



# JENN

Training and Consultancy

The path to enlightened education

**SUBJECT: MATHEMATICS**

**CONTENT: EUCLIDEAN GEOMETRY**

**ACTIVITY BOOK**

**LEARNER**

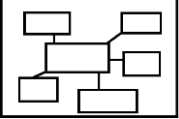
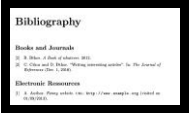
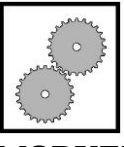
**TERM 1**

**EUCLIDEAN GEOMETRY**

**CONTENTS****PAGE**

|                                                                                                                                            |  |
|--------------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>TOPIC 1:</b><br>➤ <b>Euclidean Geometry Grade 11 Content</b><br><b>(Mixed Theorems and Applications with Riders)</b>                    |  |
| <b>TOPIC 2:</b><br>➤ <b>Euclidean Geometry Mixed Exercises (Grade 11-Grade 12)</b><br><b>(Mixed Theorems and Applications with Riders)</b> |  |

**ICON DESCRIPTION**

|                                                                                                           |                                                                                                                       |                                                                                                              |                                                                                                          |
|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| <br><b>MIND MAP</b>      | <br><b>EXAMINATION<br/>GUIDELINE</b> | <br><b>CONTENTS</b>         | <br><b>ACTIVITIES</b> |
| <br><b>BIBLIOGRAPHY</b> | <br><b>TERMINOLOGY</b>              | <br><b>WORKED EXAMPLES</b> | <br><b>STEPS</b>     |

# TOPIC: Euclidean Geometry

Duration: □

**Outcomes: At the end of the session learners must demonstrate an understanding of:**

1. The following examinable proofs of theorems:

- The line drawn from the centre of a circle perpendicular to a chord bisects the chord;
- The angle subtended by an arc at the centre of a circle is double the size of the angle subtended by the same arc at the circle (on the same side of the chord as the centre);
- The opposite angles of a cyclic quadrilateral are supplementary;
- The angle between the tangent to a circle and the chord drawn from the point of contact is equal to the angle in the alternate segment;
- A line drawn parallel to one side of a triangle divides the other two sides proportionally;
- Equiangular triangles are similar.

2. Corollaries derived from the theorems and axioms are necessary in solving riders:

- Angles in a semi-circle
- Equal chords subtend equal angles at the circumference
- Equal chords subtend equal angles at the centre
- In equal circles, equal chords subtend equal angles at the circumference
- In equal circles, equal chords subtend equal angles at the centre.
- The exterior angle of a cyclic quadrilateral is equal to the interior opposite angle of the quadrilateral.
- If the exterior angle of a quadrilateral is equal to the interior opposite angle of the quadrilateral, then the quadrilateral is cyclic.
- Tangents drawn from a common point outside the circle are equal in length.

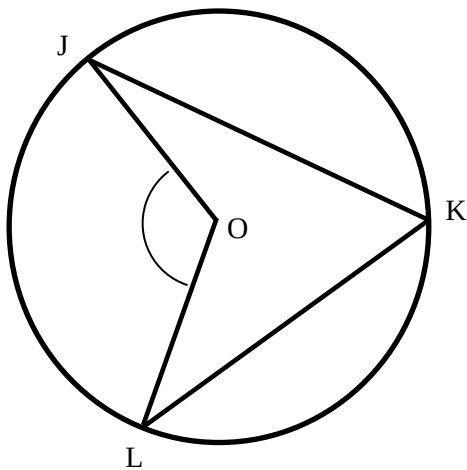
3. The theory of quadrilaterals will be integrated into questions in the examination.

4. Concurrency theory is excluded.



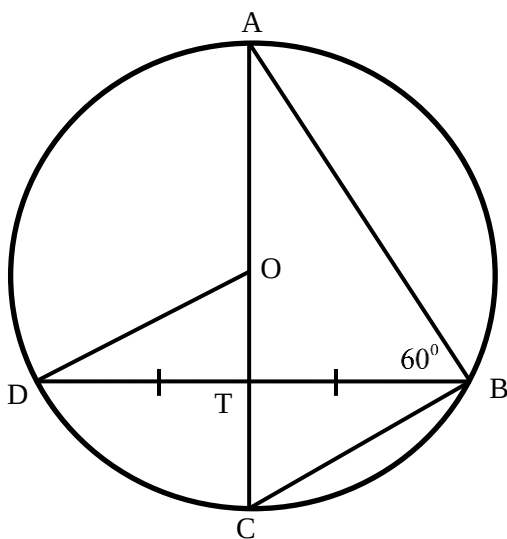
## QUESTION 1

- 1.1 In the diagram below,  $O$  is the centre of the circle.  $J$ ,  $K$  and  $L$  are points on the circumference of the circle.



Prove that the obtuse angle at  $O$ ,  $\hat{JOL} = 2\hat{JKL}$ .

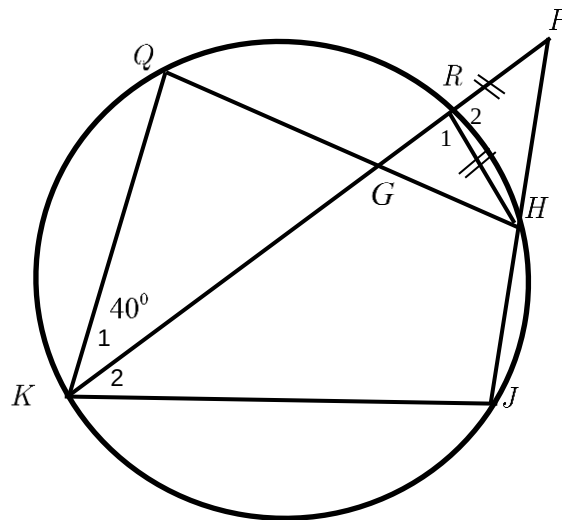
- 1.2 Given circle with centre  $O$ .  $DT = TB$  and  $\hat{ABD} = 60^\circ$ .



- 1.2.1 Determine  $\hat{BTC}$ .
- 1.2.2 Show that  $OD \parallel BC$ .

## QUESTION 2

In the diagram below, points Q, H, J and K lie on a circle. RK bisects  $\hat{K}$  and  $RH = RP$ .  
 $KR$  and  $JH$  produced meet at  $P$ .  
 $\hat{K}_1 = 40^\circ$ .



Prove that:

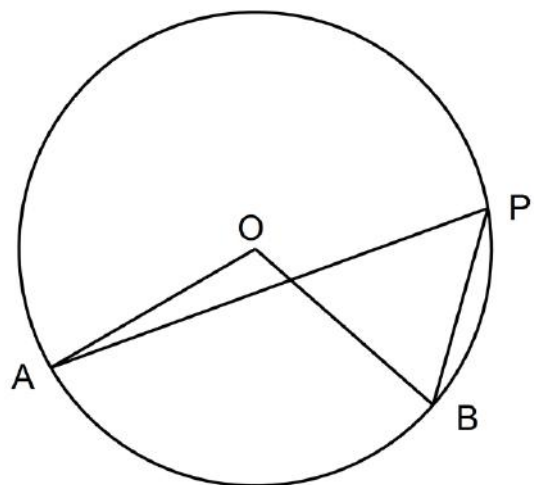
- 2.1)  $RH$  bisects  $\hat{GHP}$ .
- 2.2)  $JK = JP$ .
- 2.3)  $\hat{Q} = \hat{JKQ}$ .

## QUESTION 3

- 3.1 In the diagram alongside, which is reproduced on the diagram sheet, O is the centre of the circle through A, B and P.

Prove the theorem which states that

$$\hat{AOB} = 2\hat{APB}$$



### 3.2.1 ST is a diameter of the circle.

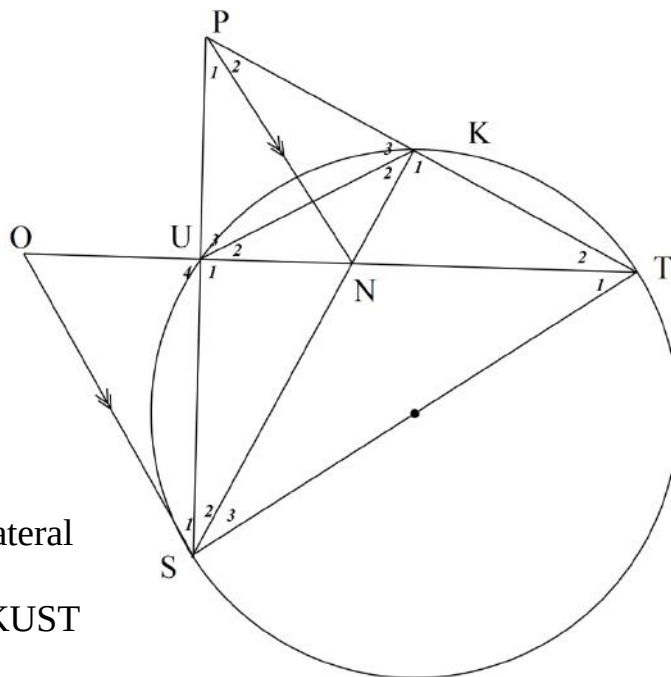
OS  $\parallel$  PN, TO bisects  $\hat{S}\hat{T}\hat{P}$ .

Prove that

### 3.2.1 PUNK is a cyclic quadrilateral

### 3.2.2 SO is a tangent to circle KUST

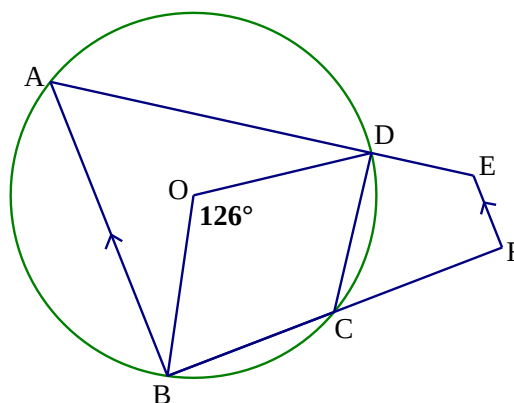
### 3.2.3 POST is a cyclic quadrilateral



### Question 4

## 4.1

It is given that  $\widehat{BOD} = 126^\circ$ , where  $O$  is the centre of the circle, and that  $AB \parallel EF$ .

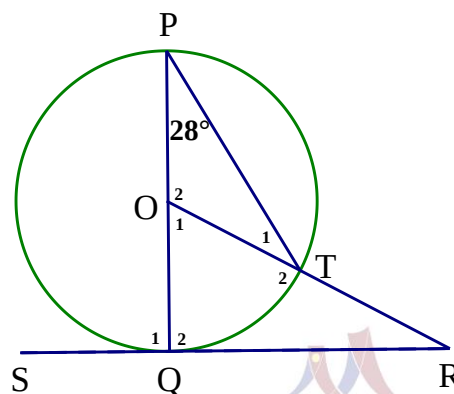


4.1.1 Determine the value of  $D\hat{C}B$ .

4.1.2 Prove that CDEF is a cyclic quadrilateral.

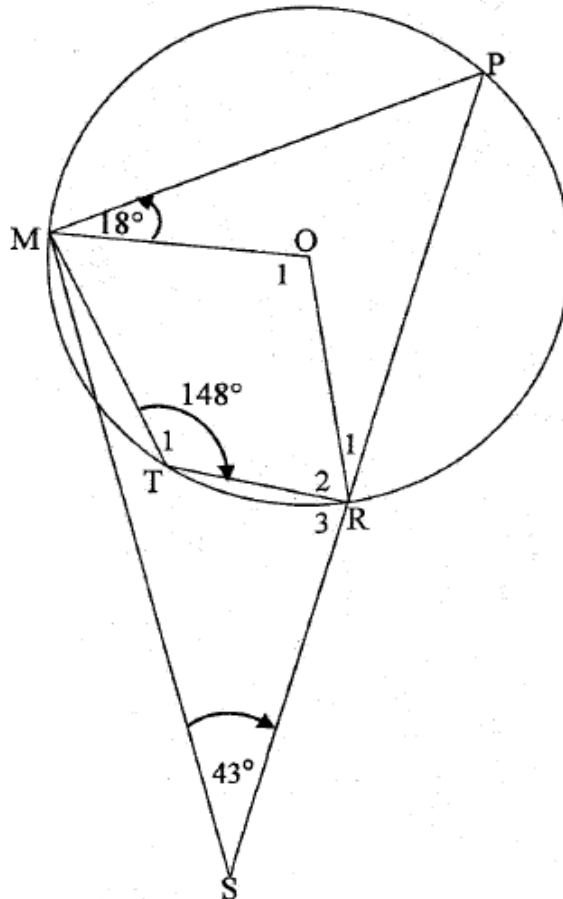
4.2 POQ is a diameter of the circle and SQR is the tangent to the circle at Q.

Given that  $\hat{P} = 28^\circ$ , determine the value of  $\hat{R}$ .



### QUESTION 5

- 5.1 In the diagram below, P, M, T and R are points on a circle having centre O. PR produced meets MS at S. Radii OM and OR and the chords MT and TR are drawn.  $\hat{T}_1 = 148^\circ$ ,  $\hat{PMO} = 18^\circ$  and  $\hat{S} = 43^\circ$ .



Calculate, with reasons, the size of:

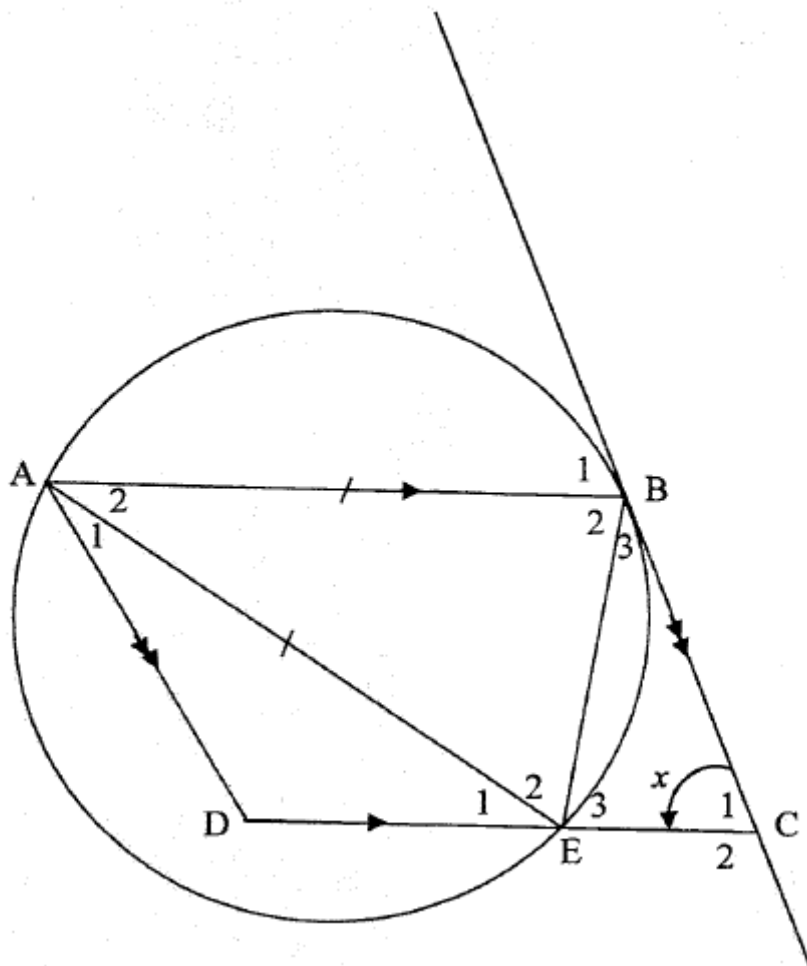
5.1.1  $\hat{P}$

5.1.2  $\hat{O}_1$

5.1.3  $\hat{OMS}$

5.1.4  $\hat{R}_3$ , if it is given that  $\hat{TMS} = 6^\circ$

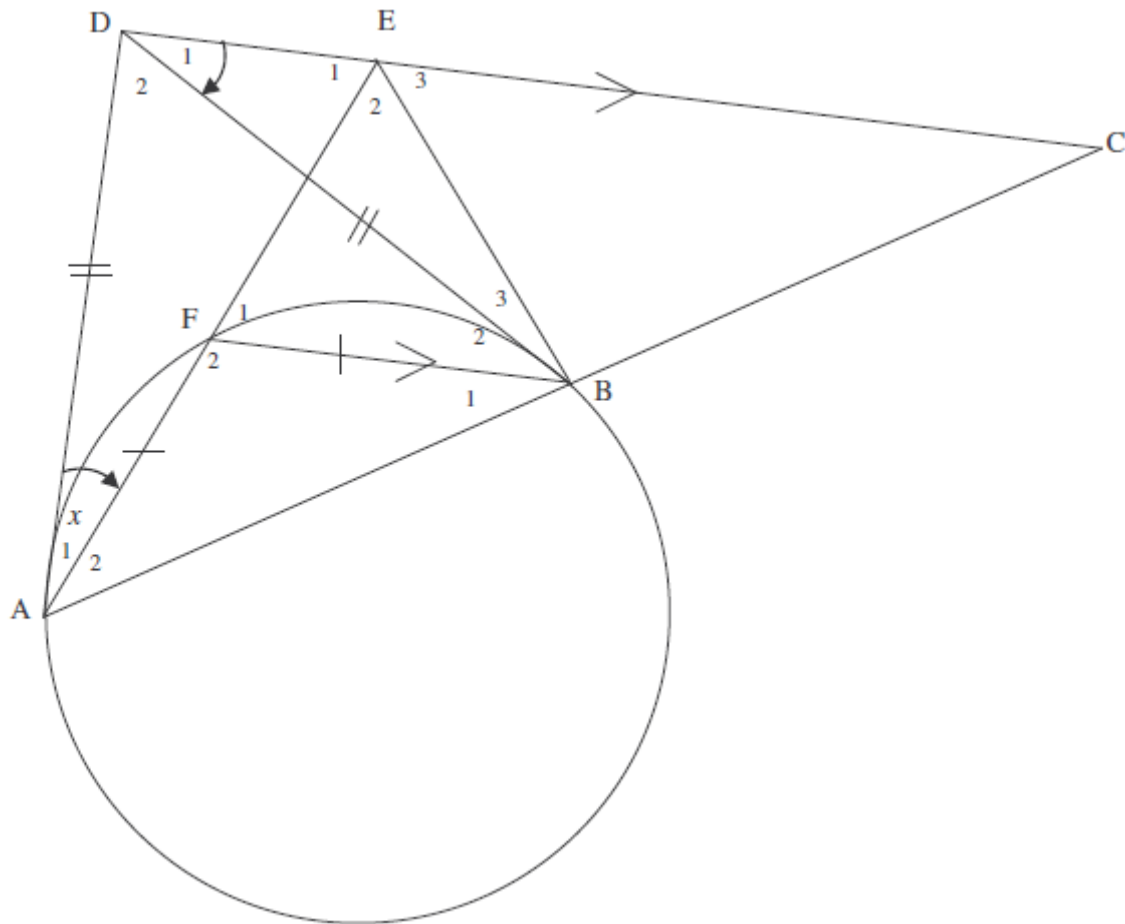
- 5.2 In the diagram below, the circle passes through A, B and E. ABCD is a parallelogram. BC is a tangent to the circle at B.  $AE = AB$ . Let  $\hat{C}_1 = x$ .



- 5.2.1 Give a reason why  $\hat{B}_1 = x$ .
- 5.2.2 Name, with reasons, THREE other angles equal in size to  $x$ .
- 5.2.3 Prove that ABED is a cyclic quadrilateral.

### QUESTION 6

In the diagram below, DA and DB are tangents to the circle at A and B.  $AF = FB$ . AB produced cuts the line through D, which is parallel to FB, at C. AF produced meets DC at E and  $\hat{DAE} = x$ .

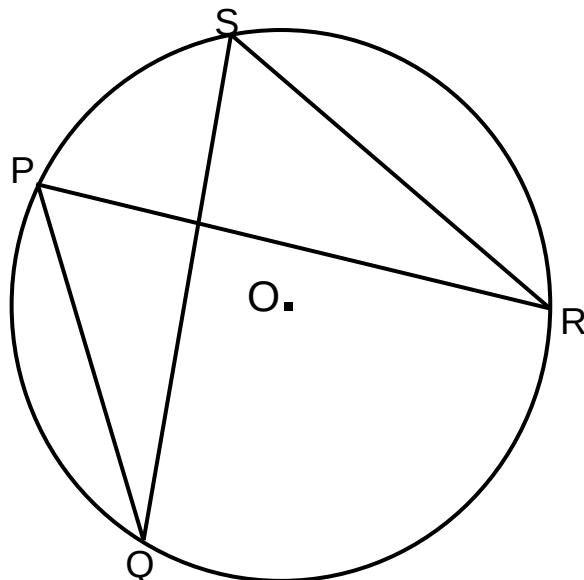


- 6.1 Find, with reasons, 5 angles each equal to  $x$ .
- 6.2 Prove that ABED is a cyclic quadrilateral.
- 6.3 Prove that  $\hat{ABE} = 3\hat{DAE}$ .
- 6.4 Prove that  $AD = BC$ .

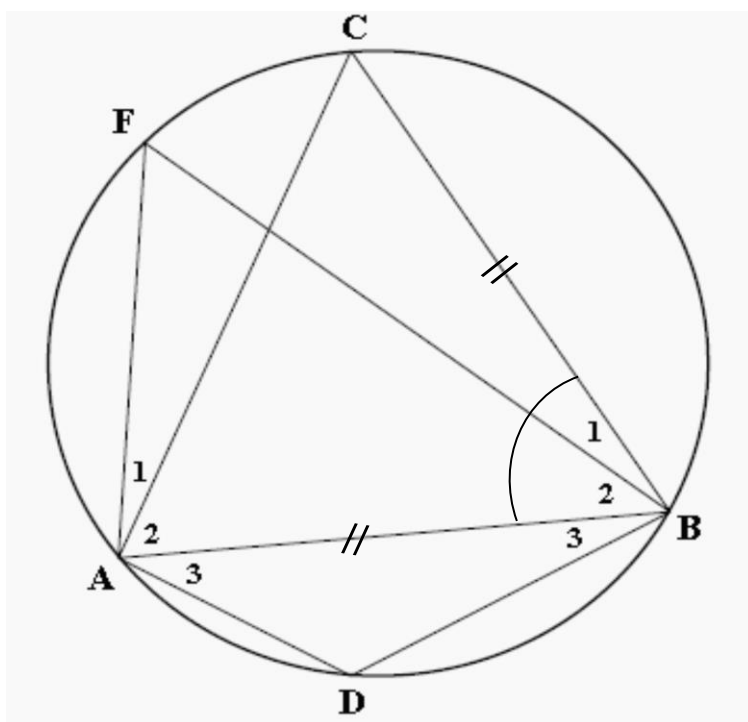
## QUESTION 7

7.1 In the diagram below  $P$ ,  $Q$ ,  $R$  and  $S$  are points on a circle with centre  $O$ . Use the diagram sheet to prove the theorem that states:

“Angles subtended by a chord (or arc) at the circumference on the same side of the chord are equal.”



7.2 In the diagram below  $A$ ,  $D$ ,  $B$ ,  $C$  and  $F$  are points on a circle.  $AB = BC$ .  $\hat{ABC} = 50^\circ$ .



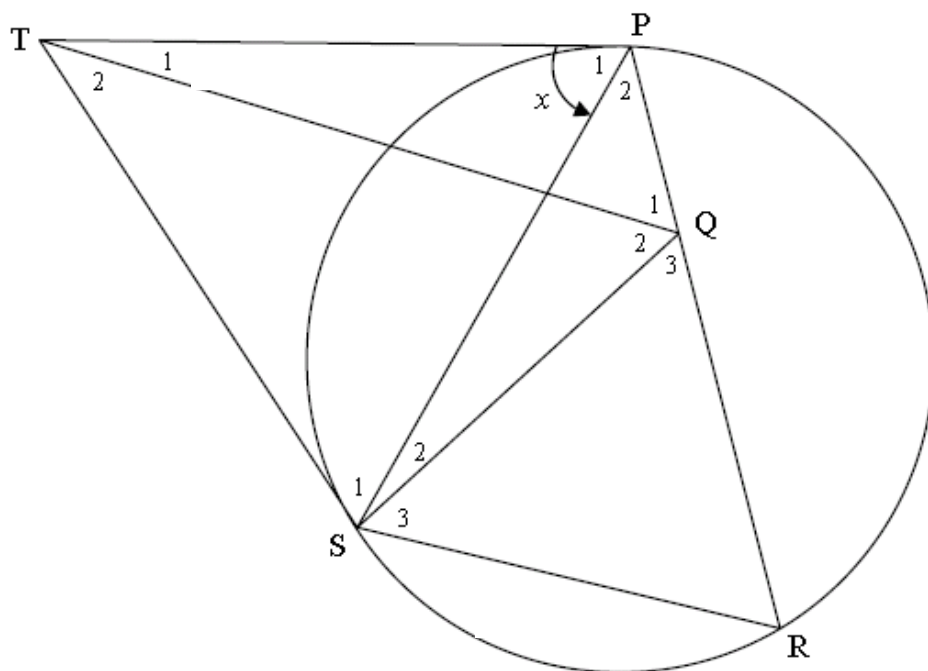
Calculate, with reasons, the size of:

- $\hat{F}$
- $\hat{D}$

### QUESTION 8

In the figure  $TP$  and  $TS$  are tangents to the given circle.  $R$  is a point on the circumference, and  $Q$  is a point on  $PR$  such that  $\hat{Q}_1 = \hat{P}_1$ .  $SQ$  is drawn.

Let  $\hat{P}_1 = x$ .

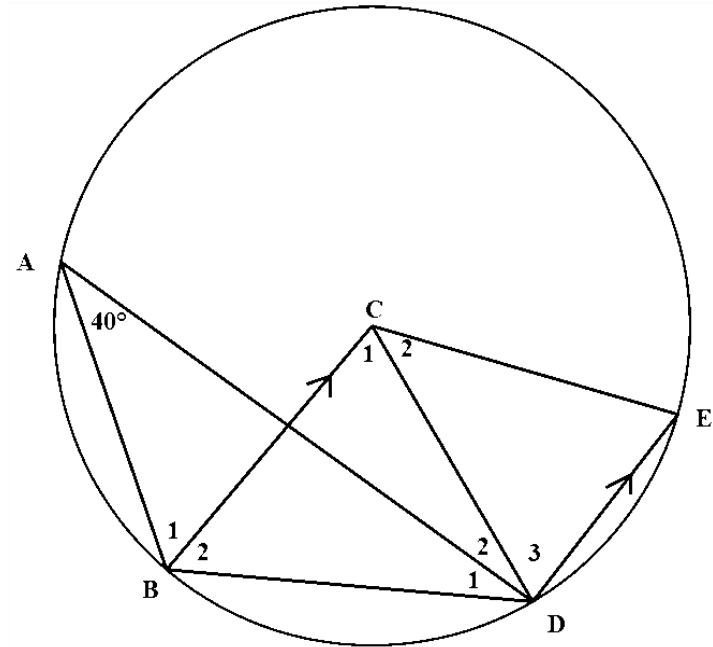


Prove that:

- 8.1  $TQ \parallel SR$
- 8.2  $QPTS$  is a cyclic quadrilateral.
- 8.3  $TQ$  bisects  $S\hat{Q}P$ .

## QUESTION 9

- 9.1 C is the centre of the circle passing through A, B, D and E.  $CB \parallel DE$  and  $\hat{BAD} = 40^\circ$ .



Calculate with reasons the size of:

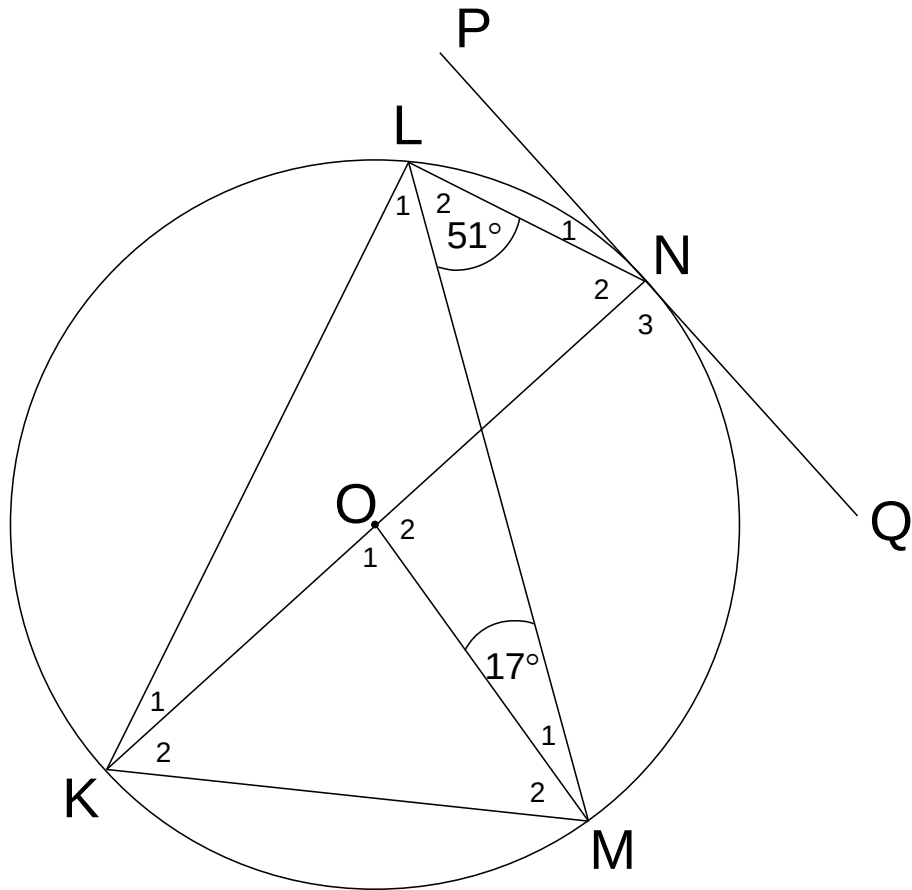
9.1.1  $\hat{C}_1$

9.1.2  $\hat{B}_2$

9.1.3  $\hat{C}_2$

# QUESTION 10

- 10.1 In the diagram below, O is the centre of circle KLMN.  $\hat{M}_1 = 17^\circ$  and  $\hat{L}_2 = 51^\circ$ . PNQ is a tangent to the circle at N.



Calculate, giving reasons, the size of:

10.1.1  $\hat{L}_1$

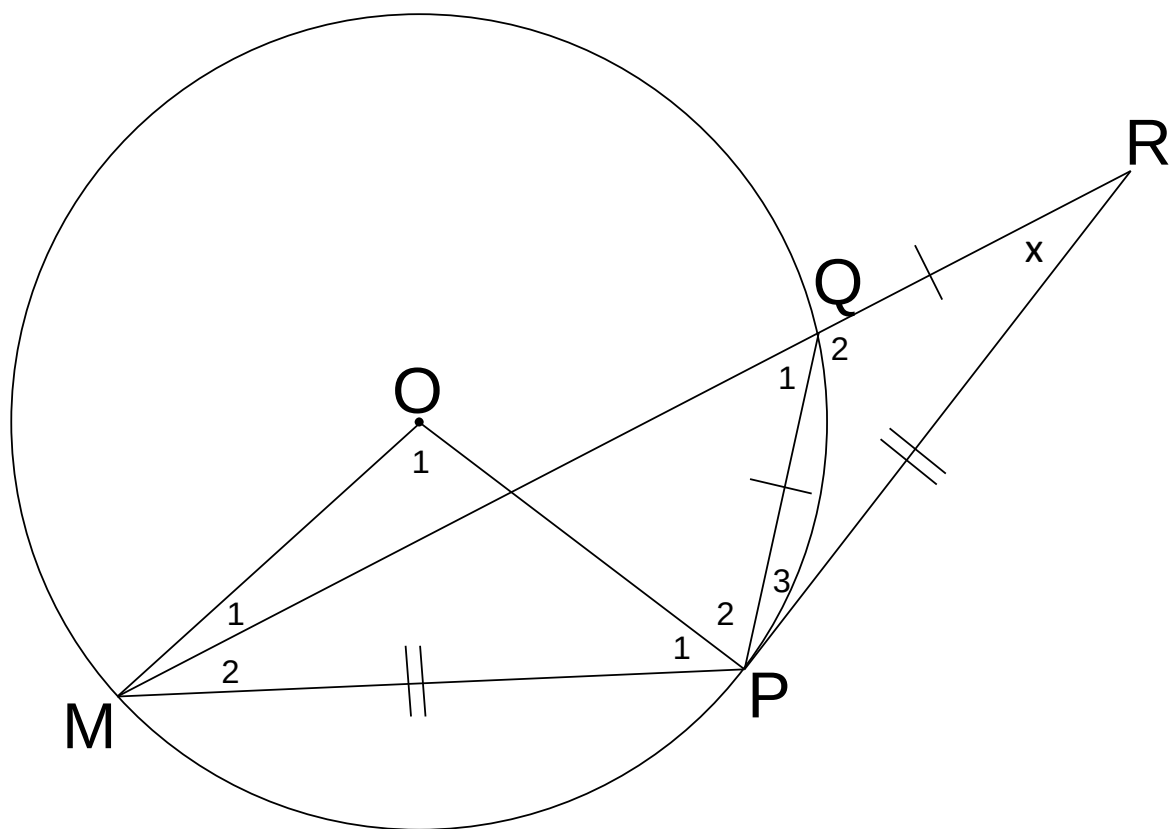
10.1.2  $\hat{O}_1$

10.1.3  $\hat{M}_2$

10.1.4  $\hat{N}_2$

10.1.5  $\hat{N}_1$

- 10.2 In the diagram below, O is the centre of circle MPQ. MQ is extended to R and PR is produced. MP = RP and QP = QR.

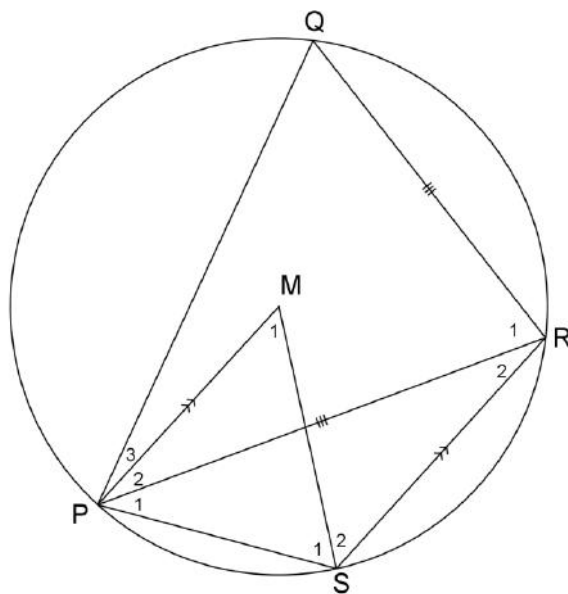


- 10.2.1 Determine  $\hat{O}_1$  in terms of  $x$  if  $\hat{R} = x$ .
- 10.2.2 Prove that RP is a tangent to the circle.

## QUESTION 11

11.1 In the diagram alongside, M is the centre of circle PQRS.  $PM \parallel DC$ ,  $QR = PR$  and

$$\hat{R}_2 = 28^\circ$$



Determine, giving reasons, the size of the following angles:

11.1.1  $\hat{S}_2$

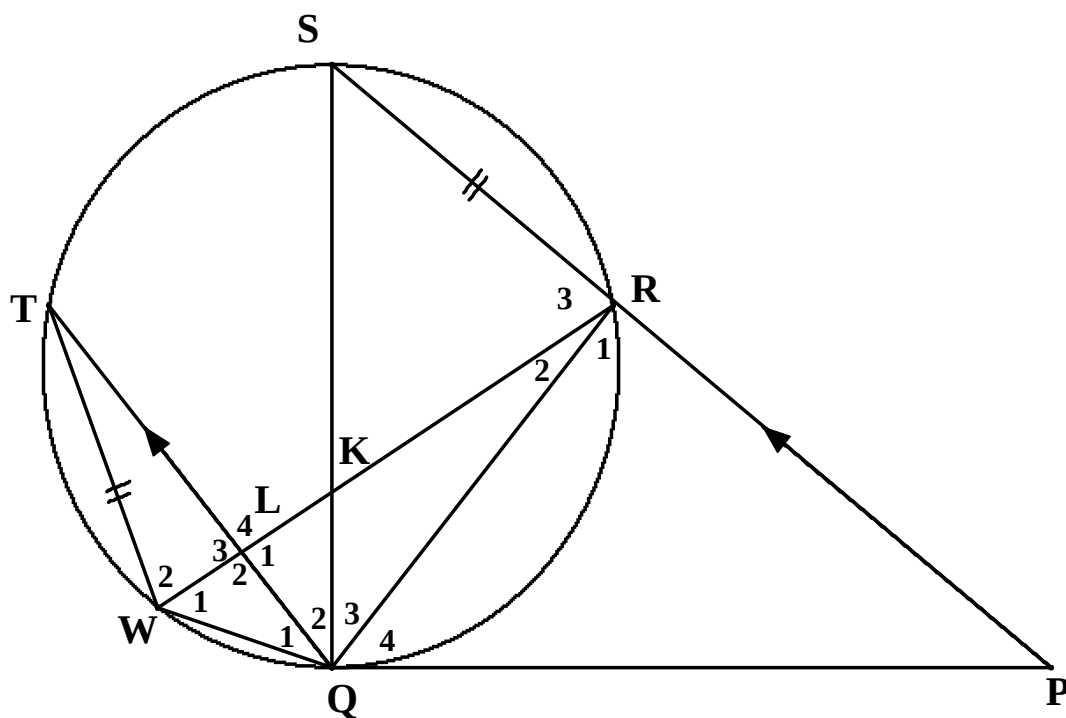
11.1.2  $\hat{PSR}$

11.1.3  $\hat{Q}$

11.1.4  $\hat{P}_3$

- 11.2 In the diagram below, PQ is a tangent to circle SRQWT at Q.  
 PRS is a straight line.  
 RW cuts SQ and QT at K and L respectively.

$PS \parallel QT$ ,  $RS = TW$  and  $\hat{Q}_2 = x$ .



11

- .2.1 Find , with reasons, three other angles equal to  $x$ .

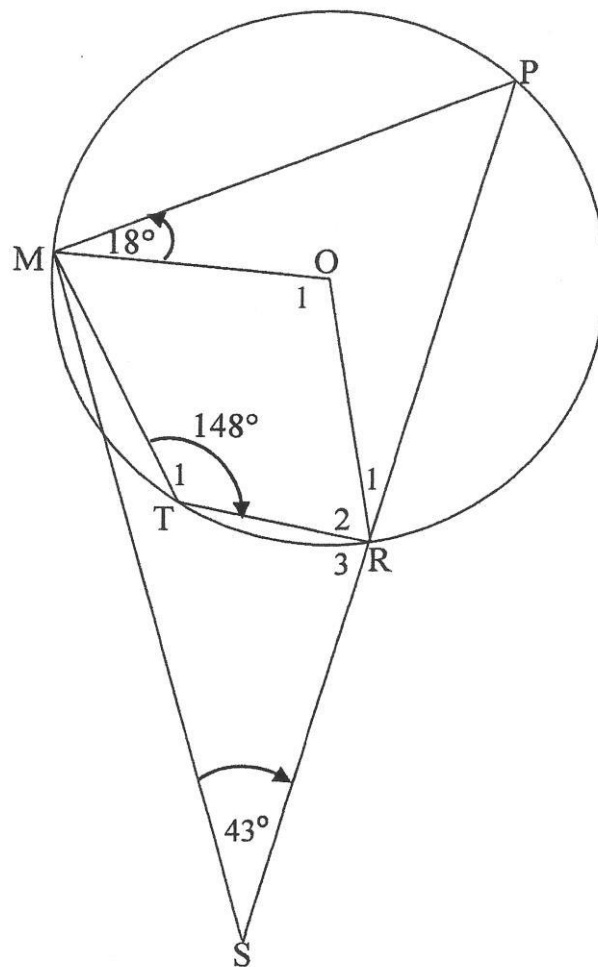
Prove that :

<sup>11</sup>  
 11.2.2  $\hat{R}_1 = \hat{L}_3$

- .2.3 PRKQ is a cyclic quadrilateral.

## QUESTION 12

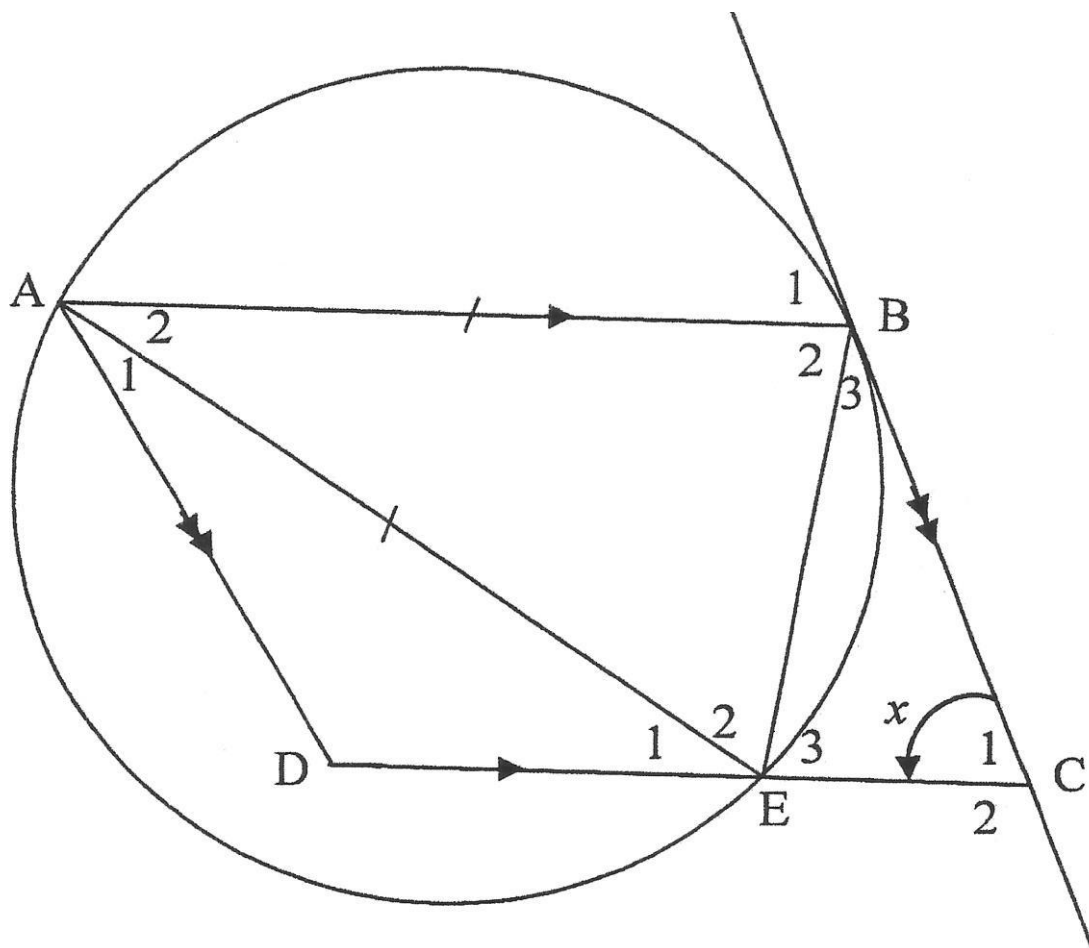
- 12.1 In the diagram below, P, M, T and R are points on a circle having centre O. PR produced meets MS at S. Radii OM and OR and the chords MT and TR are drawn.  $\hat{T}_1 = 148^\circ$ ,  $\hat{P}MO = 18^\circ$  and  $\hat{S} = 43^\circ$ .



Calculate, with reasons the the size of:

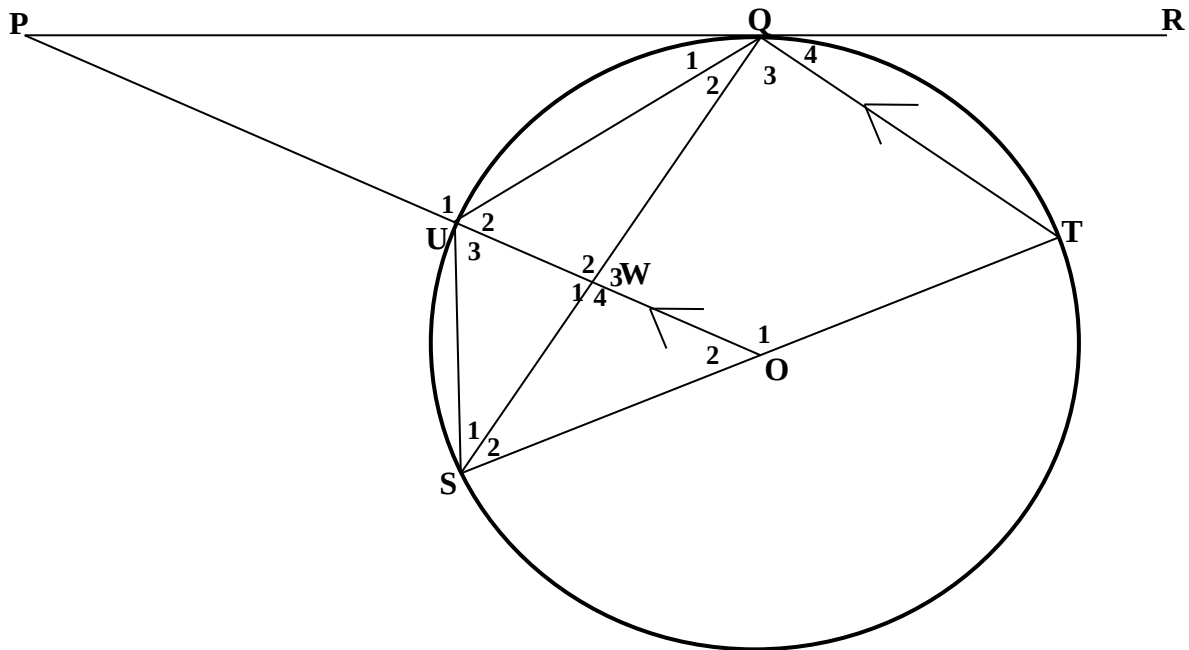
- 12.1.1  $\hat{P}$
- 12.1.2  $\hat{O}_1$
- 12.1.3  $\hat{OMS}$
- 12.1.4  $\hat{R}_3$  if it is given that  $\hat{TMS} = 6^\circ$ .

- 12.2 In the diagram below, the circle passes through A, B and E.  
 ABCD is a parallelogram. BC is a tangent to the circle at B.  
 AE = AB. Let  $\hat{C}_1 = x$ .



- 12.2.1 Give a reason why  $\hat{B}_1 = x$ .
- 12.2.2 Name, with reasons, THREE other angles equal to  $x$ .
- 12.2.3 Prove that ABED is a cyclic quadrilateral.

12.4 In the diagram below PR is a tangent to the circle at Q, OP // TQ and S, U, Q and T are points on the circle. QS and OP intersect at W. O is the centre of the circle.



12.4.1 Prove that W is the midpoint of QS.

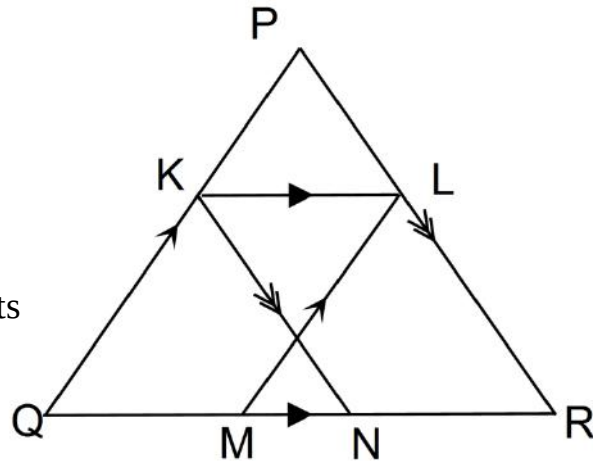
12.4.2 Prove that  $\hat{Q}_1 = \hat{Q}_2$

12.4.3 Prove that SOQP is a cyclic quadrilateral.

### QUESTION 13

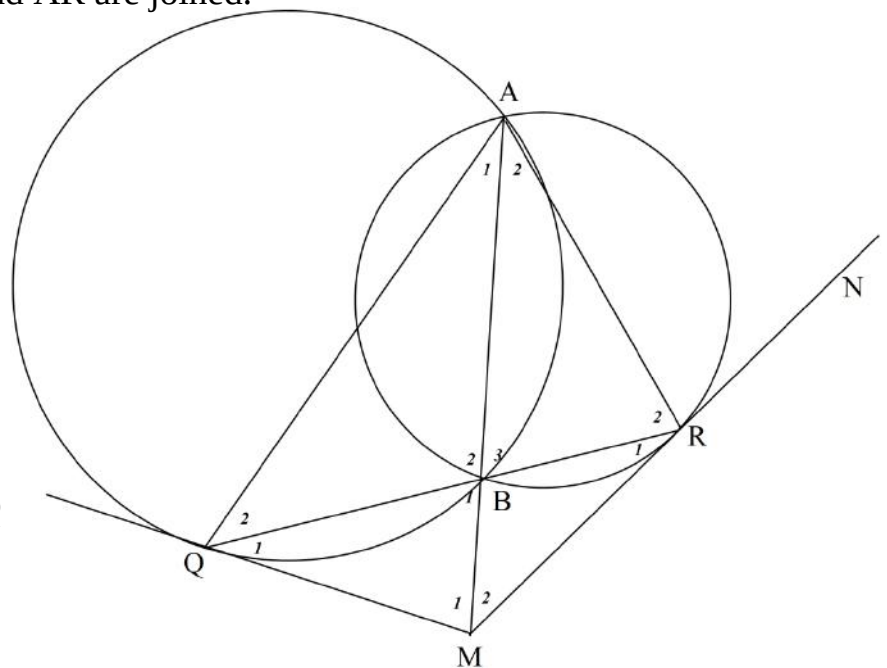
- 13.1 In the figure,  $KL \parallel QR$ , and points  $M$  and  $N$  on  $QR$  are chosen so that  $KN \parallel PR$  and  $LM \parallel PQ$ .

$PK = 3$  units,  $PL = 4$  units,  $LR = 6$  units and  $MN = 1,8$  units.



- 13.1.1 Calculate  $KQ$
- 13.1.2 State why  $QM = KL$
- 13.1.3 Prove that  $QM = NR$

- 13.2 In the figure, two circles intersect at  $A$  and  $B$ .  $AB$  produced to  $M$  bisects  $\hat{Q}AR$ . Tangents  $MQ$  and  $MR$  meet the circles at  $Q$  and  $R$  such that  $QBR$  is a straight line.  $AQ$  and  $AR$  are joined.



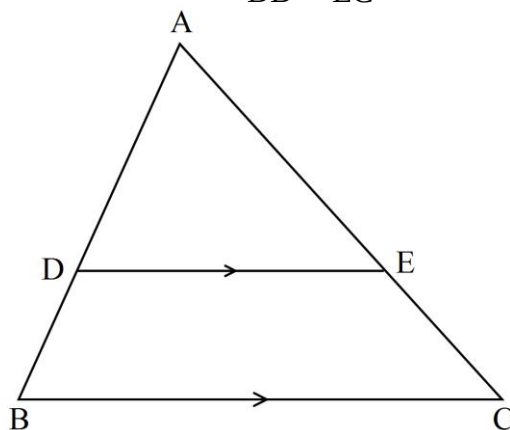
Prove:

- 13.2.1  $\triangle MQA \parallel \triangle MBQ$
- 13.2.2  $MR^2 = AM \cdot MB$
- 13.2.3  $BM \cdot AB = QB \cdot BR$

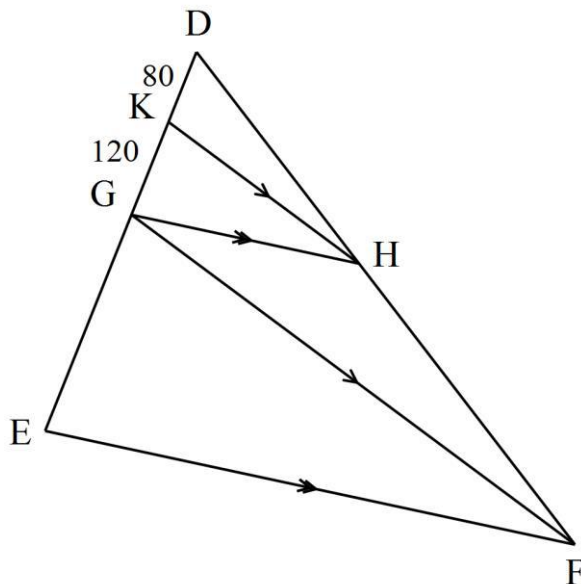
## QUESTION 14

14.1 Use the diagram below to prove the theorem that states that the line drawn parallel to one side of a triangle divides the other two sides proportionally.

i.e. Given that  $DE \parallel BC$  prove:  $\frac{AD}{DB} = \frac{AE}{EC}$



14.2 In  $\triangle DEF$ ,  $GH \parallel EF$  and  $KH \parallel GF$ .  $DK = 80$  units and  $KG = 120$  units



Determine, giving reasons,

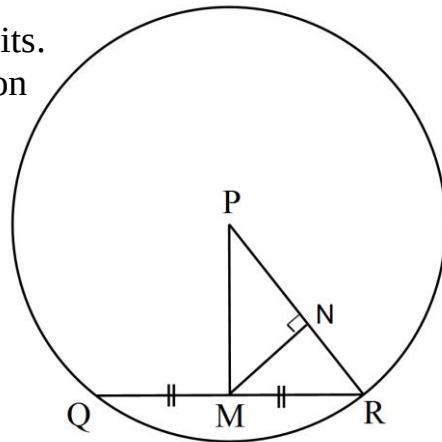
14.2.1  $\frac{DH}{HF}$  in simplest fraction form

14.2.2 the length of DE

14.2.3  $\frac{\text{Area } \triangle DHK}{\text{Area } \triangle DGF}$

## QUESTION 15

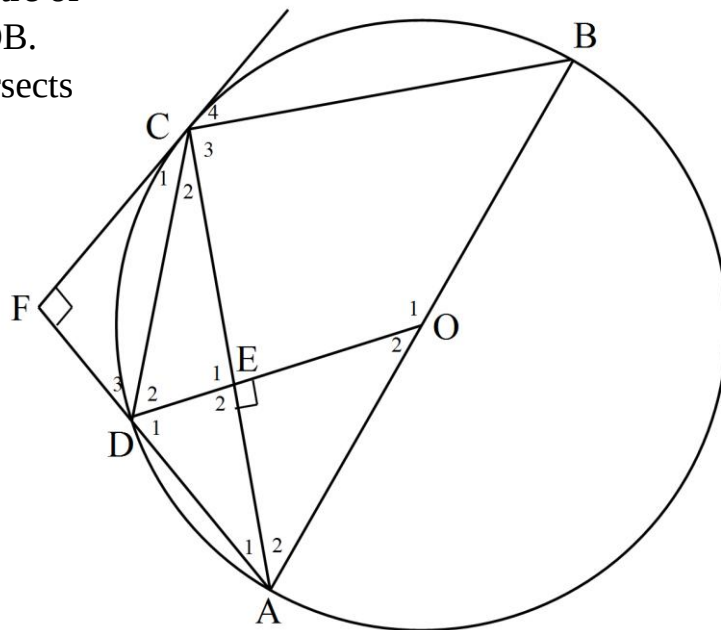
- 15.1 P is the centre of the circle with radius 73 units.  
M is the midpoint of chord QR, N is a point on PR so that  $PN = 40$  units.  $MN \perp PR$ .



15.1.1 Give a reason why  $PM \perp QR$ .

15.1.2 Determine the length of MR (to the nearest whole number), giving reasons.

- 15.2 In the diagram, O is the centre of the circle with diameter AOB.  
The tangent through C intersects AD produced at F.  
 $OD \perp AC$  and  $CF \perp AF$



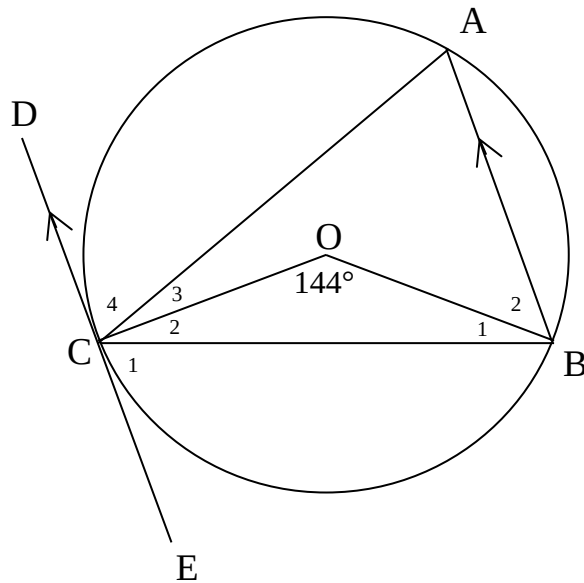
Prove that:

- 15.2.1  $\triangle FCD \parallel \triangle CAB$   
15.2.2  $FC \cdot CB = 2 FD \cdot AE$   
15.2.3 AC bisects  $\hat{FAB}$

## QUESTION 16

16.1 Complete the statement: *The angle between the tangent and a chord drawn to the point of contact is equal to ...*

16.2 In the figure O is the centre of the circle.  
DE is a tangent to the circle at C.  
DE//AB and  $\angle COB = 144^\circ$

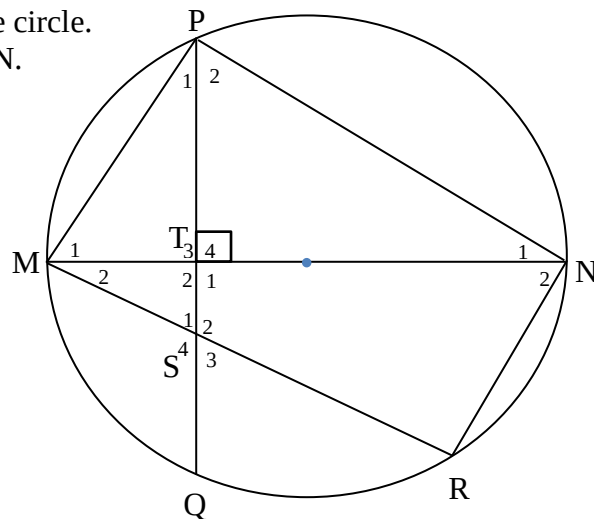


Giving reasons, find the value of :

16.2.1  $C_1$

16.2.2  $B_2$

16.3 In the given sketch, MN is a diameter of the circle.  
MPNR is a cyclic quadrilateral and  $PQ \perp MN$ .

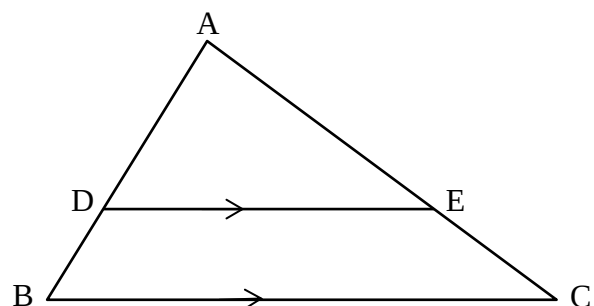


Prove:

16.3.1 TSRN is a cyclic quadrilateral

16.3.2 MP is a tangent to the circle through PTN

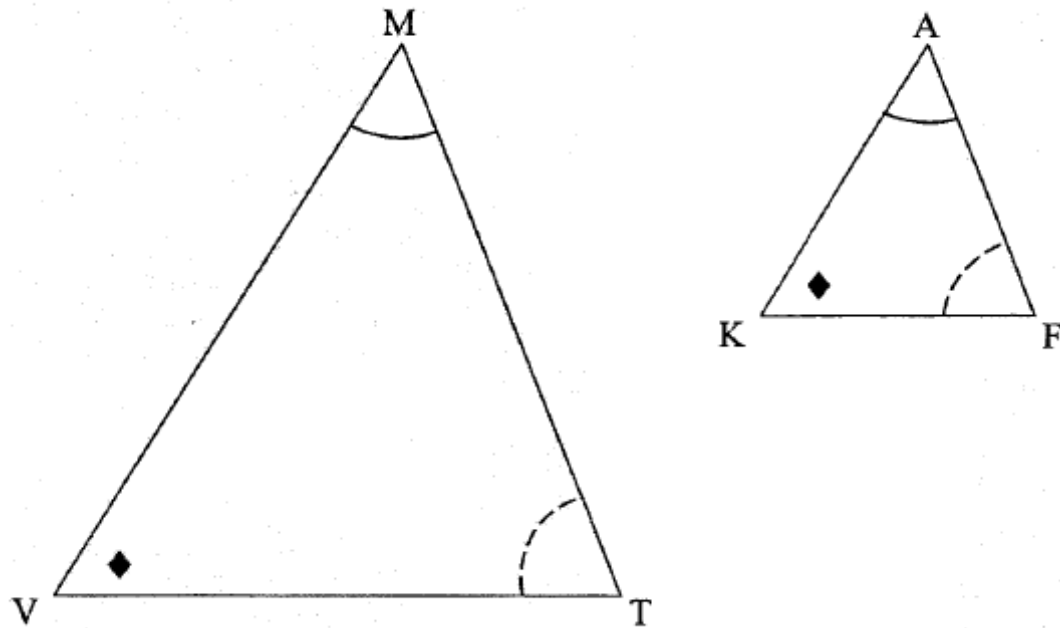
16.4 The figure alongside is reproduced on your **diagram sheet**.  
**Show your constructions on the diagram sheet** and prove the Proportional Division Theorem which states:  
*A line drawn parallel to one side of a triangle divides the other two sides proportionally.*



### QUESTION 17

17.1 In the diagram below,  $\triangle MVT$  and  $\triangle AKF$  are drawn such that

$$\hat{M} = \hat{A}, \quad \hat{V} = \hat{K} \quad \text{and} \quad \hat{T} = \hat{F}.$$

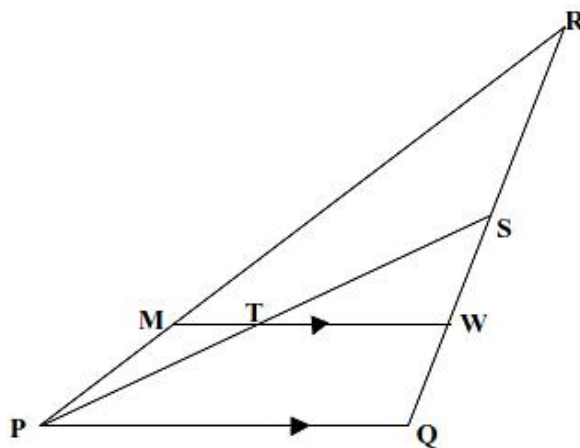


Use the diagram in the answer book to prove the theorem which states that if two triangles are equiangular, then the corresponding sides are

in proportion, that is  $\frac{MV}{AK} = \frac{MT}{AF}$ .

### QUESTION 18

In the accompanying diagram, PS bisects RQ. T is the midpoint of PS and  $MTW \parallel PQ$ .



Calculate, with reasons, the numerical value of the following:

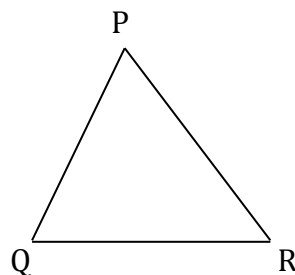
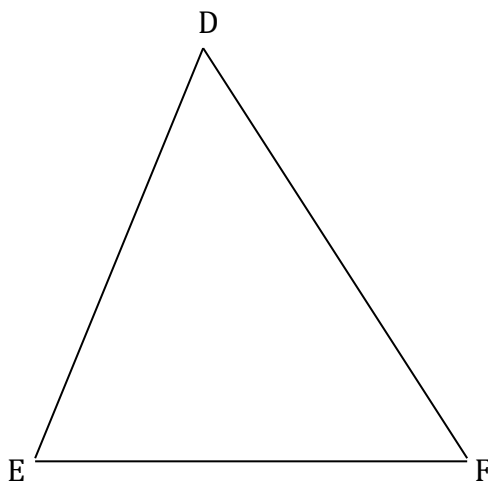
18.1  $\frac{RM}{RP}$

18.2  $\frac{\text{Area } \Delta RPS}{\text{Area } \Delta RMW}$

### QUESTION 19

19.1 In the diagram below, DEF and PQR are two triangles such that

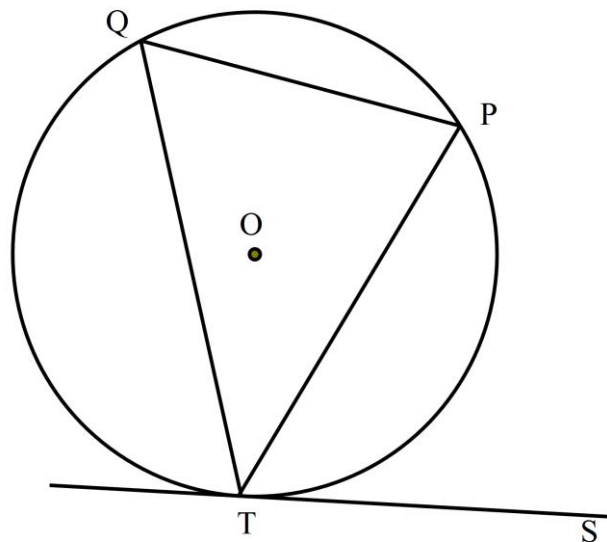
$$\hat{D} = \hat{P}, \hat{E} = \hat{Q} \text{ and } \hat{F} = \hat{R}$$



Prove the theorem, which states that:  $\frac{DE}{PQ} = \frac{DF}{PR}$

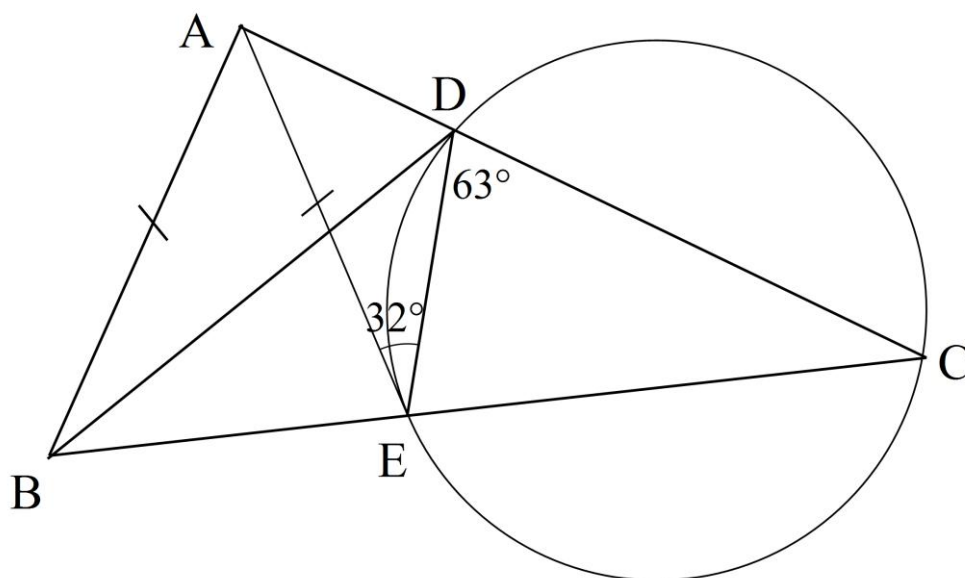
## QUESTION 20

20.1 O is the centre of the circle, and ST is a tangent to the circle at T.



Use the diagram to prove the theorem which states that  $\hat{STP} = \hat{Q}$ .

20.2 CD and CE are produced to A and B respectively so that AE is a tangent to the circle and  $AB = AE$ .  $\hat{AED} = 32^\circ$  and  $\hat{CDE} = 63^\circ$ .



20.2.1 Calculate, giving reasons, the size of

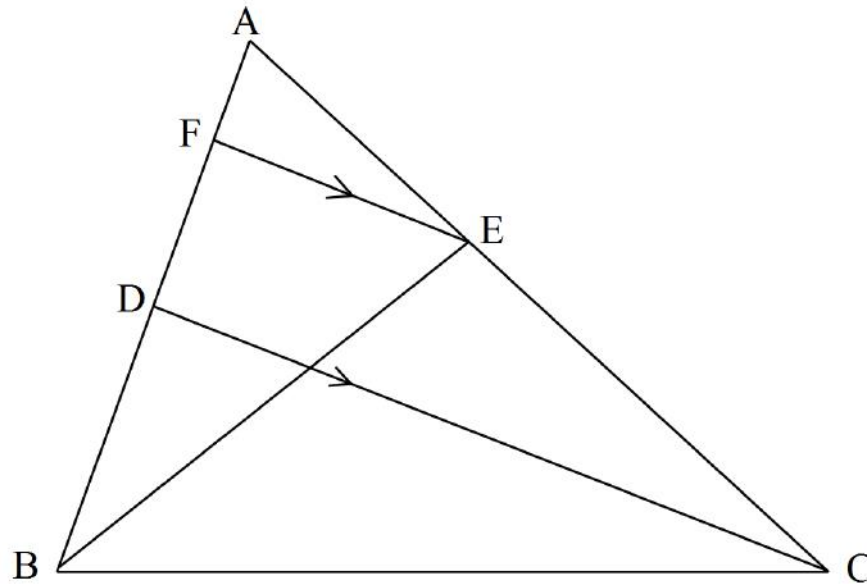
- a)  $\hat{C}$
- b)  $\hat{AEB}$

20.2.2 Prove that ABED is a cyclic quadrilateral.

20.2.3 Prove that AB is a tangent to the circle through B, D and C.

20.2.4. Calculate, giving reasons, the size of  $\hat{BDE}$ .

### QUESTION 21



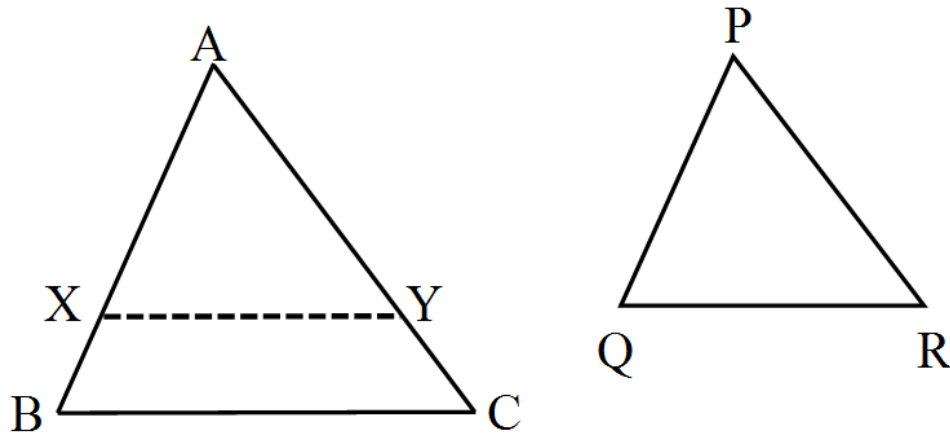
In  $\triangle ABC$ , D is the midpoint of AB,  $CD \parallel EF$  and  $\frac{AE}{EC} = \frac{2}{3}$ .

21.1 Determine, with reasons, the value of  $\frac{AF}{FB}$ .

21.2 Find the value of  $\frac{\text{Area } \triangle BCE}{\text{Area } \triangle FEA}$  (no reasons required).

## QUESTION 22

22.1 In the diagram below,  $\triangle ABC$  and  $\triangle PQR$  are given with  $\hat{A} = \hat{P}$ ,  $\hat{B} = \hat{Q}$  and  $\hat{C} = \hat{R}$ .



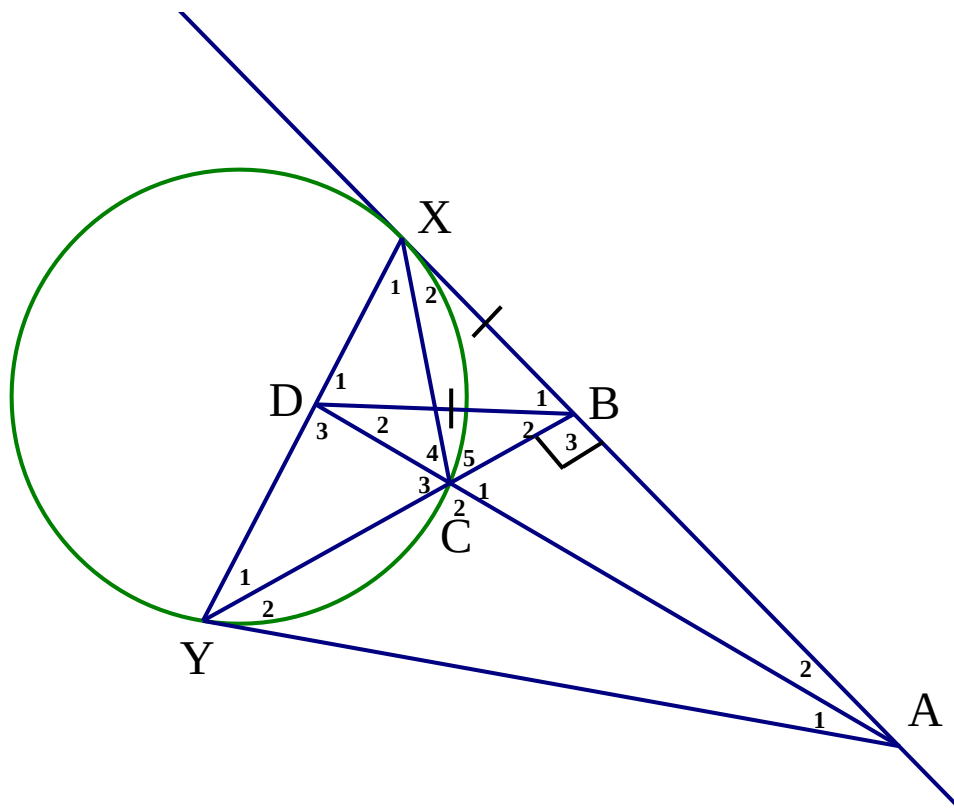
Line XY is drawn so that  $AX = PQ$  and  $AY = PR$ .

Use the diagram to prove

22.1.1  $XY \parallel BC$

22.1.2  $\frac{AB}{PQ} = \frac{AC}{PR}$

### Question 23



In the diagram XBA is the tangent to the circle at X.

- XDY is a chord, with DB constructed so that  $XB = DB$ .
- C is a point on the circle, with YCB perpendicular to XBA.
- DCA is a straight line.

23.1 Prove that  $\widehat{C}_5 = \widehat{X}_1 + \widehat{X}_2$ .

23.2 Hence, prove that XBCD is a cyclic quadrilateral.

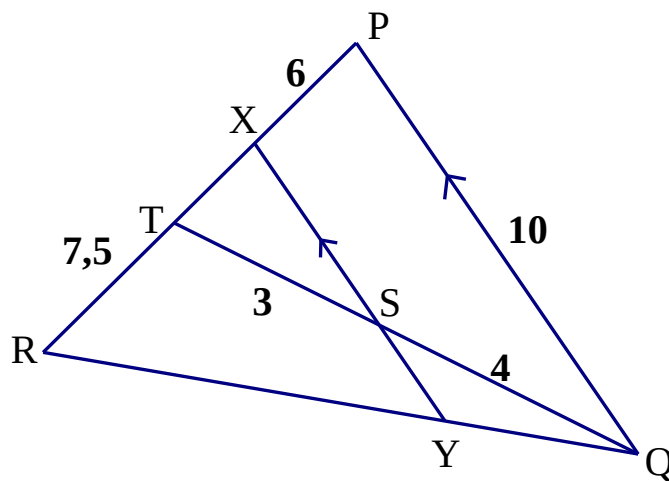
23.3 Show that the area of  $\triangle AXY = \frac{1}{2} XY \cdot AD$ .

## Question 24

24.1 Answer this question on the answer sheet provided.

Complete the proof of the theorem that states that  
if  $\triangle ABC$  is equiangular to  $\triangle PQR$  then  $\frac{AB}{PQ} = \frac{AC}{PR}$ .

24.2



Given that  $XY \parallel PQ$ ,  $PX = 6\text{cm}$ ,  $RT = 7,5\text{cm}$ ,  $TS = 3\text{cm}$ ,  $SQ = 4\text{cm}$  and  $PQ = 10\text{ cm}$  :

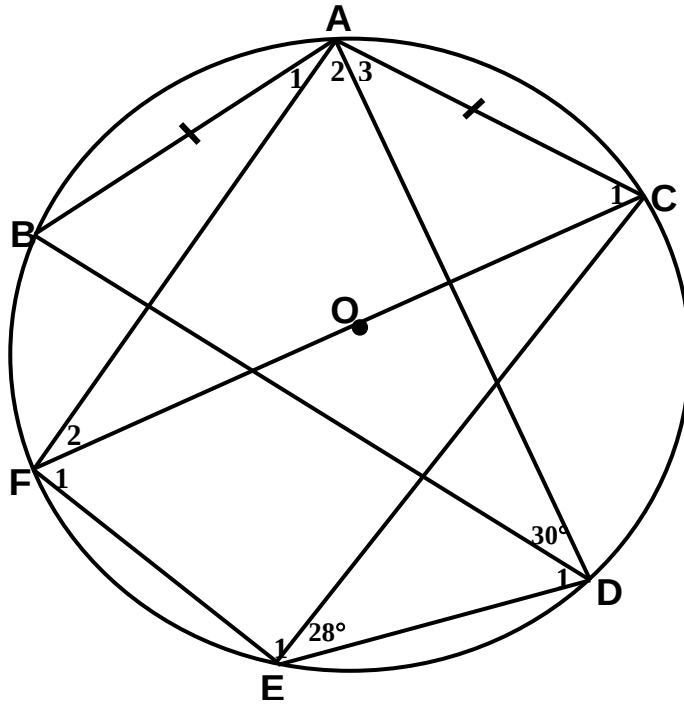
24.2.1 Find the length of TX.

24.2.2 Prove that  $\triangle RXY \parallel \triangle RPQ$

24.2.3 Hence, or otherwise, find the length of XY.

### QUESTION 25

In the diagram, O is the centre of the circle. Chords  $AB = AC$ .  $\hat{CED} = 28^\circ$  and  $\hat{ADB} = 30^\circ$



Calculate, with reasons, the sizes of the following angles:

25.1  $\hat{E}_1$

25.2  $\hat{A}_2$

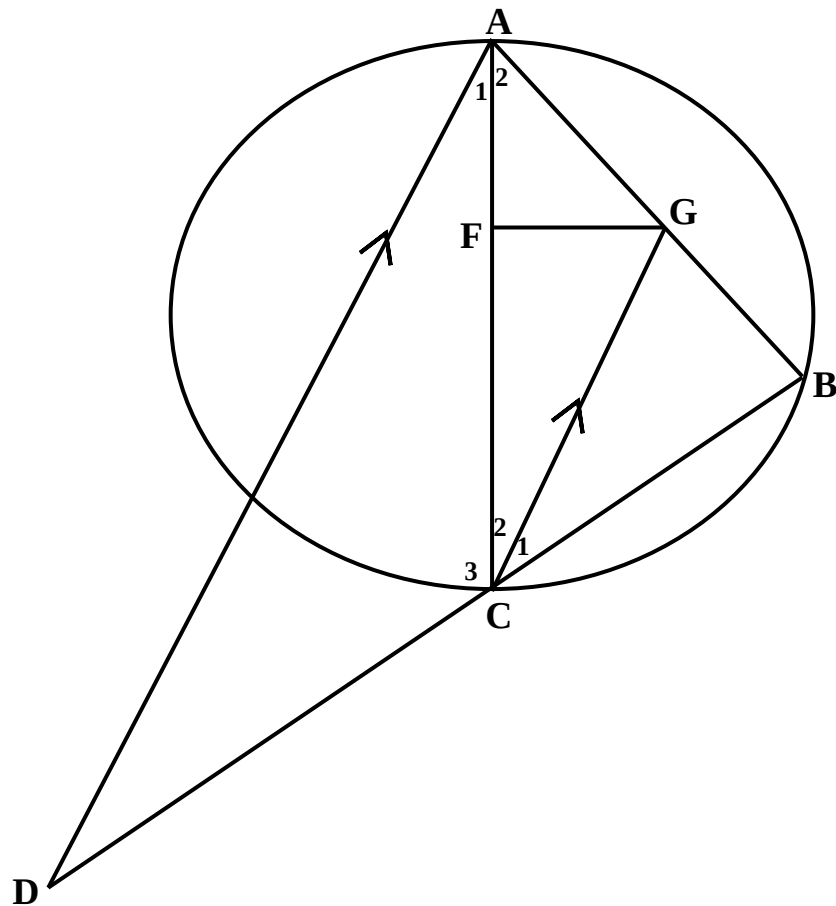
25.3  $\hat{F}_2$

## QUESTION 26

26.1 Complete the following so that the Euclidian Geometry statement is true:

A line drawn parallel to one side of a triangle divides the other two sides .....

26.2 In the diagram below,  $CG$  bisects  $\hat{ACB}$ .  $AD \parallel GC$ .

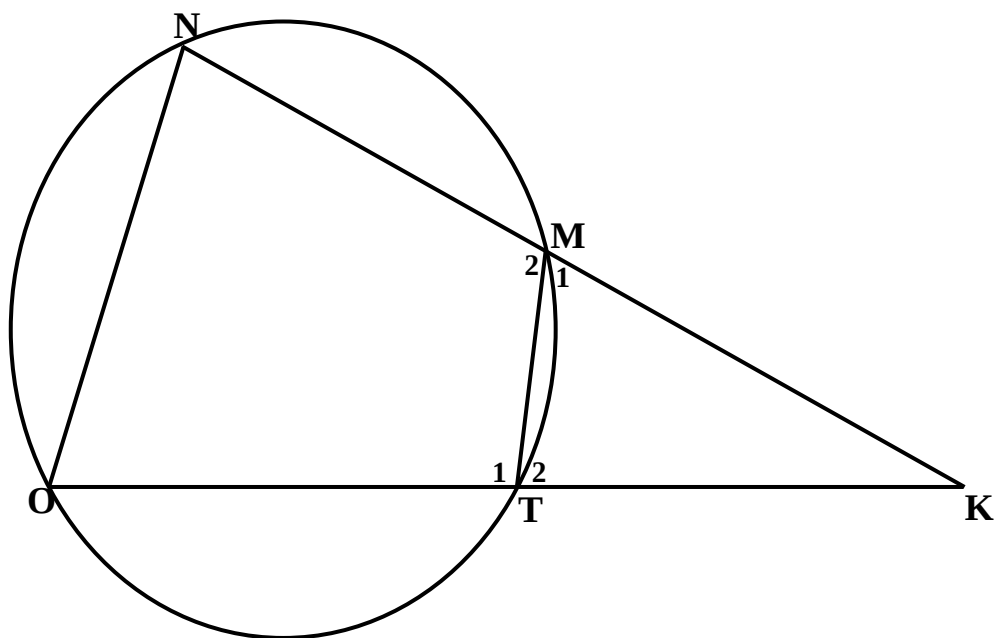


Prove, with reasons, that:

26.2.1  $AC = DC$

26.2.2  $\frac{BC}{AC} = \frac{BG}{AG}$

26.3 In the diagram, KMN and KTO are two secants of a circle.



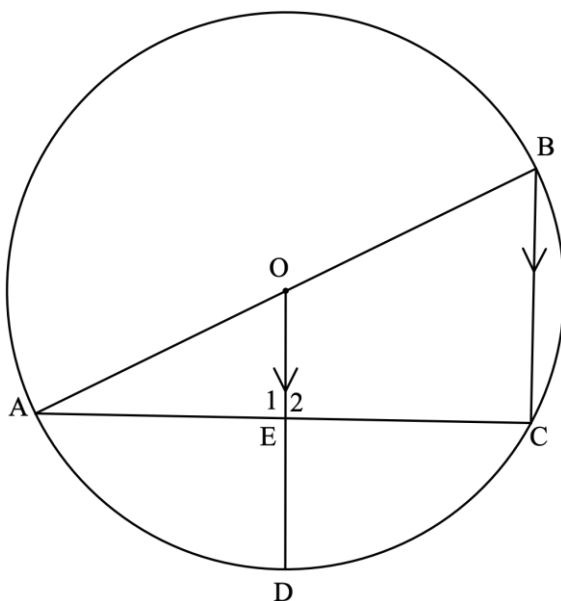
26.3.1 Prove that  $\triangle MTK \parallel \triangle ONK$ .

26.3.2 Hence, prove that  $KM \cdot KN = KT \cdot KO$

26.3.3 Calculate KT if  $OT = 6$  units,  $MN = 3$  units and  $MK = 5$  units.

### QUESTION 27

- 27.1 Complete the theorem that states: the line from the centre of the circle to the midpoint of the chord is.....
- 27.2  $AB$  is a diameter of circle  $O$ .  $OD$  is drawn parallel to chord  $BC$  and intersects  $AC$  at  $E$ .

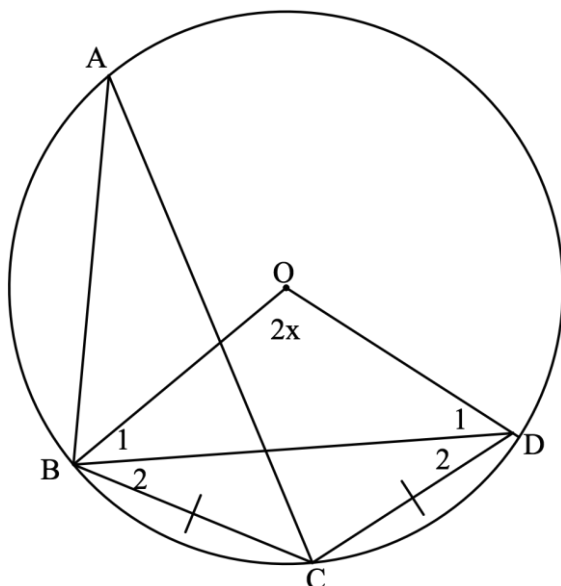


$ED = 4\text{ cm}$  and  $AC = 16\text{ cm}$ .

- 27.2.1 Prove  $AE=EC$
- 27.2.2 Why is  $\hat{E}_1 = 90^\circ$ ?
- 27.2.3 Hence calculate the length of AB.

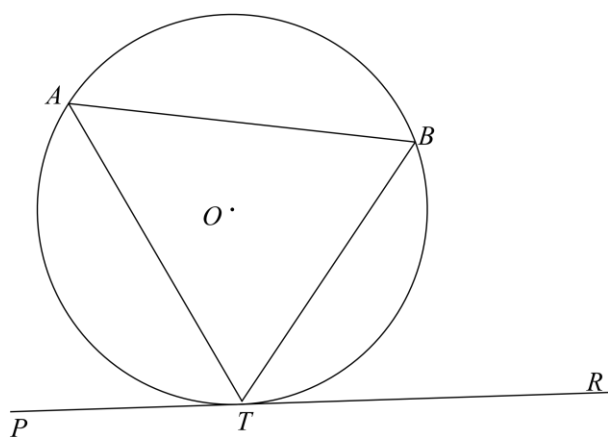
## QUESTION 28

28.1 Circle with centre  $O$  through  $A, B, C$  and  $D$  is given,  $BC = CD$  and  $\hat{BOD} = 2x$ .



Determine  $\hat{D}_2$  in terms of  $x$ .

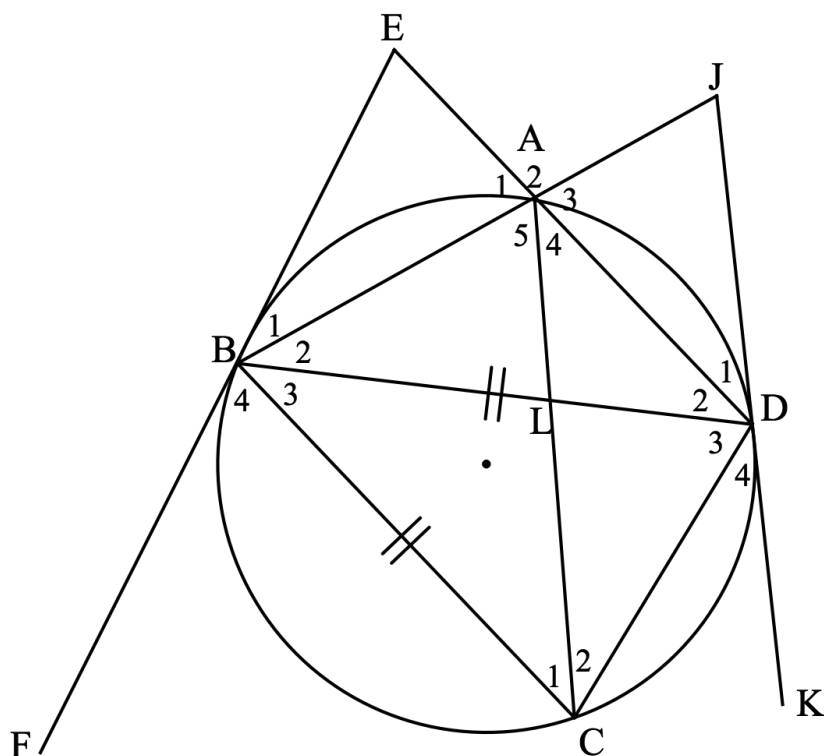
28.2 In the diagram the circle with centre  $O$  passes through points  $A, B$  and  $T$ .  $PR$  is a tangent to the circle at  $T$ .  $AB, BT$  and  $AT$  are chords.



Prove that  $\hat{BTR} = \hat{A}$

28.3 In the diagram below  $EBF$  and  $JDK$  are tangents to the circle.  $BC$  is drawn such that  $BC=BD$ .  $ED$  cuts the circle at  $A$ .  $BA$  produced meets  $JK$  at  $J$ .  $AC$  cuts  $BD$  at  $L$ .

Let  $\hat{A}_5 = x$



Prove that:

28.3.1  $\hat{BCD} = \hat{A}_5$

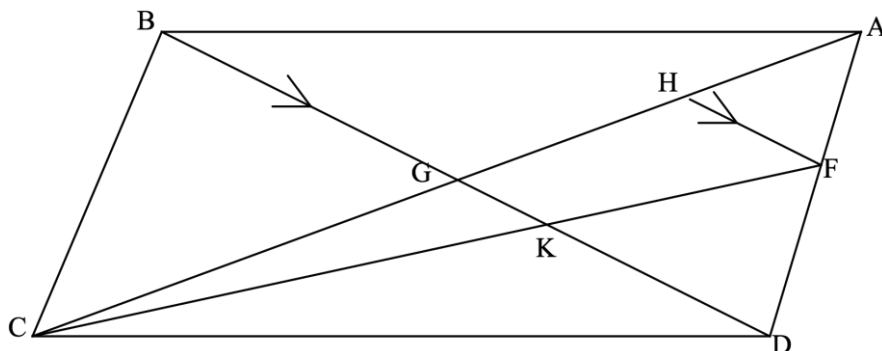
28.3.2  $\hat{A}_1 = \hat{A}_5$ .

28.3.3  $ALDJ$  is a cyclic quadrilateral.

### QUESTION 29

ABCD is a parallelogram with diagonals BD and AC . HF //BD

CG=72 units , DF=24 units and FA=40 units.



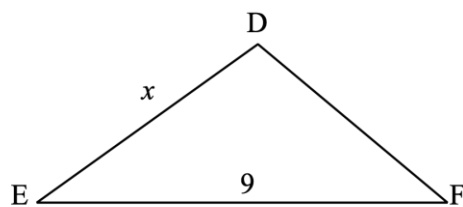
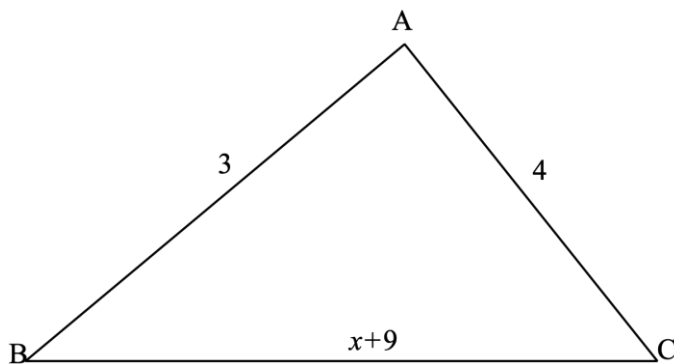
Determine, with reasons

29.1 the length of GH.

29.2 the value of the  $\frac{\text{area of } DAHF}{\text{area of } DACD}$

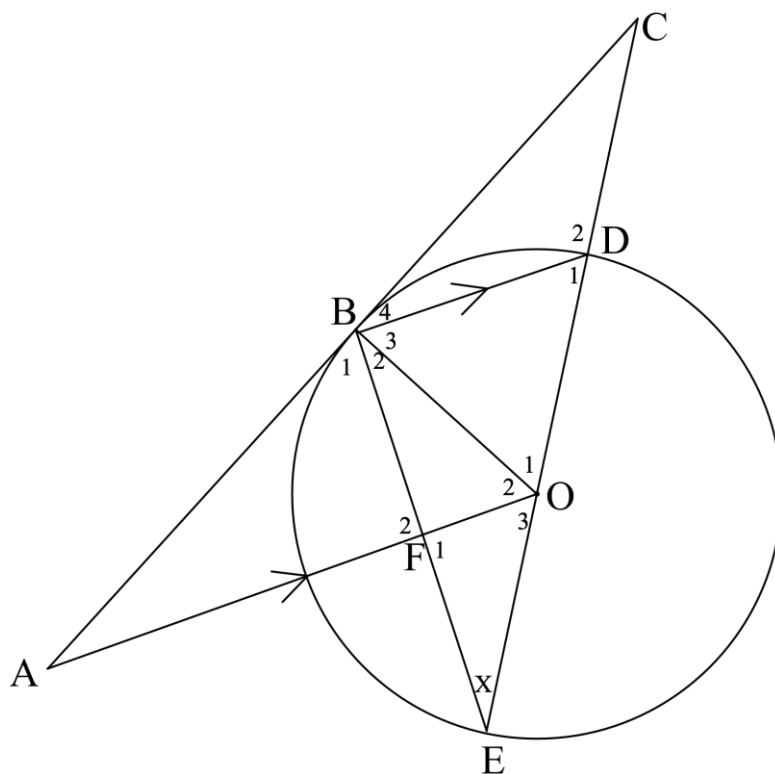
### QUESTION 30

- 30.1 In the diagram below  $\triangle ABC$  and  $\triangle DEF$  are drawn.  
 $AB = 3\text{units}$ ,  $AC = 4\text{units}$ ,  $BC = (x + 9)\text{units}$ ,  $DE = x\text{units}$   
 and  
 $EF = 9\text{units}$



If  $\triangle ABC \sim \triangle DEF$ , calculate the value of  $x$ .

- 30.2 ED is a diameter of a circle with centre O. ED is extended to C. CA is a tangent to the circle at B. AO intersects chord BE at F.  $\angle E = x$ .  $\angle BDE = x$ .



Prove that:

30.2.1  $\angle DCB \equiv \angle DCE$

30.2.2  $2EF \times CB = CE \times BD$

## Bibliography

## Bibliography

### Books and Journals

[1] D. Bloor, *A Book of Mathematics*, 2012.  
[2] C. Chou and D. Bloor, "Writing learning activities", in: *The Journal of Mathematics* (Dec. 1, 2010).

### Electronic Resources

[3] A. Aulic, *Proving activities*, (2011), <http://www.example.org> (visited on 01/09/2015).

## 1. PAST EXAMINATION PAPERS

### 1.1 TRIAL EXAMINATION PAPERS FROM:

BISHOPS (2014-2016); BERGVLIET (2014); CLAREMONT HS (2014 and 2016); HERZLIA (2016); NHHS (2014-2015); RBH (2015); SOUTHPEN HS (2014-2016); ST CYPRIANS (2014); ISLAMIA (2014); HERSCHEL (2016); WGHS (2016) and GROOTE SCHUUR (2015)

## Outcomes reached

|                                                                                                                                                                                  | YES | NO |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|----|
| 1. The line drawn from the centre of a circle perpendicular to a chord bisects the chord;                                                                                        |     |    |
| 2. The angle subtended by an arc at the centre of a circle is double the size of the angle subtended by the same arc at the circle (on the same side of the chord as the centre) |     |    |
| 3. The opposite angles of a cyclic quadrilateral are supplementary                                                                                                               |     |    |
| 4. The angle between the tangent to a circle and the chord drawn from the point of contact is equal to the angle in the alternate segment                                        |     |    |
| 5. A line drawn parallel to one side of a triangle divides the other two sides proportionally                                                                                    |     |    |
| 6. Equiangular triangles are similar.                                                                                                                                            |     |    |
| <b>Corollaries derived from the theorems and axioms:</b>                                                                                                                         |     |    |
| 1. Angles in a semi-circle equal chords subtend equal angles at the circumference                                                                                                |     |    |
| 2. Equal chords subtend equal angles at the centre                                                                                                                               |     |    |
| 3. In equal circles, equal chords subtend equal angles at the circumference                                                                                                      |     |    |
| 4. In equal circles, equal chords subtend equal angles at the centre.                                                                                                            |     |    |
| 5. The exterior angle of a cyclic quadrilateral is equal to the interior opposite angle of the quadrilateral.                                                                    |     |    |
| 6. If the exterior angle of a quadrilateral is equal to the interior opposite angle of the quadrilateral, then the quadrilateral is cyclic.                                      |     |    |
| 7. Tangents drawn from a common point outside the circle are equal in length.                                                                                                    |     |    |