Grade 7 – Book C

(Teachers Guidelines)

(Revised CAPS edition)

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Chapter C2

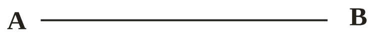
Geometry of 2-D shapes

C2.1 Lines and angles:

C2.1.1 Classification of lines:

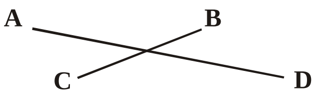
(1) Line: A set of points with no definite starting point or end point.

(2) Line segment: A set of points with a definite starting point and end point.

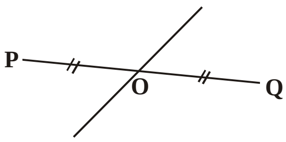


(3) Ray: A set of points with a definite starting point but no definite end point.

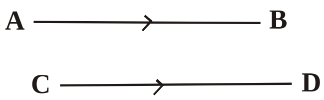
(4) Intersecting lines: Two lines intersecting each other.
∴ AD intersects BC.



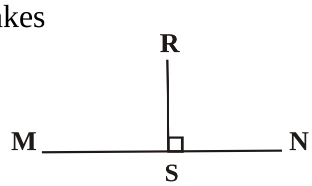
(5) Bisecting lines: One line intersects another line precisely in the middle.
∴ PO = OQ.



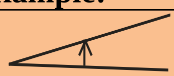
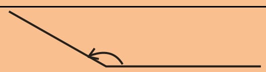
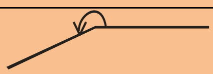
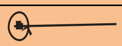
(6) Parallel lines: Two or more lines that are always the same distance from each other. The lines will therefore never cross. ∴ AB // CD.



(7) Perpendicular lines: A line that is perpendicular to another line if it makes an angle of 90° with the line. ∴ RS ⊥ MN.



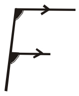
C2.1.2 Angles:

Type of angle:	Example:	Angle size:
Acute angle		Larger than 0° but smaller than 90°.
Right angle		Equal to 90°.
Obtuse angle		Larger than 90° but smaller than 180°.
Straight angle		Equal to 180°.
Reflex angle		Larger than 180° but smaller than 360°.
Revolution		Equal to 360°.

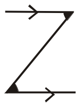
C2.1.3 Parallel lines:

If two lines are parallel to each other, the following will be valid:

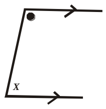
(1) Corresponding angles:
E.g. a = e ; b = f ;
c = g and d = h.

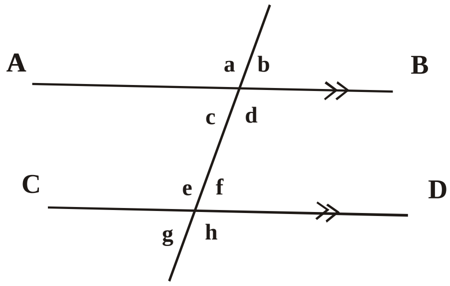


(2) Alternate angles:
E.g. e = d ; c = f ;
a = h and b = g.



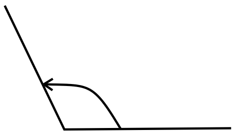
(3) Co-interior angles:
E.g. c + e = 180° and
d + f = 180°



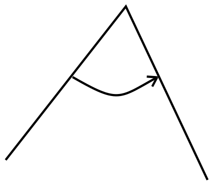


Exercise 1: Date: ____________________________

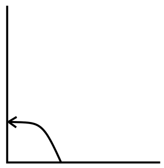
(1) Classify each of the following angles without measuring them:

(a) 

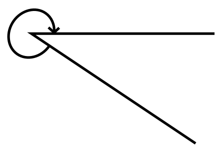
Obtuse angle

(b) 

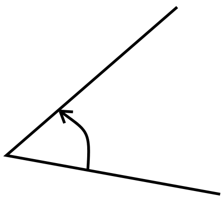
Acute angle

(c) 

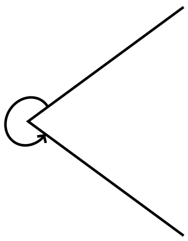
Right angle

(d) 

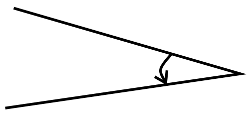
Reflex angle

(e) 

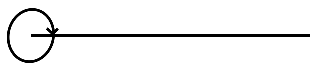
Acute angle

(f) 

Reflex angle

(g) 

Acute angle

(h) 

Revolution

(2) Classify the following pairs of angles as corresponding, alternate or co-interior angles:

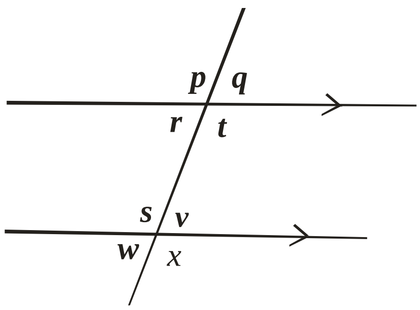
(a) p and s: **Corresponding angles**

(b) s and r: **Co-interior angles**

(c) v and r: **Alternate angles**

(d) t and x: **Corresponding angles**

(e) q and v: **Corresponding angles**



(3) Classify each of the following angles:

(a) $56°$ Acute angle

(b) $234°$ Reflex angle

(c) $180°$ Straight angle

(d) $148°$ Obtuse angle

(e) $200°$ Reflex angle

(f) $89°$ Acute angle

(g) $360°$ Revolution

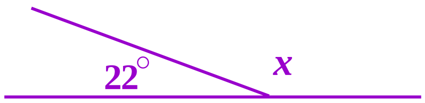
(h) $4°$ Acute angle

(i) $111°$ Obtuse angle

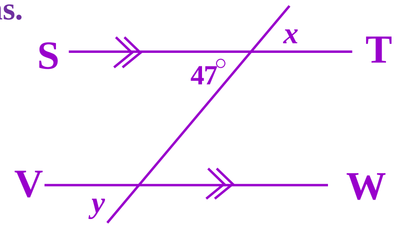
C2.1.4 Applications:

E.g.1 Calculate the value(s) of x and/or y. Provide reasons.

(a)



(b)



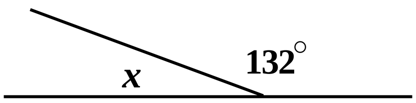
Statement:	Reason:
$x = 180° - 22°$	Adj $\angle^s$ on str line
$\therefore x = 158°$	

Statement:	Reason:
$x = 47°$	Vertically opposite $\angle^s$
$y = 47°$	Corresponding $\angle^s$; ST//VW

Exercise 2: Date: ____________________

Calculate the value(s) of x and/or y. Provide reasons.

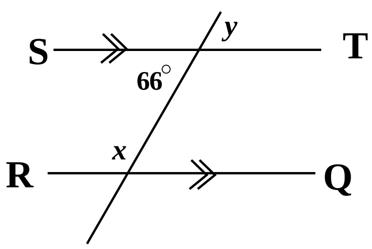
(1)



$x + 132° = 180°$ [Adj $\angle^s$ on str line]

$\therefore x = 180° - 132° \rightarrow x = 48°$

(2)



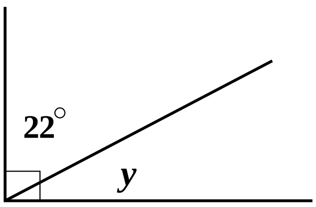
$y = 66°$ [Vertically opposite $\angle^s$]

$x + 66° = 180°$ [Co-int $\angle^s$; ST//RQ]

$\therefore x = 180° - 66°$

$\therefore x = 114°$

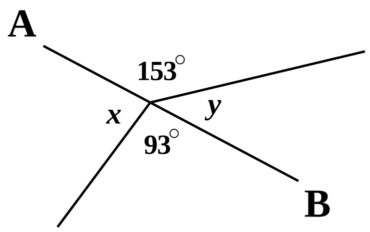
(3)



$y + 22° = 90°$ [Right angle]

$\therefore y = 90° - 22° \rightarrow x = 68°$

(4)



AB is a straight line.

$y + 153° = 180°$ [Adj $\angle^s$ on str line]

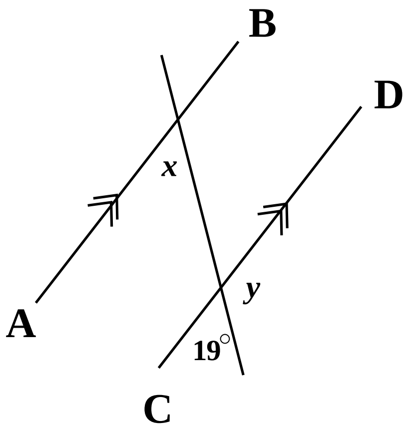
$\therefore\ y = 180° - 153° \rightarrow x = 27°$

$x + 153° + 27° + 93° = 360°$ [Revolution]

$\therefore\ x = 360° - 153° - 27° - 93°$

$\therefore\ x = 87°$

(5)



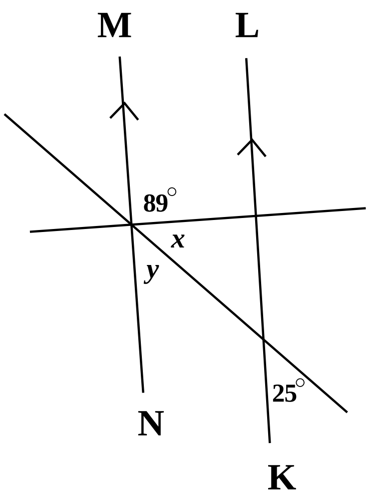
$x = 19°$ [Correspond $\angle^s$; AB//CD]

$y + 19° = 180°$ [Adj $\angle^s$ on str line]

$\therefore\ y = 180° - 19°$

$\therefore\ y = 161°$

(6)



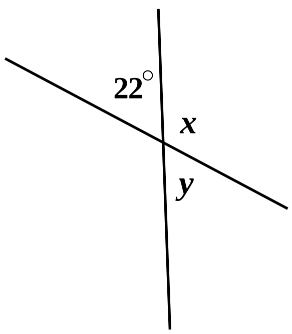
$y = 25°$ [Correspond $\angle^s$; MN//KL]

$x + y + 89° = 180°$ [Adj $\angle^s$ on str line]

$\therefore\ x = 180° - 25° - 89°$

$\therefore\ x = 66°$

(7)



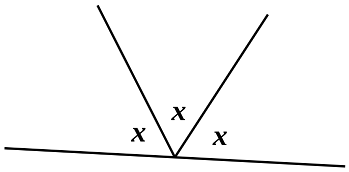
$y = 22°$ [Vertically opposite $\angle^s$]

$x + 22° = 180°$ [Adj $\angle^s$ on str line]

$\therefore\ x = 180° - 22°$

$\therefore\ x = 158°$

(8)



$x + x + x = 180°$ **[Adj $\angle^s$ on str line]**

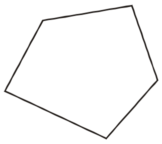
$\therefore 3x = 180°$

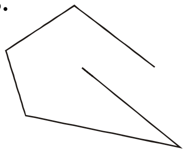
$\therefore x = \frac{180°}{3}$

$\therefore x = 60°$

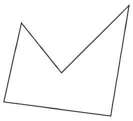
C2.2 <u>Polygon</u>:

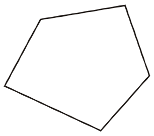
Polygons are closed figures with a certain number of sides and angles.

Closed figure: 

Non-closed figure: 

Polygons can therefore also be classified as concave or convex:

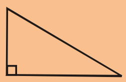
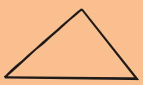
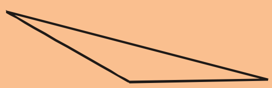
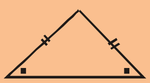
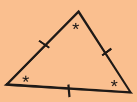
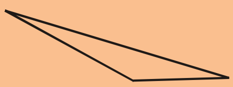
Concave: 

Convex: 

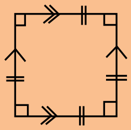
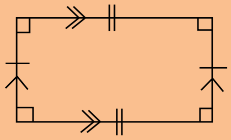
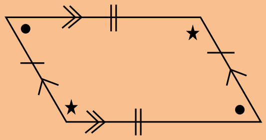
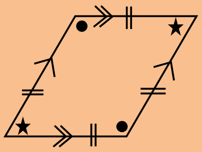
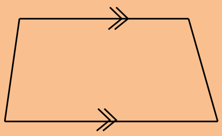
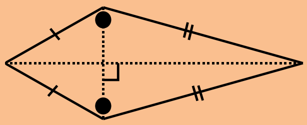
Polygons are classified according to the number of angles and sides they consist of.

* Triangles are closed figures with three angles and three sides.
* Quadrangles are closed figures with four angles and four sides.
* Pentagons are closed figures with five angles and five sides……etc.

C2.2.1 <u>Types of triangles</u>:

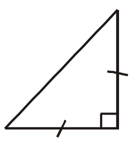
Type of triangle:	**Example:**	**Description:**
Right angled triangle		* One angle is equal to 90°.
Acute angled triangle		* All the angles are acute angles.
Obtuse angled triangle		* One of the angles is an obtuse angle.
Isosceles triangle		* Two of the sides are of equal length. * The angles opposite the equal sides are of equal size.
Equilateral triangle		* All three sides are of equal length. * All three the angles are equal to 60°.
Scalene triangle		* All three sides have different lengths.

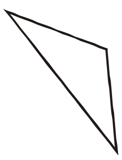
C2.2.2 Types of quadrangles:

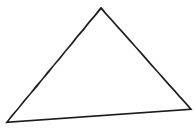
Type of quadrangles:	Example:	Characteristics:
Square		* All the sides are of equal length. * The opposite sides are parallel. * All the angles are 90°.
Rectangle		* Opposite sides are of equal length and are parallel. * All the angles are 90°.
Parallelogram		* Opposite sides are of equal length and are parallel. * The opposite angles are of equal size.
Rhombus		* All the sides are of equal length. * The opposite sides are parallel. * The opposite angles are of equal size.
Trapezium		* Only one pair of opposite sides is parallel to one another.
Kite		* Two pairs of adjacent sides are of equal length. * One pair of opposite angles is of equal size. * Diagonals are perpendicular.

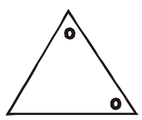
Exercise 3: Date: ________________________

(1) Classify each of the following triangles according to their angles:

(a) 

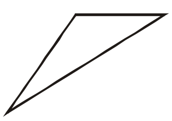
(b) 

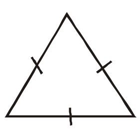
(c) 

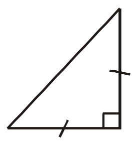
(d) 

Right angled Δ **Obtuse angled Δ** **Acute angled Δ** **Acute angled Δ**

(2) Classify each of the following triangles according to their sides:

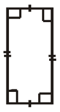
(a) 

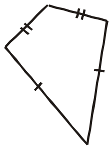
(b) 

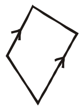
(c) 

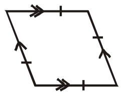
Scalene Δ **Equilateral Δ** **Isosceles Δ**

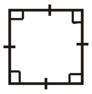
(3) Classify each of the following quadrangles:

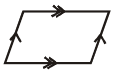
(a)  **Rectangle**

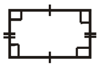
(b)  **Kite**

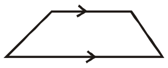
(c)  **Trapezium**

(d)  **Rhombus**

(e)  **Square**

(f)  **Parallelogram**

(g)  **Rectangle**

(h)  **Trapezium**

(4) Classify each of the following:

(a) Angle $\hat{A}$: **Right angle**

(b) Quadrilateral ABCD: **Rectangle**

(c) Triangle AEB: **Right angled triangle**

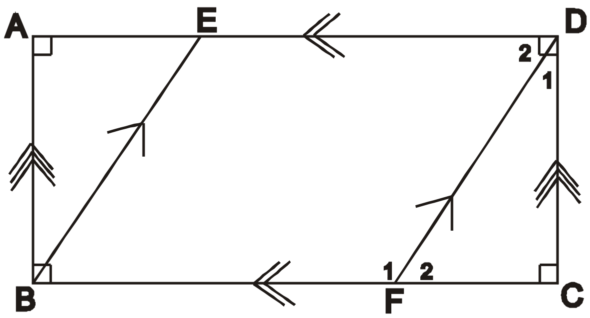
(d) Angle $\hat{F}_1$: **Obtuse angle**

(e) Quadrilateral BEDF: **Parallelogram**

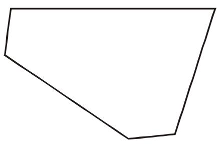
(f) Angle $\hat{D}_1$: **Acute angle**

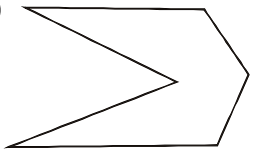
(g) Quadrilateral EDCB: **Trapezium**

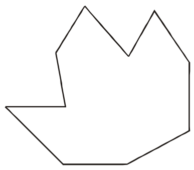
(h) Angles $\hat{D}_2$ and $\hat{F}_2$: **Alternate angles**

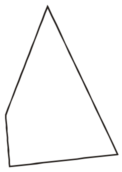


(5) Classify the following polygons: E.g. Concave pentagon

(a)  **Convex Pentagon**

(b)  **Concave Hexagon**

(c)  **Concave Decagon**

(d)  **Convex Quadrangle**

(6) Complete the following:

(a) A rhombus is a parallelogram of which **all four sides are of equal length.**

(b) A square is a rectangle of which **all four sides are of equal length.**

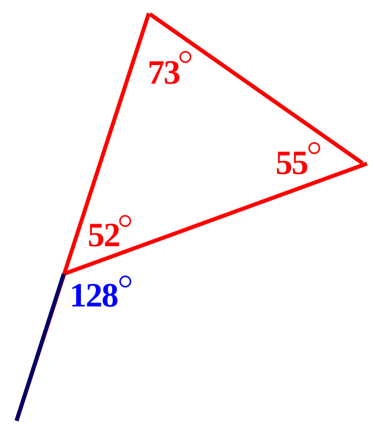
(c) A parallelogram is a quadrangle of which **the opposite sides are parallel / of equal length.**

(d) A square is a rhombus of which **all the angles are equal to ninety degrees (90°).**

(e) A trapezium is a quadrangle of which **one pair of opposite sides is parallel.**

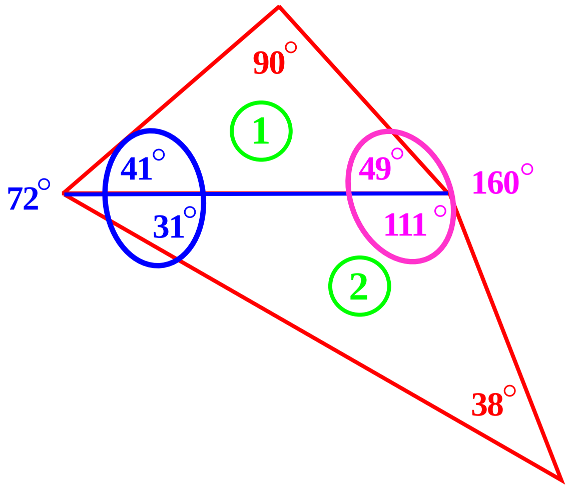
Exercise 3 no.1(a) and (b)

Possible answer!



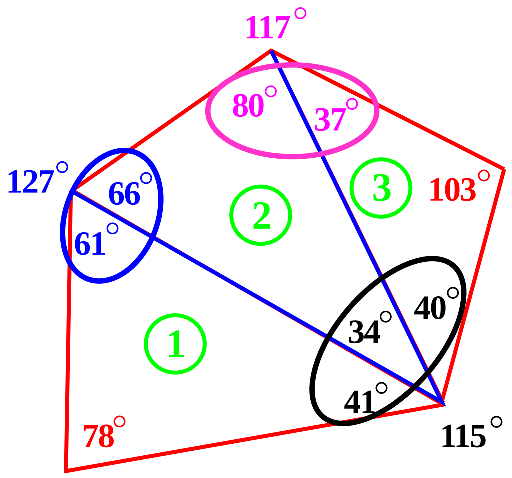
Exercise 3 no.2(a) and (b)

Possible answer!



Exercise 3 no.3(a) and (b)

Possible answer!



C2.2.3 Interior angles of polygons:

Exercise 4: Date: ________________________

(1) (a) Draw any triangle. Use a protractor and measure all the interior angles of the triangle involved. Then calculate the sum of all the interior angles of the triangle. **[See page 34.]**

$73° + 52° + 55° = 180°$

(b) Then extend any of the sides of the triangle in (a). It forms an exterior angle of the triangle. Measure the exterior angle. Determine the relation between the exterior angle and the opposite interior angles. **[See page 34.]**

Exterior angle = 128° and Sum of opposite interior angles = 73° + 55° = 128°

Exterior angle = 128° = Sum of opposite interior angles

(2) (a) Then draw any quadrilateral. Use a protractor and measure all the interior angles of the quadrilateral involved. Then determine the sum of all the interior angles of the quadrilateral.

$72° + 90° + 160° + 38° = 360°$

(b) Then divide the quadrilateral in (a) into two triangles by drawing a diagonal. Measure each triangle's interior angles and again calculate the sum of the interior angles of each triangle.

Triangle (1) : $90° + 41° + 49° = 180°$
Triangle (2) : $31° + 111° + 38° = 180°$
} $360°$

(3) (a) Then draw any pentagon. Use a protractor and measure all the interior angles of the pentagon involved. Then determine the sum of all the interior angles of the pentagon.

$127° + 117° + 103° + 115° + 78° = 540°$

(b) Then divide the pentagon in (a) into the smallest number of triangles by inserting diagonals. Measure each triangle's interior angles and calculate the sum of the interior angles of each triangle again.

Triangle (1) : $78° + 61° + 41 = 180°$
Triangle (2) : $80° + 66° + 34° = 180°$
Triangle (3) : $37° + 40° + 103° = 180°$
} $540°$

(4) From numbers 1 – 3 we can deduce the following:

3 (number of angles in triangle) − (2) = (1)

(a) The sum of the interior angles of any triangle is always equal to (1) $\times$ $180° = 180°$

4 (number of angles in quadrilateral) − (2) = (2)

(b) The sum of the interior angles of any quadrilateral is always equal to (2) $\times$ $180° = 360°$

5 (number of angles in pentagon) − (2) = (3)

(c) The sum of the interior angles of any pentagon is always equal to (3) $\times$ $180° = 540°$

(5) Predict the sum of the interior angles of an octagon without making a sketch and without Measuring it. Use the deductions in number 4.

Octagon $= (8 - (2)) \times 180°$
$= 6 \times 180° = 1\,080°$

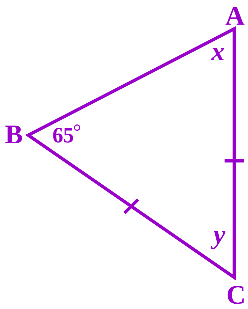
☺ **All the following are names for a type of polygon. Do research and find out which type of polygon it is. Also collect pictures of examples from everyday life of at least two types of polygons from magazines, newspapers, the internet or any other source.**

(1) hexagon (2) tetragon (3) pentagon (4) octagon

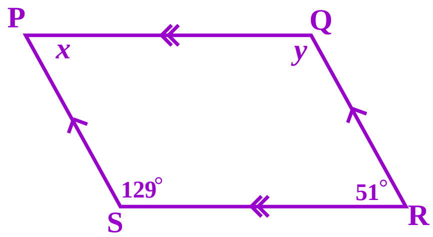
C2.2.4 Applications:

E.g.2 Calculate the value(s) of x and/or y. Provide reasons.

(a)



(b)



(a)

Statement:	**Reason:**
$x = 65°$	$\angle^s$ opp equal sides
$y = 180° - 65° - 65°$	
$\therefore y = 50°$	int $\angle^s$ of Δ

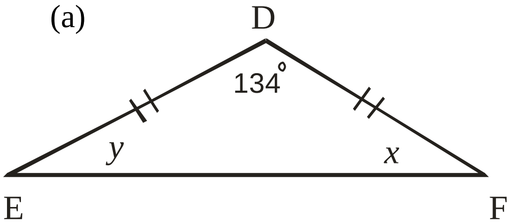
(b)

Statement:	**Reason:**
$x = 51°$	opp $\angle^s$ of parm
$y = 129°$	opp $\angle^s$ of parm

Exercise 5: Date: ________________________

(1) Calculate the value(s) of x and/or y. Provide reasons.

(a)



$y + x + 134° = 180°$ [Int $\angle^s$ of Δ]

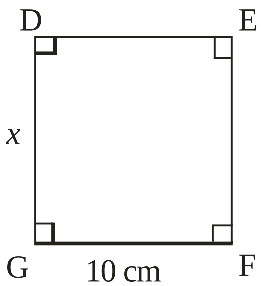
$\therefore y + x = 180° - 134°$

$\therefore y + x = 46°$

But $y = x$ [$\angle^s$ opposite equal sides]

$\therefore y = x = 23°$

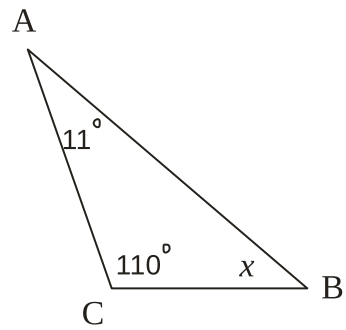
(b)



DEFG is a square.

$x = 10$ cm [Sides of square]

(c)

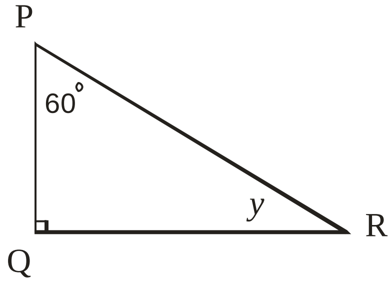


$11° + 110° + x = 180°$ **[Int ∠^{s} of Δ]**

$\therefore x = 180° - 11° - 110°$

$\therefore x = 59°$

(d)

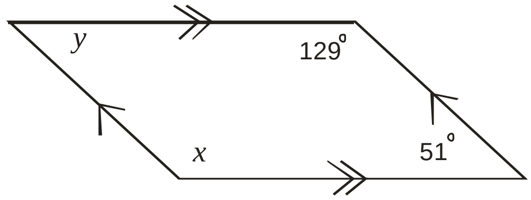


$60° + 90° + y = 180°$ **[Int ∠^{s} of Δ]**

$\therefore y = 180° - 60° - 90°$

$\therefore y = 30°$

(e)



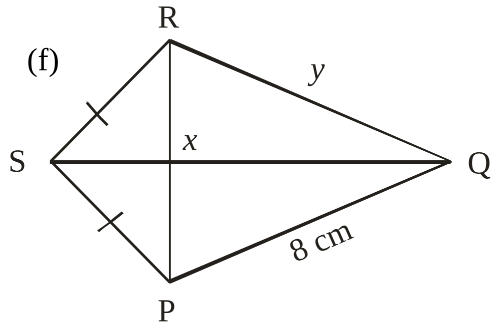
$x = 129°$

[Opposite angles of parallelogram]

$y = 51°$

[Opposite angles of parallelogram]

(f)



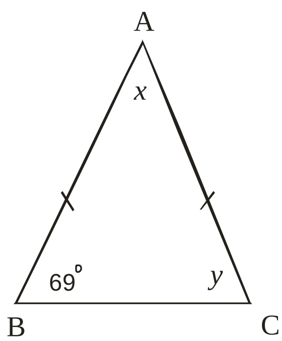
$x = 90°$

[Diagonals of kite ⊥]

$y = 8$ cm

[Adjacent sides of kite equal]

(g)



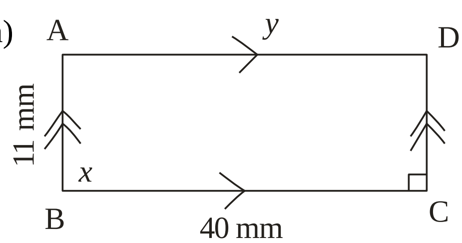
$y = 69°$ **[∠^{s} opposite equal sides]**

$69° + 69° + x = 180°$ **[Int ∠^{s} of Δ]**

$\therefore x = 180° - 69° - 69°$

$\therefore x = 42°$

(h)

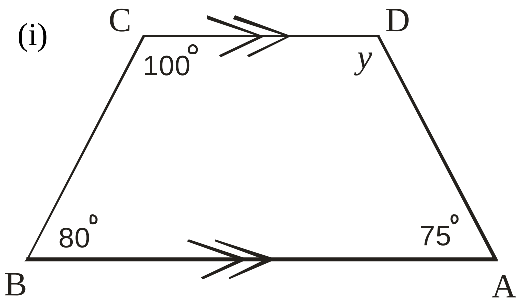


ABCD is a rectangle.

$x = 90°$ **[Angles of rectangle]**

$y = 40$ mm **[Opposite sides of rectangle]**

(i)



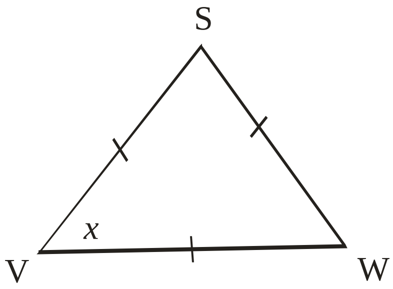
$100° + 80° + 75° + y = 360°$

$\therefore y = 360° - 100° - 80° - 75°$

$\therefore y = 105°$

[Int ∠^{s} of quadrilateral / trapezium]

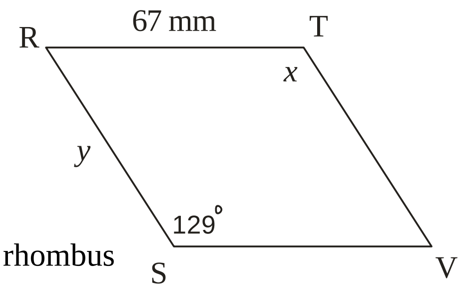
(j)



$x = 60°$

[Int ∠^{s} of equilateral Δ]

(k)



RSTV is a rhombus

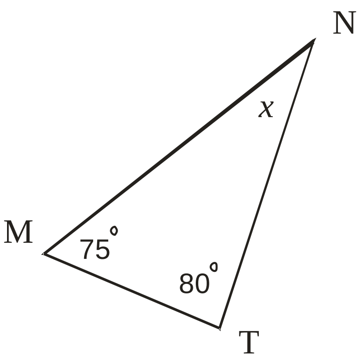
$x = 129°$

[Opposite angles of rhombus]

$y = 67$ mm

[All sides of rhombus equal]

(l)



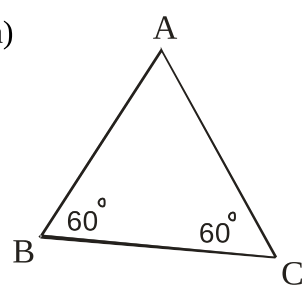
$75° + 80° + x = 180°$ **[Int ∠^{s} of Δ]**

$\therefore x = 180° - 75° - 80°$

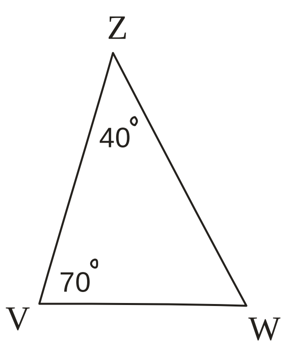
$\therefore x = 25°$

(2) Are the following triangles isosceles, equilateral and / or right-angled triangles?

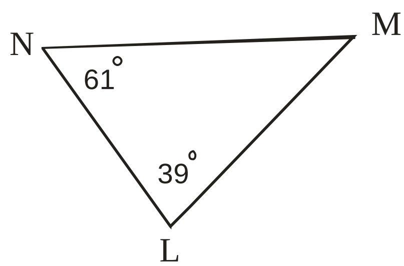
(a)



(b)



(c)



$\hat{A} = 60°$ **[Int ∠^{s} of Δ]**

$\therefore$ **Equilateral Δ**

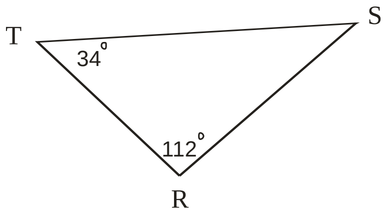
$\hat{W} = 70°$ **[Int ∠^{s} of Δ]**

$\therefore$ **Isosceles Δ**

$\hat{M} = 80°$ **[Int ∠^{s} of Δ]**

$\therefore$ **None**

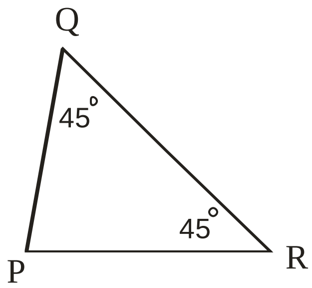
(d)



$\hat{S} = 34°$ [Int $\angle^s$ of Δ]

∴ Isosceles Δ

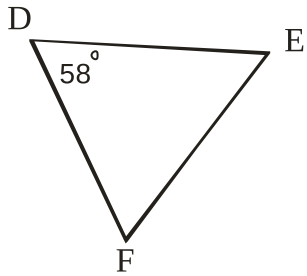
(e)



$\hat{P} = 90°$ [Int $\angle^s$ of Δ]

∴ Right angled isosceles Δ

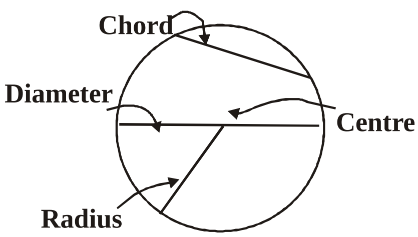
(f)

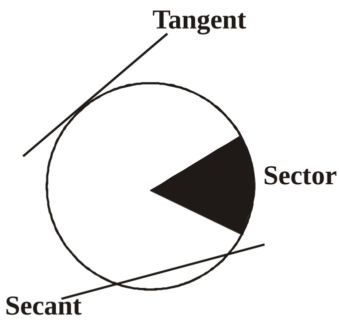


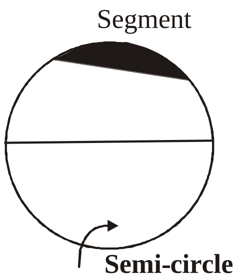
∴ None

Not enough information

C2.3 Circles:



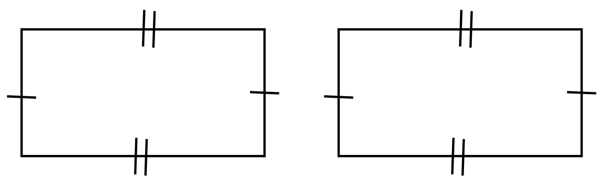




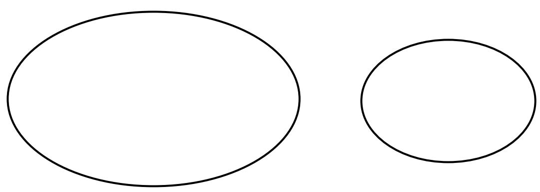
Remember: * Concentric circles have the same centre but different radii.
* All radii in a circle have the same length.
* The diameter of a circle is twice the length of the radius.

C2.4 Congruent and similar figures:

Congruent figures are the same in all aspects.
∴ The figures have the same form and size.
The symbol ≡ is used to indicate congruency.

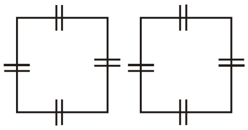


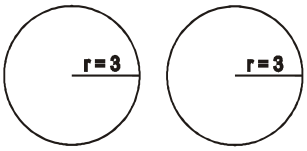
Similar figures are figures with the same shape, but do not necessarily have the same size.
The symbol /// is used to indicate similarity.

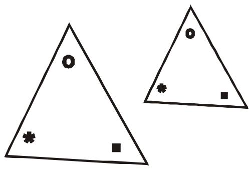


Exercise 6: Date: ______________________

(1) Which of the following pair of figures are congruent?

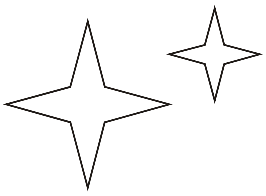
(a) 

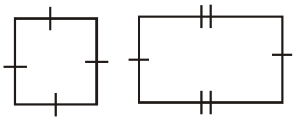
(b) 

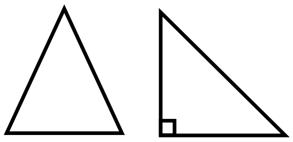
(c) 

Congruent **Congruent** **Not congruent**

(2) Which of the following pair of figures are similar?

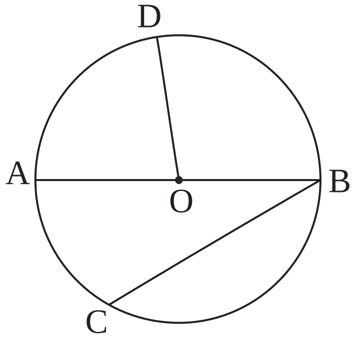
(a) 

(b) 

(c) 

Similar **Not similar** **Not similar**

(3) Consider the following circles and name the line segments as requested as a diameter, a radius or a chord. O is the centre of the circle.

(a) 

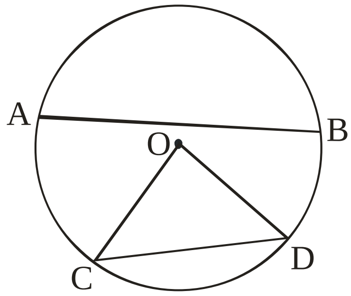
AB, BC, OD and AO

AB → Diameter

BC → Chord

OD → Radius

AO→ Radius

(b) 

AB, OC, DC and OD

AB → Chord

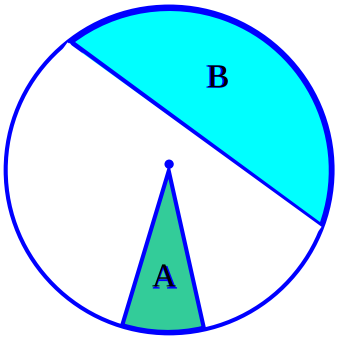
OC → Radius

DC → Chord

OD → Radius

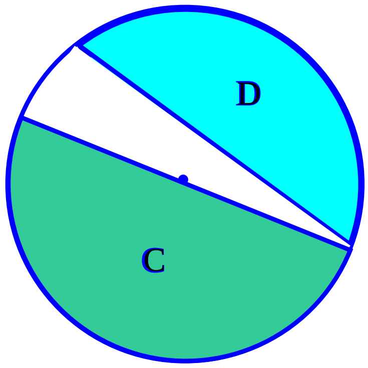
(3) Consider the following circles and name the shaded areas as requested as semi-circle, a sector or a segment. O is the centre of the circle.

(a)



Area A and area B.

(b)



Area C and area D.

Area A → Sector

Area B → Segment

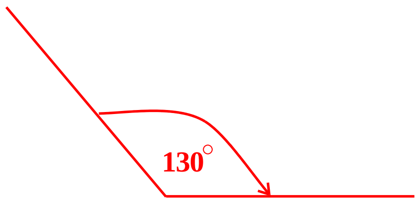
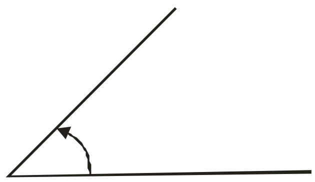
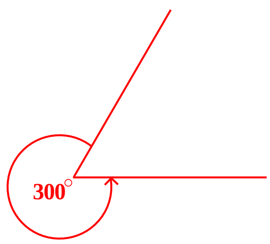
Area C → Semi-circle

Area D → Segment

C2.5 REVISION EXERCISE:

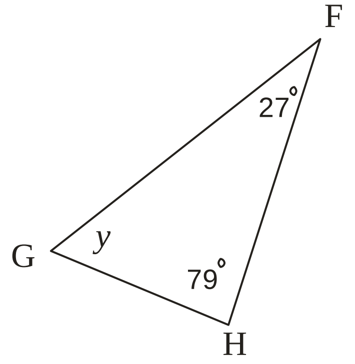
Date: ___________________________

(1) Complete the following table:

	Type of angle:	Size of angle:	Construction of angle:
(a)	Obtuse angle	**130°** **Possible answer!**	
(b)	**Acute angle**	**45°**	
(c)	**Reflex angle**	300°	

(2) Calculate the value(s) of x and / or y. Give reasons.

(a)

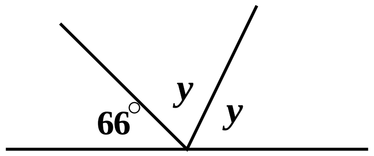


$y + 27° + 79° = 180°$ **[Int $\angle^s$ of Δ]**

$\therefore y = 180° - 27° - 79°$

$\therefore y = 74°$

(b)



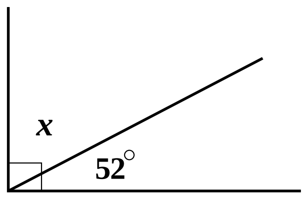
$y + y + 66° = 180°$ **[Adj $\angle^s$ on str line]**

$\therefore 2y = 180° - 66°$

$\therefore 2y = 114°$

$\therefore y = \frac{114°}{2} \rightarrow \therefore y = 57°$

(c)

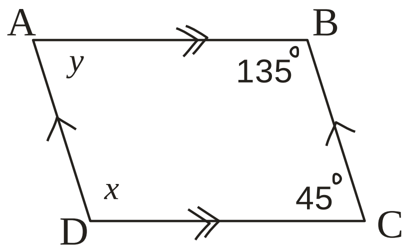


$x + 52° = 90°$ **[Right angle]**

$\therefore x = 90° - 52$

$\therefore x = 38°$

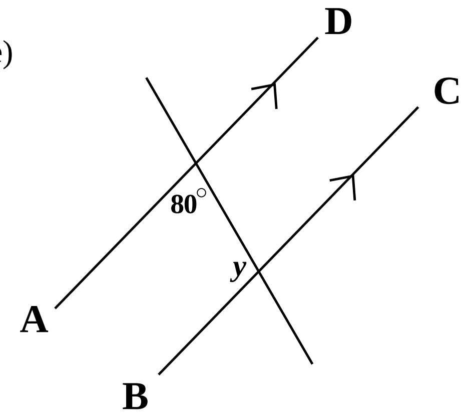
(d)



$x = 135°$ **[Opposite angles of parallelogram]**

$y = 45°$ **[Opposite angles of parallelogram]**

(e)

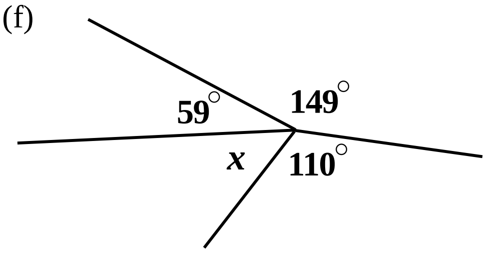


$y + 80° = 180°$ **[Co-int $\angle^s$; AD//BC]**

$\therefore y = 180° - 80°$

$\therefore y = 100°$

(f)



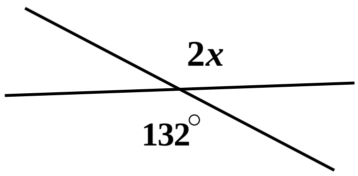
$x + 59° + 149° + 110° = 360°$

$\therefore x = 360° - 59° - 149° - 110°$

$\therefore x = 42°$

[Revolution]

(g)

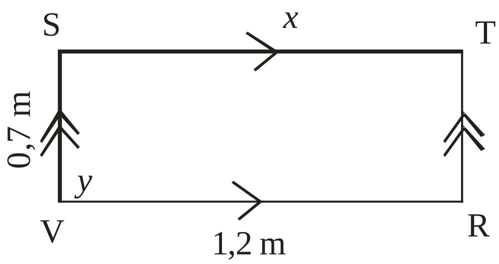


$2x = 132°$ **[Vertically opposite $\angle^s$]**

$\therefore x = \frac{132°}{2}$

$\therefore x = 66°$

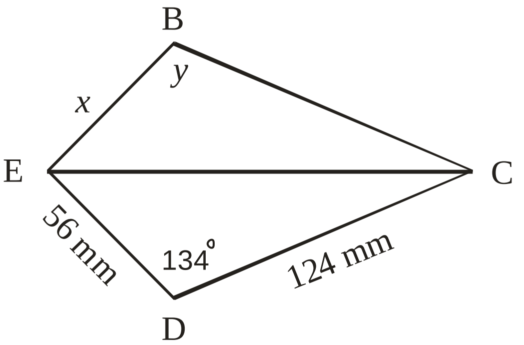
(h) STVR is a rectangle



$x = 1,2$ m **[Opposite sides of rectangle]**

$y = 90°$ **[Angles of rectangle]**

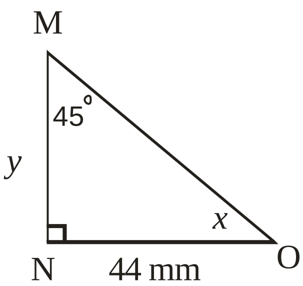
(i) BCDE is a kite



$x = 56$ mm **[Adjacent sides of kite]**

$y = 134°$ **[Opposite angles of kite]**

(j)



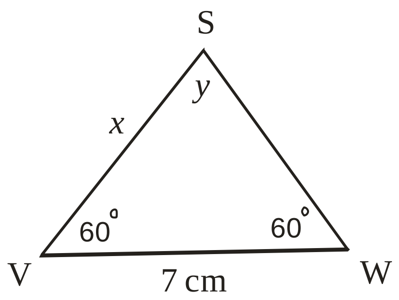
$x + 45° = 90°$ **[Right angled triangle]**

$\therefore x = 90° - 45°$

$\therefore x = 45°$

$y = 44$ mm **[sides opposite equal $\angle^s$]**

(k)



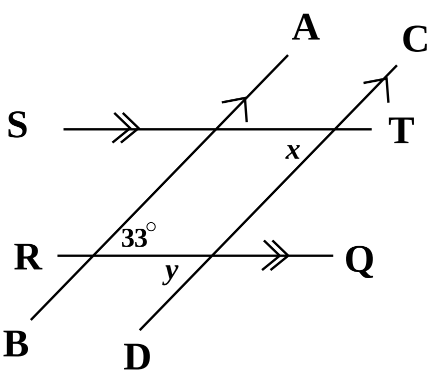
$x + 60° + 60° = 180°$ **[Int $\angle^s$ of Δ]**

$\therefore y = 180° - 60° - 60°$

$\therefore y = 60°$

$x = 7$ cm **[Sides of equilateral triangle]**

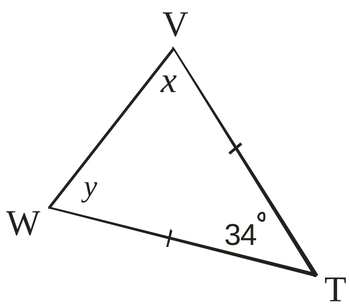
(l)



$\therefore y = 33°$ **[Alternate $\angle^s$; AB//CD]**

$\therefore x = 33°$ **[Correspond $\angle^s$; ST//RQ]**

(m)



$y + x + 34° = 180°$ **[Int $\angle^s$ of Δ]**

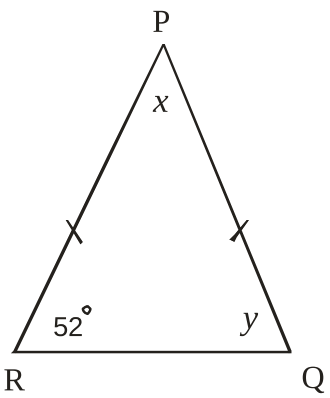
$\therefore y + x = 180° - 34° = 146°$

But $y = x$ **[$\angle^s$ opposite equal sides]**

$\therefore y = x = \frac{146°}{2}$

$\therefore y = x = 73°$

(n)



$y = 52°$ **[$\angle^s$ opposite equal sides]**

$x + 52° + 52° = 180°$ **[Int $\angle^s$ of Δ]**

$\therefore x = 180° - 52° - 52°$

$\therefore x = 76°$

(3) Fit column B to column A:

	Column A	
(a)	All three sides are equal in length.	E
(b)	Twice the radius.	H
(c)	Sum of interior angles is $540°$.	A
(d)	Same shape but not the same size.	J
(e)	Angles opposite equal sides are equal is size.	G
(f)	A quadrilateral with only one pair of opposite sides parallel.	C
(g)	An angle greater than $180°$ and smaller than $360°$.	D
(h)	A quadrilateral with two pairs of adjacent sides equal in length.	F
(i)	Sum of the interior angles of a triangle.	I
(j)	A parallelogram of which all the sides are of equal length.	K

	Column B
A.	Pentagon.
B.	Congruent figures.
C.	Trapezium.
D.	Reflex angle.
E.	All three angles are equal to $60°$.
F.	Kite.
G.	Isosceles triangle.
H.	Diameter.
I.	$180°$.
J.	Similar figures.
K.	Rhombus.
L.	Straight angle.
M.	$360°$

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