Guidance for tutors

Outcome	SA6	**Student can consistently:**	Understand and apply circle theorems to find missing angles.

How the topic is examined

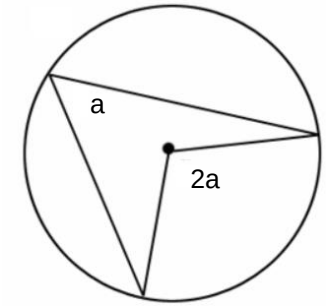
- Examined through test paper questions.
- Questions are equally likely to appear on calculator and non-calculator papers.
- Questions on this topic are very common and often students are asked to recognise and use several of these theorems each year.
- Students will be asked to work out a missing angle and they will be required to give reasons for their answers.
- The more complicated problems often have more than one of these theorems in the same diagram and students have to use their knowledge of multiple ones to find a missing angle.

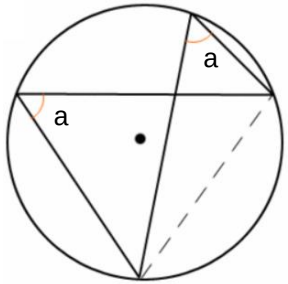
Prior knowledge

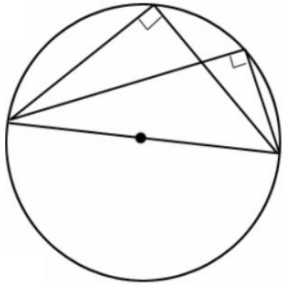
- Students should be confident with:
  - Basic angle and shape properties (SA2)
- In addition questions involving this topic can have links to:
  - Equation of a circle (AG11)
  - Pythagoras' theorem (SPT1)

Suggested tuition approaches

- Students need to be aware of the following circle theorems and then be able to apply this knowledge.







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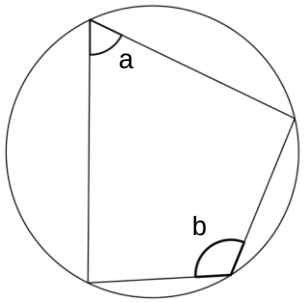
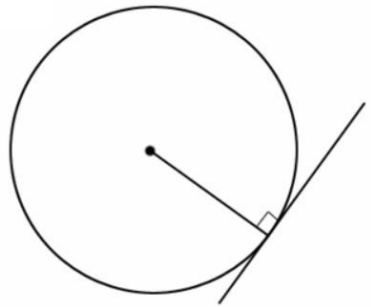
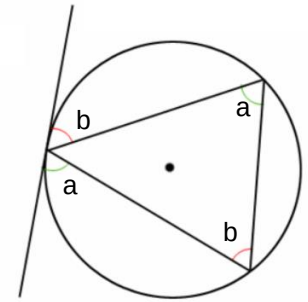
	Angle at the centre is twice the angle at the circumference. Angle at the centre theorem.	Angles in the same segment are equal.	An angle at the circumference in a semi-circle is always a right angle.
	 This is called a cyclic quadrilateral		
	Opposite angles in a cyclic quadrilateral add up to 180°. $(a + b = 180)$	The tangent to a circle is always at right angles to the radius of the circle.	Angles in alternate segments are equal.

- It is advisable to work through each theorem, one at a time answering problems on those (see questions below) then start to introduce problems that require using one or more of these diagrams.
- It is important that students used exact mathematical language in their solution. For example it is not sufficient to say (angles = 180° if finding missing angles in a cyclic quadrilateral. Students must write that opposite angles in a cyclic quadrilateral add up 180°)
- Students should meet problems that have many of these angle facts combined. (See past paper questions)
- Students should write all the angles that they find on the diagram. This should then be backed up with a calculation and/or statement in the answer space. Examiners are allowed to award marks for angles shown on a diagram.
- It is the norm for students to be required to give reasons for all their answers.

Common errors and misconceptions

- Generally students forget and confuse the different theorems. Particular ones of difficulty are the alternate segment theorem and tangent is 90° to radius.
- Students struggle with the angle at the centre theorem, when the angle at the centre is greater than 180°.

Guidance for tutors

	• Students don't use correct mathematic language (e.g. they write "butterfly theorem" etc…) • Problems that require application of more than one theorem are common however students struggle to get started. Encourage them to write values on the diagram and look for each theorem in turn.

Suggested resources	• Questions
	  ○ http://www.cimt.org.uk/projects/mepres/allgcse/bka3.pdf (pp 96 - 115)
	  ○ https://corbettmaths.files.wordpress.com/2013/02/circle-theorems.pdf
	• Past GCSE Questions
	  ○ https://keshgcsemaths.files.wordpress.com/2013/11/90_circle-theorems.pdf
	• Video tutorial
	  ○ http://corbettmaths.com/2013/04/04/circle-theorems-theorems/
	  ○ http://corbettmaths.com/2013/04/04/circle-theorems-examples/