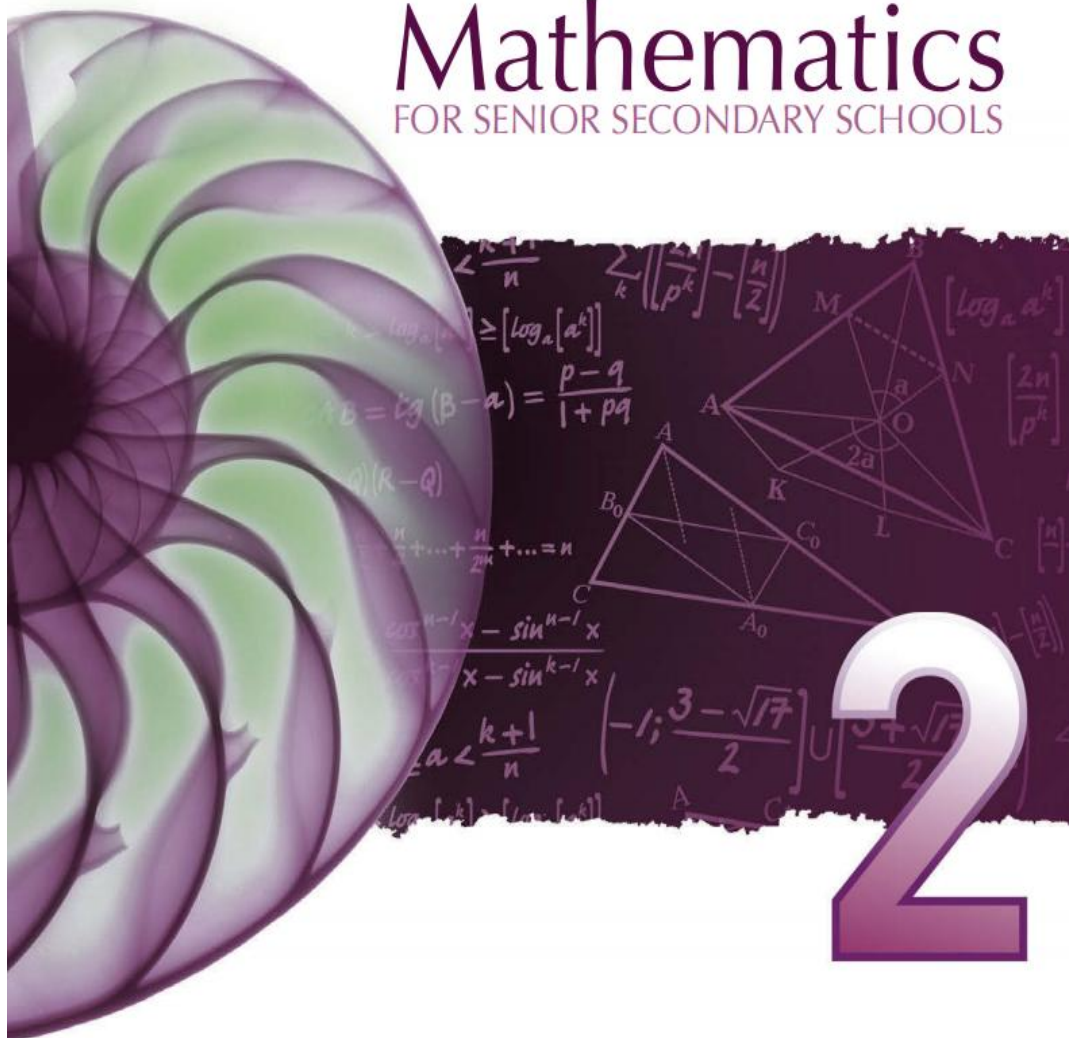


APPENDIX I

# New General Mathematics

FOR SENIOR SECONDARY SCHOOLS



TEACHER'S GUIDE

## Chapter 2

## Circle geometry 1: Chords, arcs and angles

### Learning objectives

By the end of this chapter, the students should be able to:

1. Define and name the lines and regions of a circle, including cyclic quadrilaterals.
2. Recall, use and apply mid-point properties of chords.
3. Recall, use and apply the following properties of angles subtended by arcs and chords at the centre and circumference of a circle:
  - angle at centre =  $2 \times$  angle at circumference
  - angles in the same segment are equal
  - angle in a semi-circle =  $90^\circ$ .
4. Recall, use and apply the following properties of cyclic quadrilaterals:
  - opposite angles are supplementary
  - exterior angle = opposite interior angle.

### Teaching and learning materials

**Students:** Mathematical set (including a protractor and compass).

**Teacher:** Posters, cardboard models, chalkboard instruments (especially a protractor and compass), computer instructional materials where available.

### Areas of difficulty

- Students tend to forget theorems and deductions made from them.

Students must always give a reason for each statement that they make that is based on some or other theorem, and they either do not give the reason or do not know how.

To help the students, you could give them summaries of the theorems and suggestions of the reasons they can give. Below are suggestions:

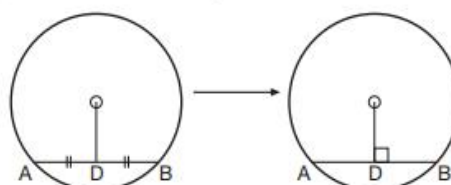
1. Theorem 10 and the rules that follow can be remembered as follows:

#### Three facts:

- Centre circle
- Midpoint chord
- Perpendicular chord

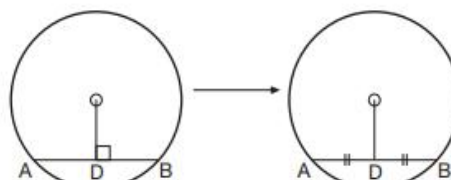
If **two** of these facts are **present**, then the **other one** is also **present**.

- a) Given: Centre circle, Centre chord:  $\perp$  chord



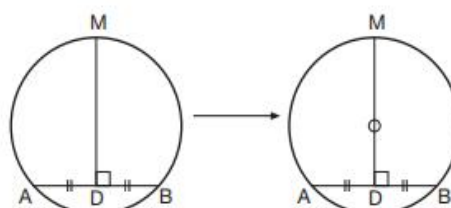
Reason given if this fact is used: **OD bisects AB**

- b) Given: Centre circle,  $\perp$  chord Centre chord



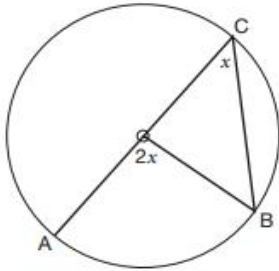
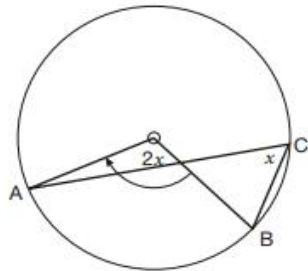
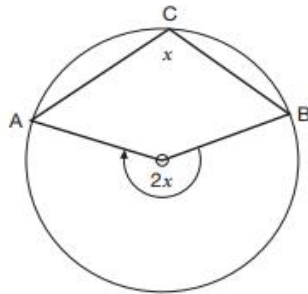
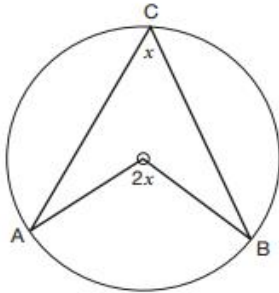
Reason given if this fact is used: **OD  $\perp$  AB**

- c) Given: Centre chord,  $\perp$  chord centre circle



Reason given if this fact is used: **AD = DB, MD  $\perp$  AB**

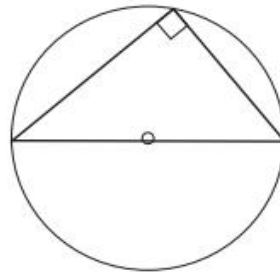
2. Angle at the centre of a circle subtended by a certain arc is equal to twice the angle at the circumference subtended by the same arc.



Reason given if this theorem is used:  
 $\angle \text{ at centre} = 2 \times \angle \text{ at circumf. on AB}$   
 (it is always easier to write reasons as short as possible)

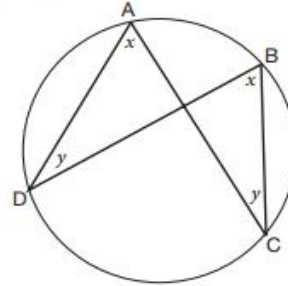
3. Deductions from this theorem:

a)



Reason given if this fact is used:  $\angle \text{ in semi - circle}$

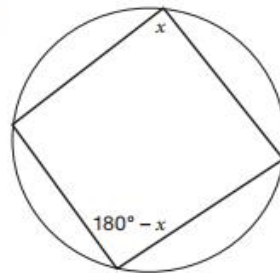
b)



Reason given if this fact is used:  
 $\angle \text{'s on DC} = \text{ or } \angle \text{'s on AB} =$

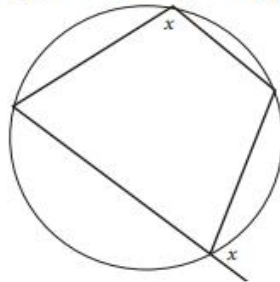
4. Cyclic quadrilateral theorems:

a)



Reason given if this theorem is used:  
**opp.  $\angle$ 's cyclic quad suppl**

b)



Reason given if this theorem is used:  
**Ext  $\angle$  cyclic quad = opp interior  $\angle$**

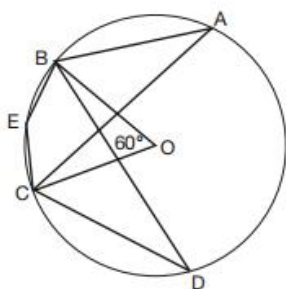


- Students find it difficult to recognise the angle(s) at the circumference subtended by the same arc as the angle at the centre of the circle. You can help them by teaching them to use their thumb and forefinger to trace the angle at the centre starting from the two points of the arc that subtend this angle. Then they start at the same two points and trace the angle at the circumference of the circle subtended by the same arc (chord).
- Students find it difficult to recognise the angle(s) at the circumference subtended by the same arc. You can help them by teaching them to use their thumb and forefinger to trace the one angle starting from the two points of the arc that subtends this angle. Then they start at the same two points and trace the other angle(s) at the circumference subtended by the same arc (chord).
- Students find it difficult to see the exterior angle of the cyclic quadrilateral. You can help them to recognise any exterior angle by letting them draw any quadrilateral. Then they must lengthen its sides to get as many as possible of its exterior angles.
- Students find it difficult to see which interior angle is the angle opposite the exterior angle of the quadrilateral. Teach them that:
  - It is not any of the angles which share a side or a produced side with the exterior angle.
  - Neither is it the angle adjacent to the exterior angle.
  - So it could only be one other angle.

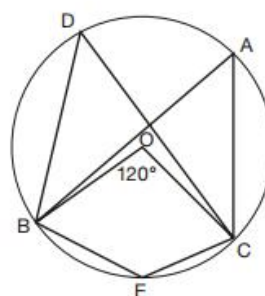
### Supplementary worked examples

If students find it difficult in the beginning to recognise angles at the centre of a circle and the angles at the circumference of the circle that are equal to twice the angle at the centre of the circle, you can let them do the following problems.

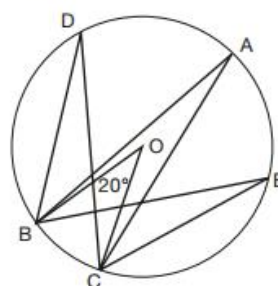
1. If  $\angle O = 60^\circ$ , find the sizes of,  $\angle A$ ,  $\angle D$  reflex  $\angle O$  and  $\angle E$ .



2. If  $\angle O = 120^\circ$ , find the sizes of  $\angle A$ ,  $\angle D$ , reflex  $\angle O$  and  $\angle E$ .



3. If  $\angle O = 20^\circ$ , find the sizes of  $\angle D$ ,  $\angle A$  and  $\angle E$ .



### Solutions

1.  $\angle A = 30^\circ = \angle D$  ( $\angle$  at centre =  $2 \times \angle$  at circumference on BC)  
 Reflex  $\angle O = 300^\circ$  ( $\angle$ 's around a point =  $360^\circ$ )  
 $\angle E = 150^\circ$  ( $\angle$  at centre =  $2 \times \angle$  at circumference on AD)
2.  $\angle D = \angle A = 60^\circ$  ( $\angle$  at centre =  $2 \times \angle$  at circumference on BC)  
 Reflex  $\angle O = 240^\circ$  ( $\angle$ 's around a point =  $360^\circ$ )  
 $\angle E = 120^\circ$  ( $\angle$  at centre =  $2 \times \angle$  at circumference on AD)
3.  $\angle D = \angle A = \angle E = 10^\circ$  ( $\angle$  at centre =  $2 \times \angle$  at circumference on BC)

## Chapter 12

## Circle geometry: Tangents

### Learning objectives

By the end of this chapter, the students should be able to:

1. Define and apply the properties of a tangent of a circle.
2. Recall, use and apply the following tangent properties to solve circle problems:
  - tangents from an external point are equal
  - the alternate segment theorem
  - angle between tangent and radius =  $90^\circ$ .

### Teaching and learning materials

**Students:** Textbook, exercise book.

**Teacher:** Posters, cardboard models, chalkboard instruments (especially a protractor and a compass), computer instructional materials where available.

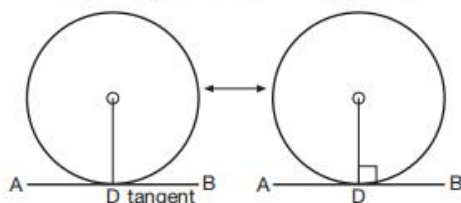
### Glossary of terms

**Secant** of a circle is a line that intersects the circle in two places or it has two points in common with the circle.

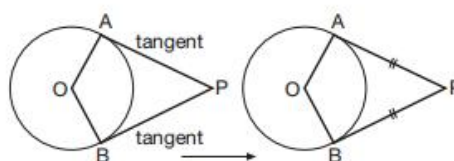
**Tangent of a circle** is a line that intersects the circle in only one place. We can also say that it has only one point in common with the circle.

### Areas of difficulty

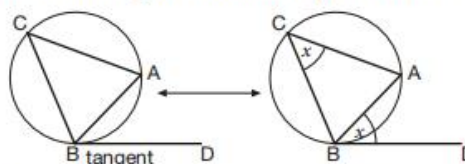
- Students tend to forget theorems and deductions made from them.
  - Students must always give a reason for each statement that they make which is based on some or other theorem and they either do not give the reason or do not know how.
  - To help them you could give them summaries of the theorems and suggestions of the reasons they can give. Below are suggestions:



**Reason:** Radius  $\perp$  tangent



**Reason:** Tangents from same point P are =



**Reason:** Angle between tangent BD and chord BA = angle on BA

- Students find it difficult to recognise the angle in the alternate or opposite segment which is equal to the angle between the tangent and the chord.
  - Teach them that it is always the angle on the chord and the angle that touches the circumference of the circle.
  - If they still cannot recognise this, let them put their forefinger and thumb on the chord that shares the point of contact with the tangent and follow the two lines at its ends to the angle on the circumference of the circle.