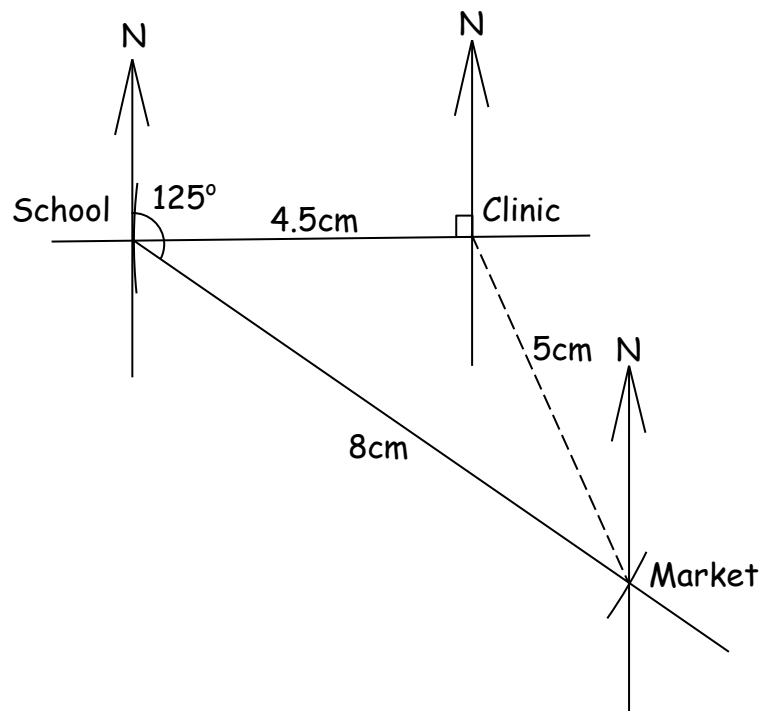
Drawing distance

Clinic to School

$$\left(\frac{450}{100}\right)\text{cm} = 4.5\text{cm}$$

School to Market

$$\left(\frac{800}{100}\right)\text{cm} = 8\text{cm}$$



- b) Find the shortest distance between the market and the clinic.

$$5 \times 100\text{m} = 500\text{m}$$

*The shortest distance between the market and the clinic is 500 meters*

- c) Find the bearing of the market from the clinic.

*The bearing of the market from the clinic is  $156^\circ$*

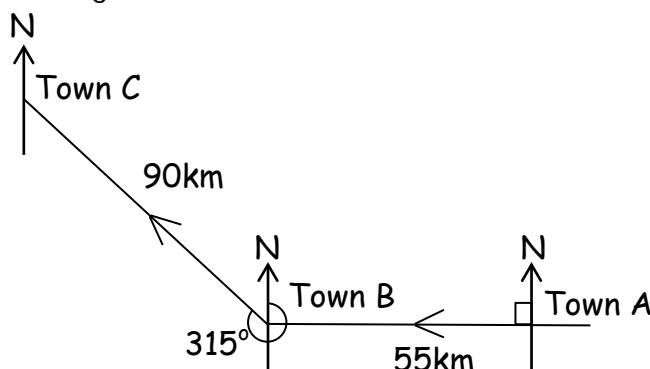
## TOPIC 7: GEOMETRIC CONSTRUCTION



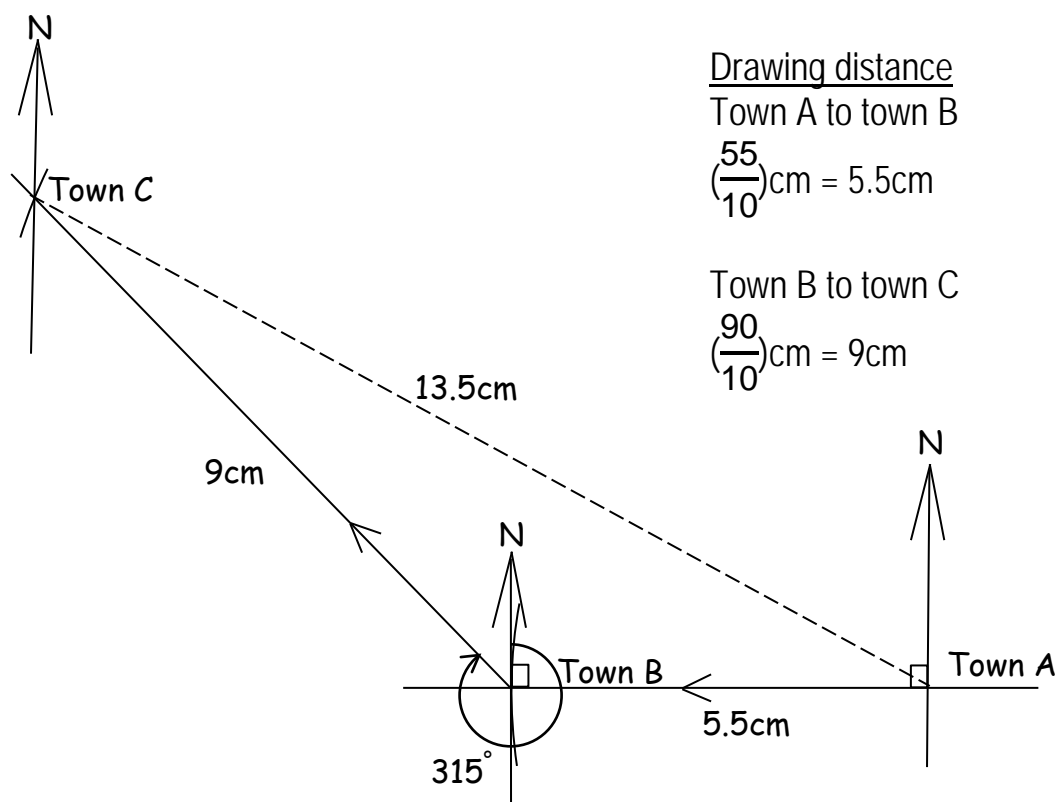
### Example 2

A tourist left town A and travelled 55 kilometres westwards to town B. He then turned on a bearing of  $315^\circ$  from town B and travelled to town C which is a distance of 90 kilometres.

- a) Draw a sketch diagram to show the tourist's movement.



- b) Using a scale of 1 centimetre to represent 10 kilometres, draw an accurate diagram to show the tourist's journey.



- c) Find in kilometres, the shortest distance between town C and town A.

$$\left(\frac{135}{10} \times 10\right)\text{km} = 135\text{km}$$

- d) On which bearing is town C from town A?

$$180^\circ + 118^\circ = 298^\circ$$

## TOPIC 7: GEOMETRIC CONSTRUCTION

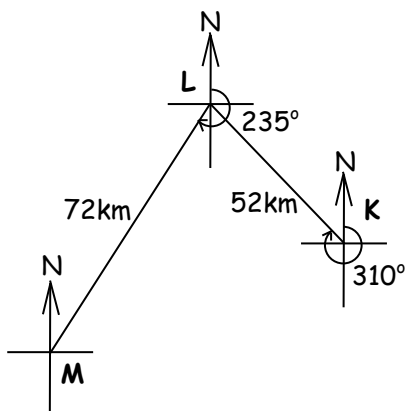


### Example 3

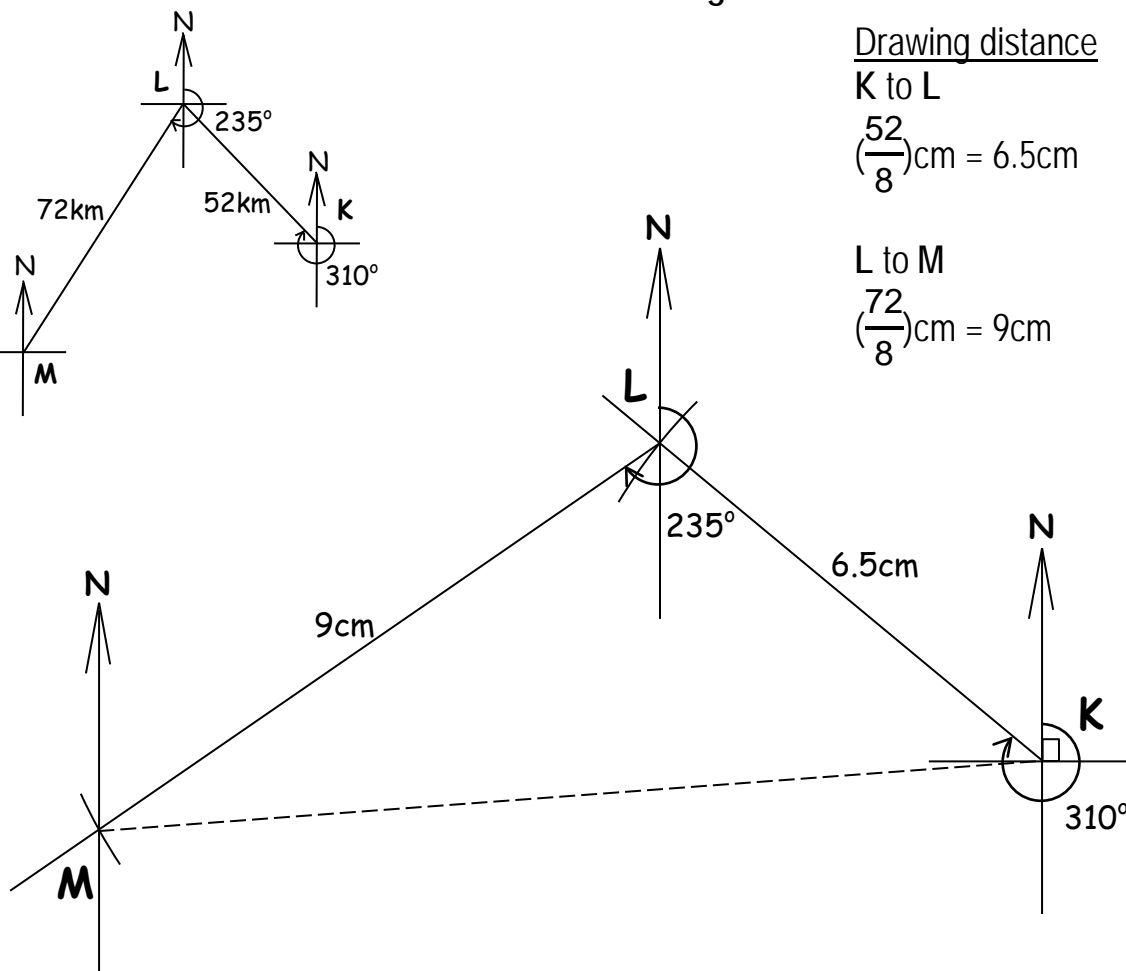
A boat sailed from **Port K** on a bearing of  $310^\circ$  a distance of 52 kilometres to **Port L**. It then left **Port L** and sailed on a bearing of  $235^\circ$  to **Port M** for 72 kilometres.

- a) Using a scale 1 centimetre to represent 8 kilometres, draw an accurate diagram to show the route of the boat.

Sketch



Accurate diagram



- b) Find the bearing of Port M from Port K.

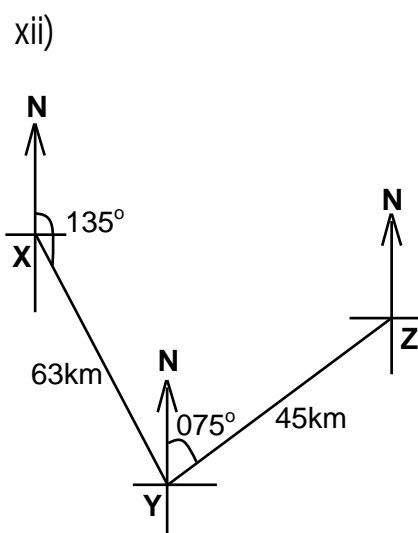
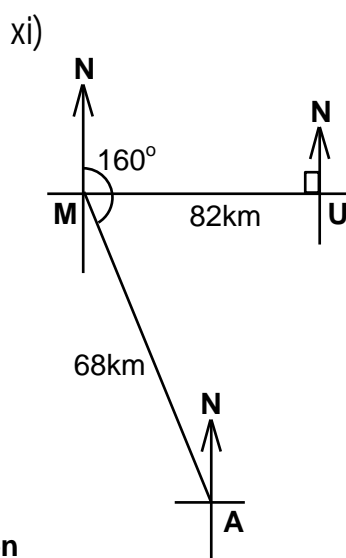
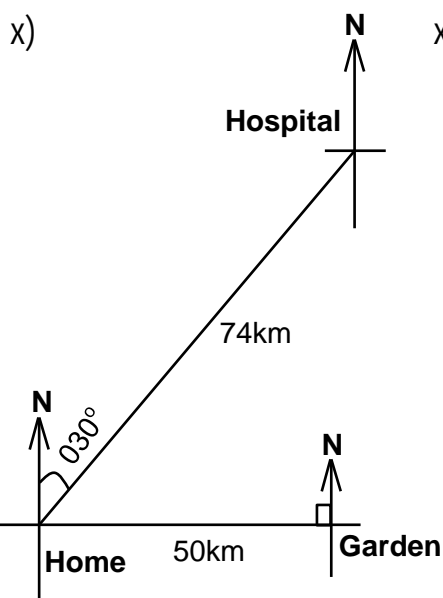
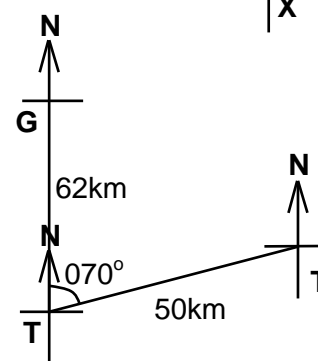
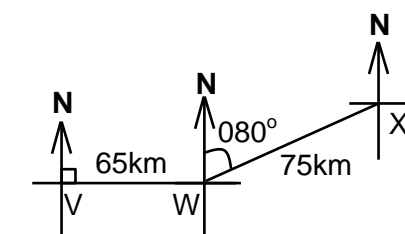
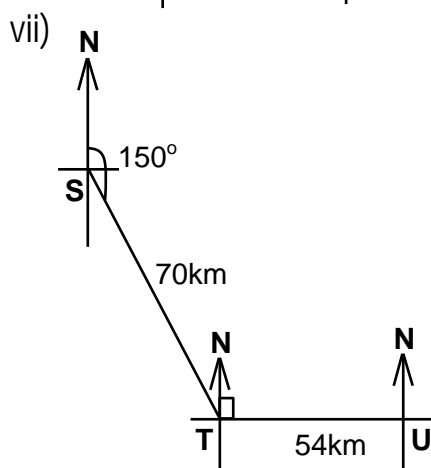
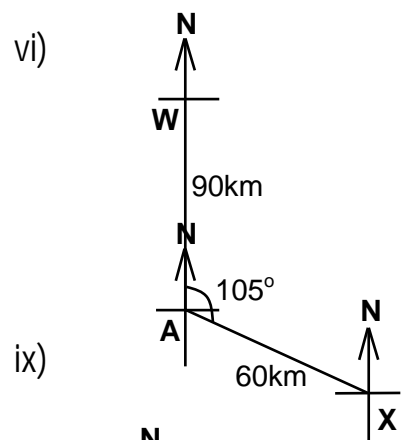
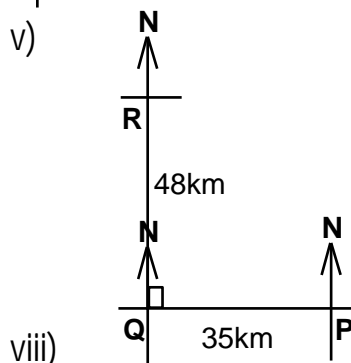
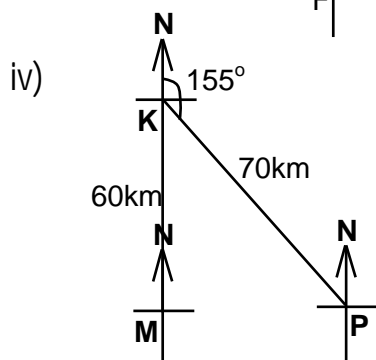
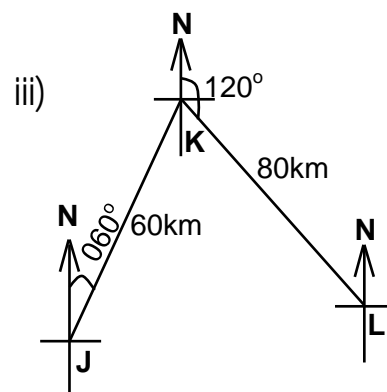
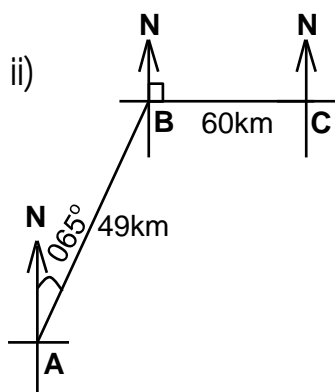
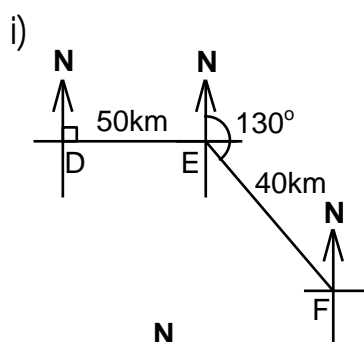
$$180^\circ + 86^\circ = 266^\circ$$

- c) Find the shortest distance between Port M and Port K.

$$\left(\frac{125}{10} \times 8\right)\text{km} = 100\text{km}$$



1. Use 1 centimetre to represent 10 kilometres, draw an accurate diagram for each of the following:



## TOPIC 7: GEOMETRIC CONSTRUCTION



2. Amos moved from point A for 160 metres eastward to point B. He then turned northward and moved 200 metres to point C. Finally, he turned westward and moved 80 metres to point D.
  - a) Using a scale drawing of 1 cm to represent 20 metres, draw an accurate diagram to show the man's movements.
  - b) Measure the distance between A and D.
  - c) What is the size of angle BAD?
3. Timothy left village X and drove westward to village Y, a distance of 30km. He then drove southwards from village Y to village Z, a distance of 24km and returned directly from Z to X.
  - a) Using a scale of 1 cm to represent 6 km, draw an accurate diagram to show Timothy's journey.
  - b) Find the shortest distance from X to Z in Kilometres (km).
4. The bearing of town B from town A is  $120^\circ$  and town B is 4 km from A. The bearing of town C from B is  $60^\circ$  and town C is 5km from B.
  - a) Draw an accurate diagram showing the three towns. (Use scale: 1 cm = 1 km).
  - b) Find the shortest distance between A and C in kilometres.
5. A tourist left town A and travelled 55 km westwards to town B. He then turned on a bearing of  $215^\circ$  and travelled to town C which is a distance of 65 km.
  - a) Draw a sketch diagram to show the tourist's journey.
  - b) Using a scale of 1cm to represent 10km, draw an accurate diagram to show the tourist's journey.
  - c) Find the shortest distance from town C to A in km.
6. A school library is 70 metres east of the main hall. The staff room is 60 metres from the library on a bearing of  $240^\circ$ .
  - a) Using a scale of 1 centimetre to represent 10 metres, show the three places on an accurate diagram.
  - b) Find the shortest distance between the main hall and the staff room.
7. Town Q is 72km away from town P on a bearing of  $250^\circ$  and town C is 45km away from town Q on a bearing of  $320^\circ$ .
  - a) Using a scale of 1 cm to represent 9km, draw an accurate diagram to show the 3 towns.
  - b) Find the bearing of town C from town P.
8. Village B is 60km away from village A on a bearing of  $320^\circ$ . Village C is 84km from B on a bearing of  $250^\circ$ . Using a scale of 1cm to represent 12km, draw an accurate diagram to show the location of the three villages.
9. A rectangular piece of land measures 60 metres by 40 metres. Using a scale of 1 centimetre to represent 10 metres, make a scale drawing of the plot. Hence find the length of the diagonal.

## TOPIC 7: GEOMETRIC CONSTRUCTION



10. Fly Emirates plane left Entebbe airport on a bearing of  $270^\circ$  for Morocco a distance of 600km. It then left Morocco for Accra on a bearing of  $240^\circ$  a distance of 500km.
  - a) Using a scale of 1cm to represent 100km, draw an accurate diagram to show the flight of the plane.
  - b) Find the shortest distance between Entebbe and Accra in km.
11. Town A is 30km west of town B and town C is 40km from B on a bearing of  $150^\circ$ . Using a scale of 1cm = 10km.
  - a) Draw a sketch to show the above information.
  - b) Draw an accurate diagram showing the three places.  
(Using a scale 1 cm to represent 20 km)
  - c) Find the shortest distance between A and C in km.
12. Town P is 50km west of town Q and town R is 40km from town Q on a bearing of  $150^\circ$ .
  - a) Using the scale of 1 cm = 10km, draw a rough sketch showing the three towns.
  - b) Draw an accurate diagram showing the three places.
13. Towns P and Q are 120km apart and town Q is on a bearing of  $120^\circ$  from P.
  - a) Draw a sketch diagram to show the above information.
  - b) Construct an accurate diagram to show the towns.
  - c) From your diagram, find the bearing of P from Q.
14. Town R is 40km west of town K and town M is 60km from K on a bearing of  $225^\circ$ .
  - a) Using the scale of 1cm = 10km, draw a rough sketch to show the above information.
  - b) Construct an accurate diagram showing the three places.
  - c) Find the shortest distance in km.
15. Town P is 40km on a bearing of  $120^\circ$  from town X and town R is 50km on a bearing of  $270^\circ$  from town P.
  - a) Using the scale of 1cm = 10km, draw a sketch to show the three towns.
  - b) Construct an accurate diagram showing the three places.
16. A tourist left town A and travelled 55km westwards to town B. He then turned on a bearing of  $215^\circ$  from town B and travelled to town C which is a distance of 65km.
  - a) Draw a sketch diagram to show the tourist's journey.
  - b) Using a scale of 1cm to represent 10km, draw an accurate diagram to show the tourist's journey,
  - c) Find the shortest distance from town C to A in km.
17. Town M is 60km in the North East of town N. Town L is 40km on a bearing of  $120^\circ$  from town N.
  - a) Draw a rough sketch for the above, taking a scale of 1cm:10km.
  - b) Draw an accurate diagram to show the three towns.

## TOPIC 7: GEOMETRIC CONSTRUCTION



18. Town C is on a bearing of  $150^\circ$  from town A which is 40km away and town C is 50km from town B on a bearing of  $070^\circ$ . Using a scale of  $1\text{cm} = 10\text{km}$ , draw a sketch then an accurate diagram. What is the shortest distance between A and B in km?
19. The bearing of Kasalu from Kitovu is  $285^\circ$ . The two towns are 400km apart. Lambu is 140km from Kitovu on a bearing of  $025^\circ$ .
- Using a scale of 1cm to represent 40km, draw an accurate diagram to show the location of the three towns.
  - Find the shortest distance between Kasalu and Lambu.
  - What is the bearing of Kasalu from Lambu?
20. A ship leaves a port and sets sail on a bearing of  $060^\circ$ . After 40km, it alters its course to a bearing of  $325^\circ$  and continues in this direction for 50km. Use a scale of  $1\text{cm} = 6.25\text{km}$ .
- Draw an accurate diagram to show the ship's movement.
  - Find
    - the distance of the ship from the port.
    - its bearing from the port.
21. There is a road running for 2500m from Zakayo's home on a bearing of  $000^\circ$ . The road then goes 3000m on a bearing of  $305^\circ$  and it ends at a market.
- Use a scale  $1\text{cm} : 500\text{metres}$ , draw an accurate diagram.
  - How far is the market from Zakayo's home?
22. A squad of scouts is  $2\frac{1}{2}\text{ km}$  from a school on a bearing of  $027^\circ$ . Another squad is  $3\frac{1}{2}\text{ km}$  from the same school on a bearing of  $304^\circ$ . Use a scale  $1\text{cm} : 0.5\text{km}$  to draw an accurate diagram, then find the distance between the two squads.
23. A helicopter flew from town A to town B 360km away on a bearing of  $240^\circ$ . It then flew to town C 450 km away on a bearing of  $300^\circ$ .
- Draw a sketch to show the helicopter's flight.
  - Using a scale of 1cm to represent 60km, draw an accurate diagram to show the helicopter's flight.
  - What is the bearing of town A from town C?
24. A ship sailed from port A 350km on a bearing of  $120^\circ$  to port B. It changed direction and sailed 420 m to port C on a bearing of  $215^\circ$ .
- Draw a sketch map showing the above information.
  - Using a scale, 1cm to represent 70km, draw an accurate figure showing the three places.
  - Find the shortest distance between ports A and C.

## TOPIC 7: GEOMETRIC CONSTRUCTION



25. A boy walks 6km from point P to point Q on a bearing of  $065^\circ$ . He then walks from point Q to point R a distance of 10km on a bearing of  $120^\circ$ .
- Draw a sketch showing the above information.
  - Using a scale, 1cm to represent 2km, draw an accurate diagram showing the boy's movement.
  - What is the bearing of point P from point R?
26. A ship sails 70km due east from point P to point A. It then sails 30km due south from point A.
- Draw a sketch for the given information.
  - Use a scale 1cm : 10km, draw an accurate diagram to show the location of the three places.
27. A Uganda Air Force pilot flew from Entebbe Air Base for a distance of 60km on a bearing of  $204^\circ$ , then flew 102km on a bearing of  $345^\circ$  to Kyankwanzi.
- Using a scale of 1cm to represent 12km, draw an accurate diagram to show the location of Kyankwanzi.
  - Find the bearing of Kyankwanzi from Entebbe Air Base.
28. Kenneth's father has hidden Kenneth's birthday present in a field near their house. He has given him instructions to help him find it.



*From the post, walk 40 metres West  
and then 70 metres Southeast*

Kenneth has decided to draw an accurate map to help using a scale of 1cm : 10m.

- Draw his route.
  - How far is his house from field?
29. An animal passed by a hunter's home. He chased it Southwards for 300 metres to the church. It then ran for 450 metres on a bearing of  $335^\circ$  from the church to the main road where it was knocked by a speeding car.
- Using a scale (1cm : 50m), draw an accurate diagram.
  - How far is the hunter's home from the main road?
30. Hill A and Hill B are 70km apart. The direction of Hill B from Hill A is  $S35^\circ E$ . Hill C is 95km East of Hill B.
- Draw an accurate diagram (1cm : 10km).
  - Find the bearing of Hill A from Hill C.