Name	Date started	Target end date

WJEC GCSE Mathematics and Numeracy (Double Award) — Question Pack

The standard circle theorems — angle at the centre, angle in a semicircle, angles in the same segment, cyclic quadrilaterals, the tangent-radius

REVISE
.wales

2.17 — Circle theorems

Spec 3.4.4, 3.4.5 — Unit 2 (no calculator)

The standard circle theorems — angle at the centre, angle in a semicircle, angles in the same segment, cyclic quadrilaterals, the tangent-radius right angle, equal tangents from an external point, and the alternate segment theorem. Sourced from legacy WJEC GCSE Mathematics / Mathematics–Numeracy Higher non-calculator papers, organised for revision under the 2025 spec.

2025 SPECIFICATION

Estimated time for entire question pack: ~1 hours 42 minutes

*Derived from the GCSE Higher pace of **~1.5 min/mark** (68 marks across 18 questions).*

*You are advised to **not** attempt to complete all of this in one sitting.*

ABOUT THIS QUESTION PACK

This is a **focused single-topic practice pack**, not a single mock paper. Questions are organised against the 2025 specification.

Questions are ordered chronologically by sitting, with custom-written and SAM questions at the end.

INSTRUCTIONS

Use black ink or black ball-point pen. Show all working — method marks are awarded for clear setup.

*A calculator is **not** permitted on any question in this pack (Unit 2 is the non-calculator paper).*

Circle theorems — what the new spec asks

WJEC GCSE Mathematics (first teaching 2025) · Unit 2: non-calculator.

Centre & circumference 3.4.4

- Angle at centre $=2\times$ angle at circumference, same arc.
- Angle in a semicircle (diameter) $=90^\circ$.
- Angles in the same segment are equal.

Cyclic quadrilaterals 3.4.4

- All four vertices on the circle.
- Opposite interior angles sum to 180°.
- Exterior angle = opposite interior angle.

Tangents 3.4.5

- Tangent and radius meet at 90° at the point of contact.
- Two tangents from a common external point are equal in length.
- The line from the external point to the centre bisects the angle between the tangents.

Alternate segment 3.4.5

- Angle between tangent and chord = inscribed angle in the alternate segment.
- Look for the chord touching the tangent at the point of contact.
- Quote the theorem by name in any proof.

Crib sheet »

Circle theorems in one page

Quick-reference notes — revisit before each question. Don't use during the questions.

Angle at the centre

$$\text{angle at centre} = 2\times \text{ angle at circumference}$$

Same arc: the central angle is twice the inscribed angle.

E.g. arc AB: inscribed angle $= 35^\circ \Rightarrow$ central angle $= 70^\circ$.

Angle in a semicircle

Any angle inscribed in a semicircle (subtended by a diameter) is 90°.

Special case of the 'angle at the centre' rule when the central angle is 180°.

Same segment

Angles in the same segment, standing on the same arc, are equal.

Two inscribed angles looking at the same chord from the same side $\Rightarrow$ they're equal.

Cyclic quadrilateral

$$\text{opposite angles sum to } 180^\circ$$

Any quadrilateral with all four vertices on the circle.

Opposite pairs add to 180°. Exterior angle equals the opposite interior angle.

Tangent ⊥ radius

A tangent meets a radius at 90° at the point of contact.

Two tangents from the same external point are equal in length — the lines from the point form an isosceles 'kite' with the centre.

Alternate segment theorem

The angle between a tangent and a chord equals the angle in the alternate segment (the inscribed angle standing on the same chord from the other side).

Reasoning & proof

For 'find angle x' questions, mark every angle you can deduce on the diagram first.

State the theorem you're using on each step: 'angle in semicircle', 'cyclic quad opposite angles', etc.

Common traps

- Confusing 'angle at centre $= 2\times$ angle at circumference' with the reverse.
- Using the tangent-radius rule for a chord instead of a tangent.
- Forgetting the cyclic-quad rule needs *all four* vertices on the circle.

Examiner only

8. *In this question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

Points A, B, C and D lie on the circumference of a circle, centre O.
BD is a diameter of the circle.
The straight line $BC = 4{\cdot}7$ cm and $B\hat{A}C = 28°$.

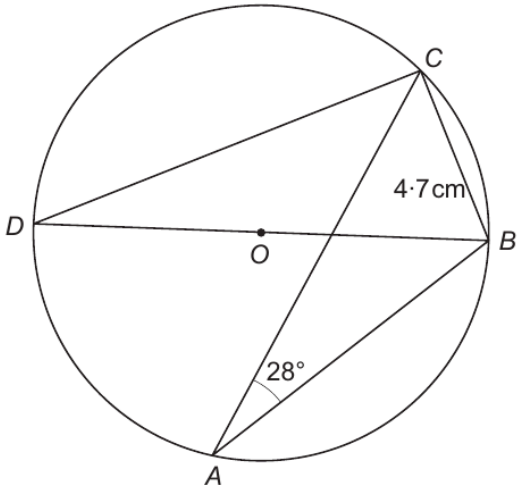


Diagram not drawn to scale

Write down the size of $B\hat{D}C$.
Hence, calculate the length BD.
You must show all your working. [5 + 2 OCW]

Examiner only

13. The points P, Q and R lie on the circumference of a circle, centre O.
PQ is a diameter of the circle.
The straight line ARB is a tangent to the circle.

$\hat{QRB} = x$, where x is measured in degrees.

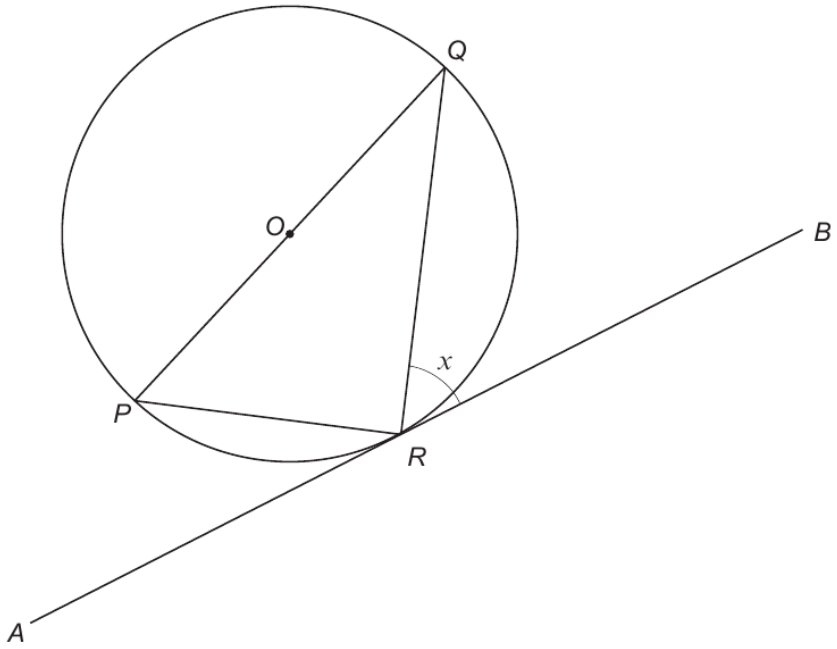


Diagram not drawn to scale

Calculate the size of $\hat{PQR}$ in terms of x.
You must give a reason for each step of your solution. [4]

Examiner only

12. A, B and C are points on the circumference of a circle.
XY is a tangent to the circle at the point A.

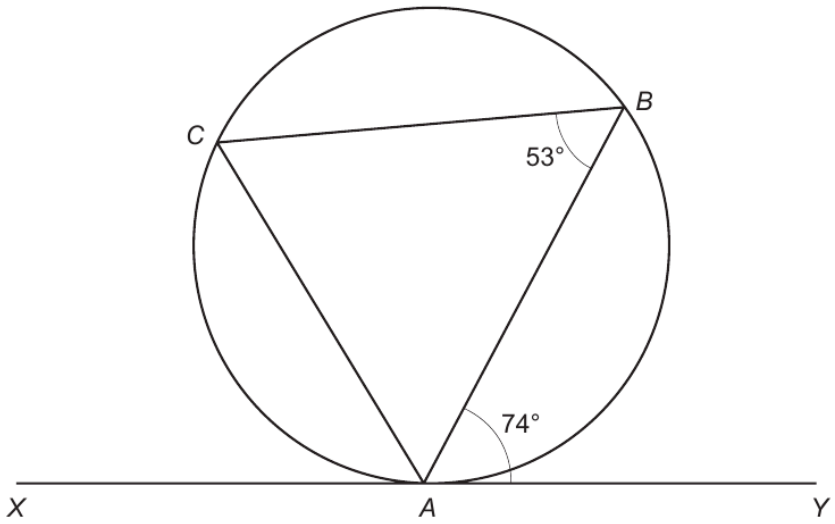


Diagram not drawn to scale

$\widehat{BAY} = 74°$ and $\widehat{ABC} = 53°$.
Prove that triangle ABC is an isosceles triangle.
You must give a reason for any statement that you make or any calculation that you carry out.
[5]

Examiner only

4. *In this question you will be assessed on the quality of your organisation, communication and accuracy in writing.*

PQ and PR are tangents to a circle with centre O.
$\hat{RPQ} = 30°$.

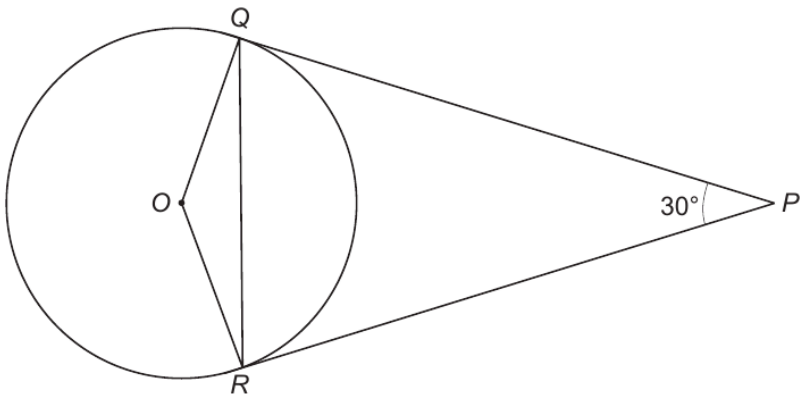


Diagram not drawn to scale

Find the size of $\hat{OQR}$.

You must indicate any angles you calculate.
You must give a reason for each stage of your working. [5 + 2 OCW]

$\hat{OQR}$ = ... °

Examiner only

10. The line *GH* is a tangent to the circle at point *Y*.
The line *EF* is parallel to the line *GH*.
The vertices of triangle *EFY* lie on the circle.
$E\hat{Y}G = 60°$.

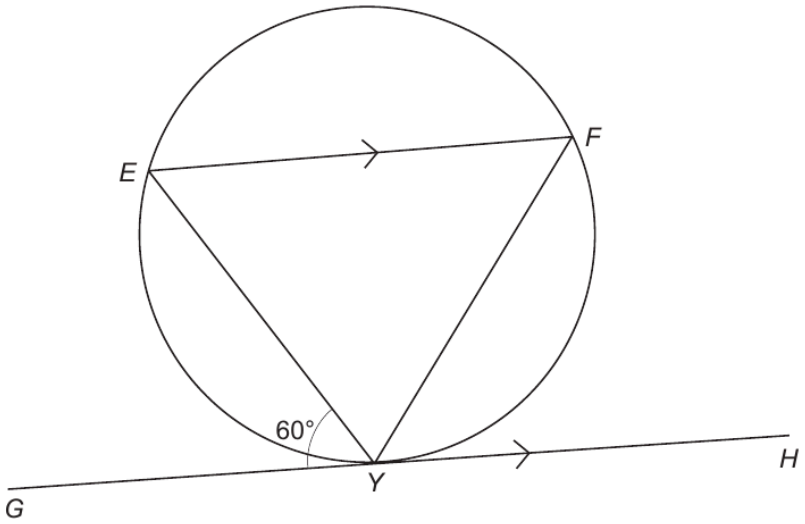


Diagram not drawn to scale

Prove that *EFY* is an equilateral triangle.
Give a reason for each step to justify your proof. [3]

Examiner only

19. BC is the tangent to the circle at point E, as shown below.

$EC = 8\,\text{cm}$, $AC = 11\,\text{cm}$ and $D\hat{C}E = 31°$.

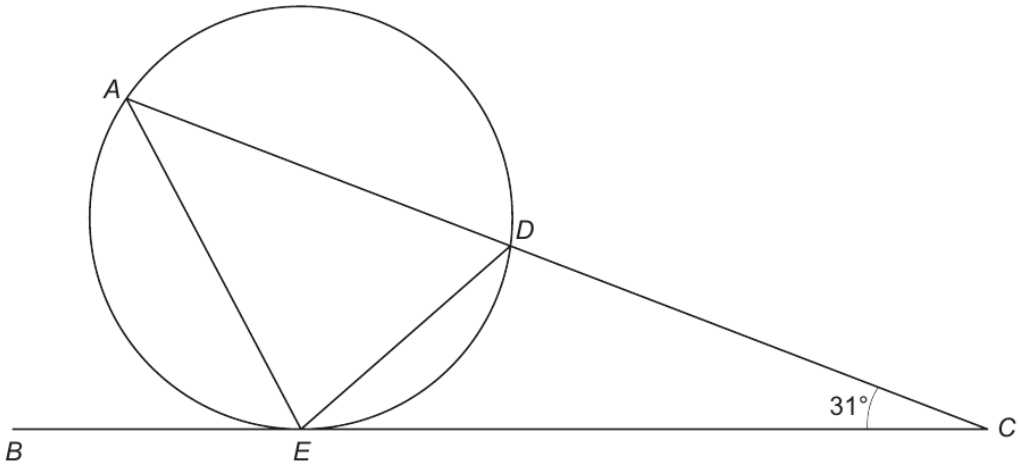


Diagram not drawn to scale

(a) Calculate the length of AE. [3]

Examiner only

(b) Calculate the size of $C\hat{E}D$. [4]

END OF PAPER

Examiner only

14. In the diagram below, AC and BD are diameters of a circle, centre O.

$AO = 30\,\text{cm}$ and $\widehat{AOB} = 20°$.

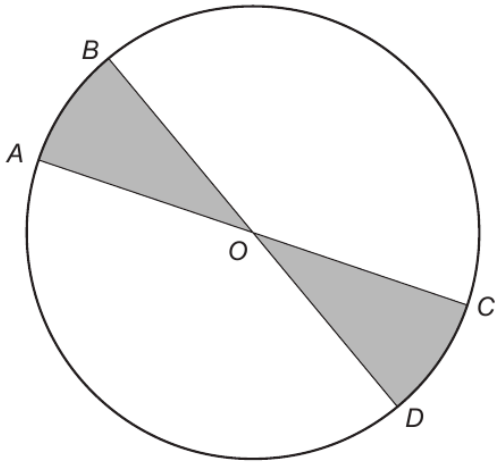


Diagram not drawn to scale

A second circle has an area which equals the total shaded area above.

Calculate the radius of the second circle. [3]

Examiner only

9. When a number is reduced by 15%, the answer is 6154.
What is the original number? [3]

10. $ABCD$ is a cyclic quadrilateral in a circle with centre O.
$\hat{ABC} = 126°$.

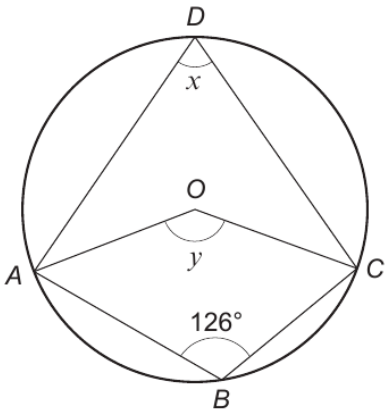


Diagram not drawn to scale

Write down the size of each of the angles x and y.
You must give a reason for each of your answers. [4]

x = ... °

Reason: .....

.....

y = ... °

Reason: .....

.....

Examiner only

14. The points A, B and C lie on the circumference of a circle.
The straight lines EBD and ECF are tangents to the circle.
$\hat{BEC} = 58°$ and $\hat{BCA} = 35°$.

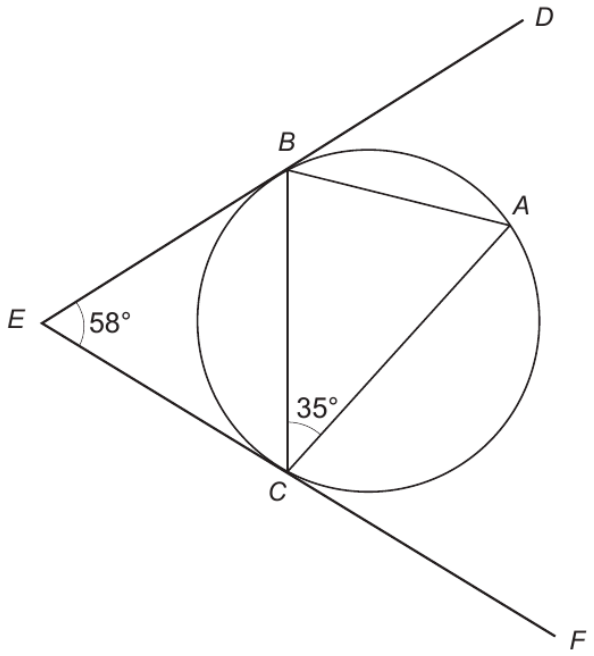


Diagram not drawn to scale

Find the size of $\hat{ABC}$.
You must show all your working. [4]

Examiner only

12. The points *A*, *B*, *C* and *D* lie on the circumference of a circle.
The straight line *EDF* is a tangent to the circle at *D*.

$\widehat{BAC} = x$ and $\widehat{CDE} = 2x$, where x is measured in degrees.

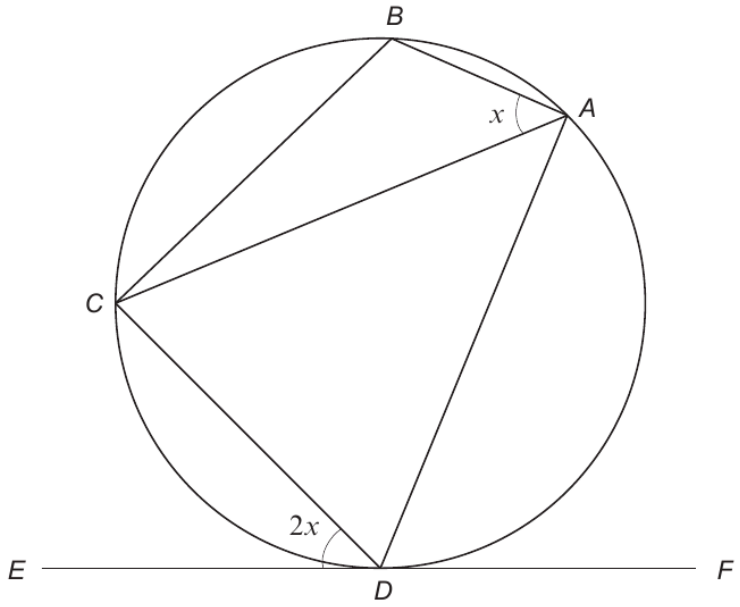


Diagram not drawn to scale

Find the size of $\widehat{BCD}$ in terms of x.
Express your answer in its simplest form.
You must give a reason for each step of your solution. [4]

Examiner only

8. A circle, centre O, has a radius of 4 cm.
A and B are points on the circumference of the circle.
Lines PA and PB are both tangents to the circle.
PB = 12 cm.

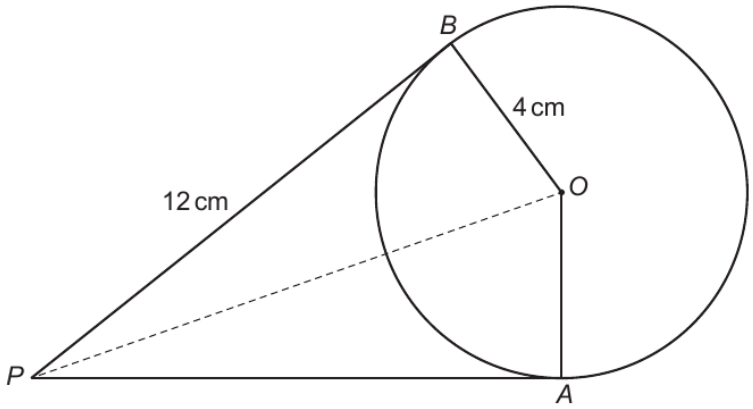


Diagram not drawn to scale

(a) What is the length of PA?
State the circle theorem you have used to find your answer. [1]

PA = ...

Circle theorem: .....

.....

(b) What is the size of $\hat{PAO}$?
State the circle theorem you have used to find your answer. [1]

$\hat{PAO}$ = ...

Circle theorem: .....

.....

(c) Calculate the area of the quadrilateral $PAOB$. [2]

.....

.....

.....

.....

.....

Examiner only

10. The diagram below shows a circle with centre at point *O*.
A, *B*, *C* and *D* are all points on the circumference of the circle.

AB = 7·5 cm and *BC* = 4·7 cm.

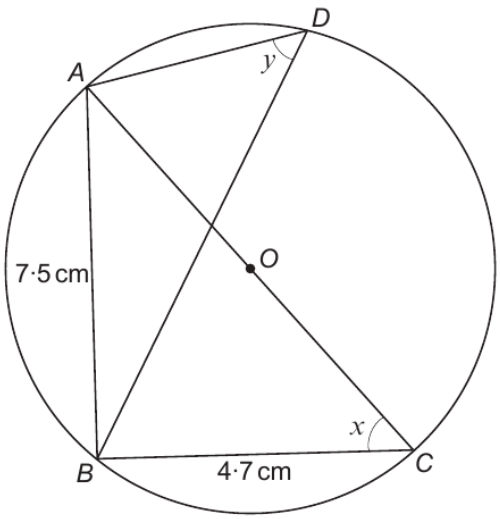


Diagram not drawn to scale

(a) (i) Give the reason why $\hat{ABC}$ is 90°. [1]

(ii) Calculate the size of angle x. [3]

(b) Write down the size of angle y.
State the circle theorem you have used to find your answer. [2]

y = ...

Circle theorem used: .....

Examiner only

14. *DE* is the tangent to the circle at point *A*, as shown below.
BC = 7 cm and *AC* = 13 cm.
$B\hat{A}D = 68°$ and $C\hat{A}E = 80°$.

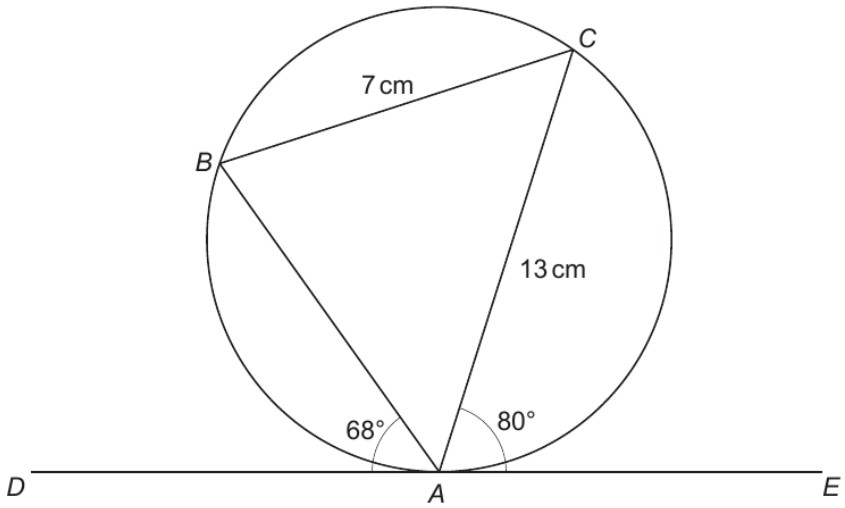


Diagram not drawn to scale

(a) Find the size of $A\hat{C}B$.
State the angle property you have used to find your answer. [2]

(b) Calculate the area of the triangle *ABC*. [2]

Examiner only

10. XY is a tangent to a circle, centre O, at the point A.
$\hat{AYO} = 54°$.

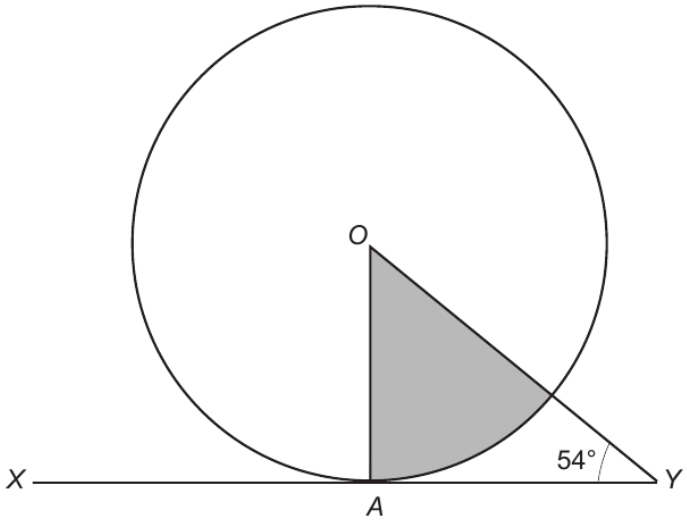


Diagram not drawn to scale

(a) What percentage of the whole circle is shaded?
You **must** show how you calculated your answer. [3]

(b) What tangent property of circles did you use in order to answer part (a)? [1]

Examiner only

10. The points B, C, D and E lie on the circumference of a circle, with centre O.
AF is a tangent to the circle.
AO is a straight line.

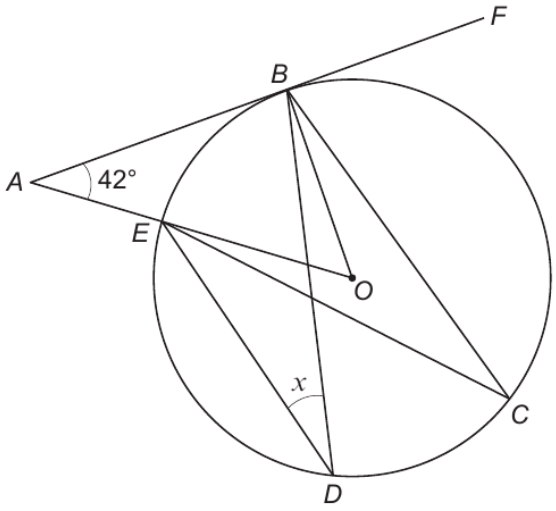


Diagram not drawn to scale

Calculate the size of angle x.
You must show all your working. [3]

Examiner only

13. Points A, B, C, D lie on a circle.
The line FAE is a tangent to the circle at A.

$B\hat{C}D = 114°$.

$D\hat{B}A = x°$.

$B\hat{A}E = 2x°$.

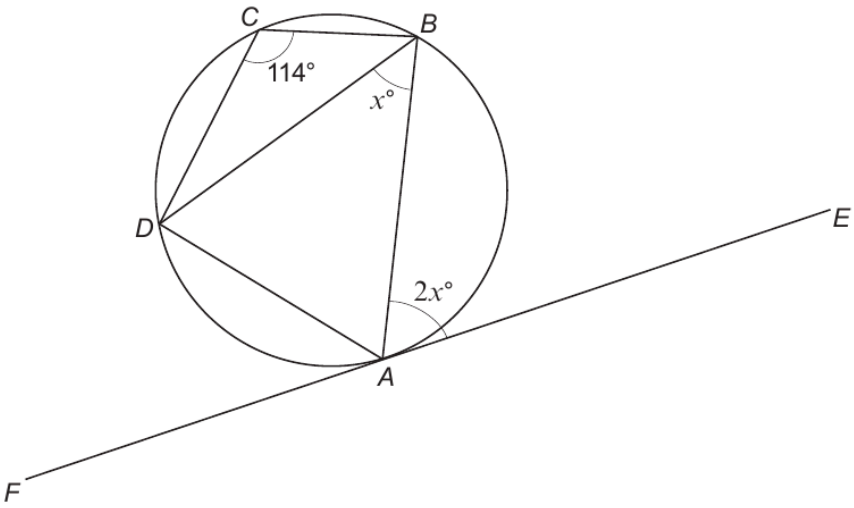


Diagram not drawn to scale

Calculate the value of x.
You must state any circle theorems that you use. [5]

Examiner only

13. FD is the tangent to the circle at point E, as shown below.
$ABCD$ is a straight line.
$A\hat{B}E = 130°$ and $B\hat{E}C = 60°$.

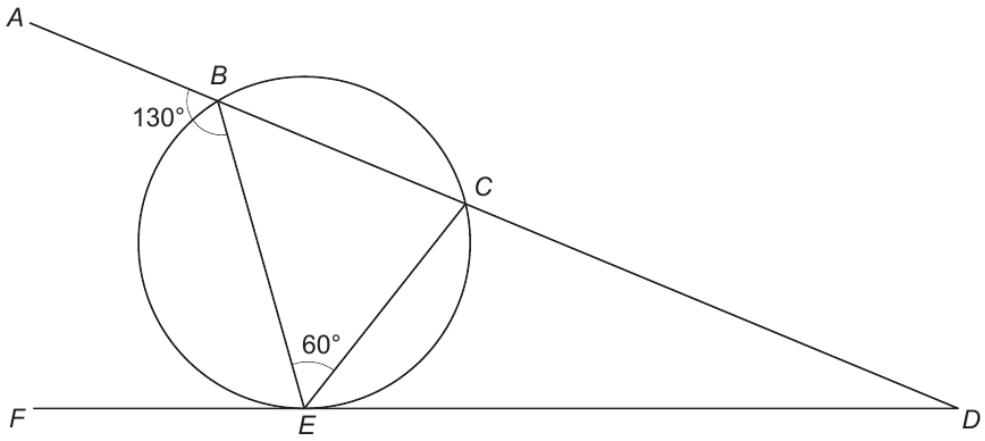
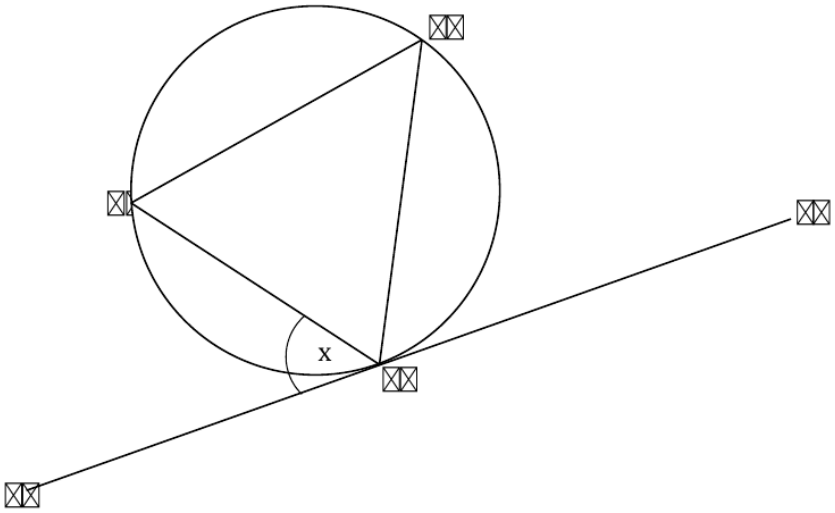


Diagram not drawn to scale

Calculate the size of $C\hat{D}E$. [2]

$C\hat{D}E =$ ..... °


x