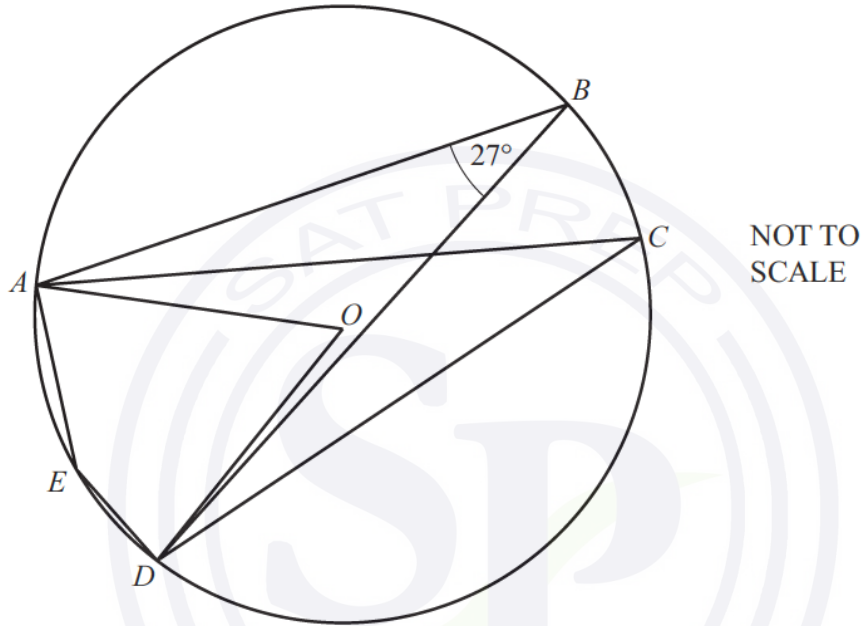


Extended Mathematics
Topic : Geometry
Year : May 2013 - May 2023
Paper -4
Questions Booklet

Question 1

(a)



A, B, C, D and E are points on the circle centre O .
 Angle $ABD = 27^\circ$.

Find

(i) angle ACD ,

Answer(a)(i) Angle $ACD = \dots\dots\dots$ [1]

(ii) angle AOD ,

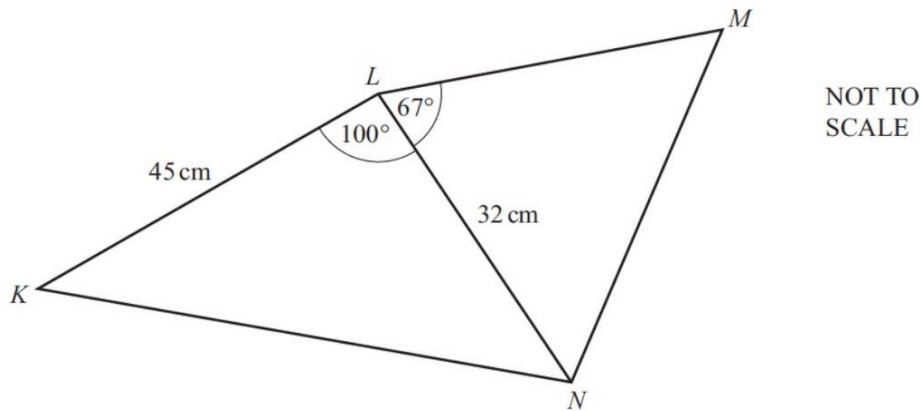
Answer(a)(ii) Angle $AOD = \dots\dots\dots$ [1]

(iii) angle AED .

Answer(a)(iii) Angle $AED = \dots\dots\dots$ [1]

Continue on the next page..

(b)



The diagram shows quadrilateral $KLMN$.
 $KL = 45$ cm, $LN = 32$ cm, angle $KLN = 100^\circ$ and angle $NLM = 67^\circ$.

(i) Calculate the length KN .

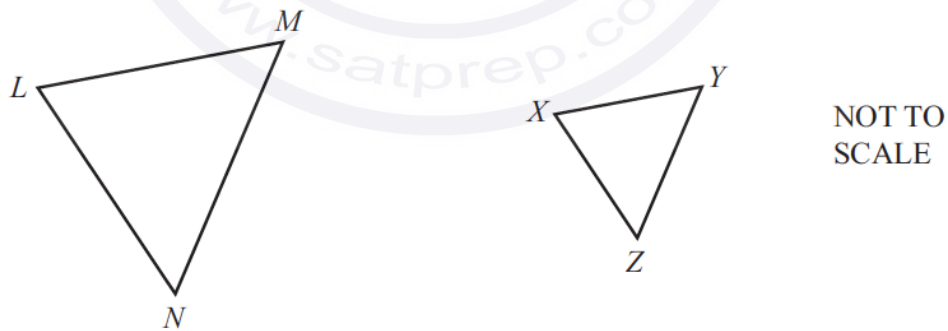
Answer(b)(i) $KN = \dots\dots\dots$ cm [4]

(ii) The area of triangle LMN is 324 cm².

Calculate the length LM .

Answer(b)(ii) $LM = \dots\dots\dots$ cm [3]

(iii) Another triangle XYZ is mathematically similar to triangle LMN .

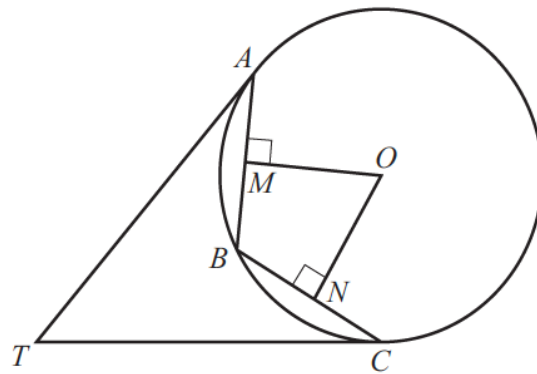


$XZ = 16$ cm and the area of triangle LMN is 324 cm².

Calculate the area of triangle XYZ .

Answer(b)(iii) $\dots\dots\dots$ cm² [2]

Question 2



NOT TO SCALE

A, B and C lie on the circle centre O , radius 8.5 cm.
 $AB = BC = 10.7$ cm.
 OM is perpendicular to AB and ON is perpendicular to BC .

- (a) Calculate the area of the circle.

Answer(a) cm² [2]

- (b) Write down the length of MB .

Answer(b) cm [1]

- (c) Calculate angle MOB and show that it rounds to 39° correct to the nearest degree.

Answer(c)

[2]

- (d) Using angle $MOB = 39^\circ$, calculate the length of the **major** arc AC .

Answer(d) cm [3]

- (e) The tangents to the circle at A and at C meet at T .

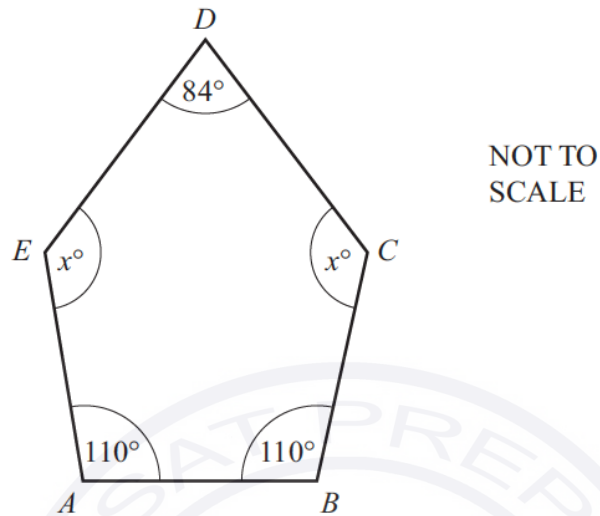
Explain clearly why triangle ATB is congruent to triangle CTB .

Answer(e)

[3]

Question 3

(a)



In the pentagon $ABCDE$, angle $EAB = \text{angle } ABC = 110^\circ$ and angle $CDE = 84^\circ$.
Angle $BCD = \text{angle } DEA = x^\circ$.

(i) Calculate the value of x .

Answer(a)(i) $x = \dots\dots\dots$ [2]

(ii) $BC = CD$.
Calculate angle CBD .

Answer(a)(ii) Angle $CBD = \dots\dots\dots$ [1]

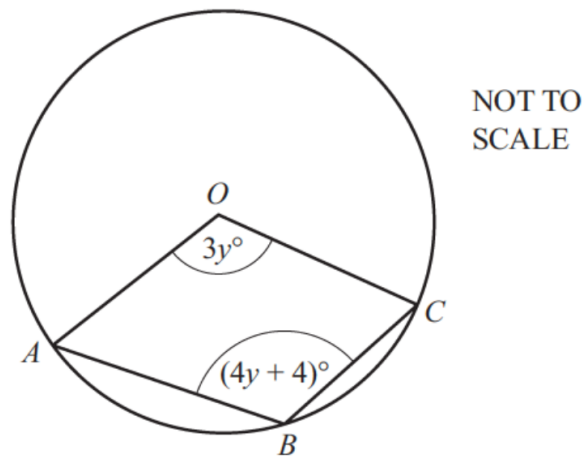
(iii) This pentagon also has one line of symmetry.
Calculate angle ADB .

Answer(a)(iii) Angle $ADB = \dots\dots\dots$ [1]

Continue on the next page..

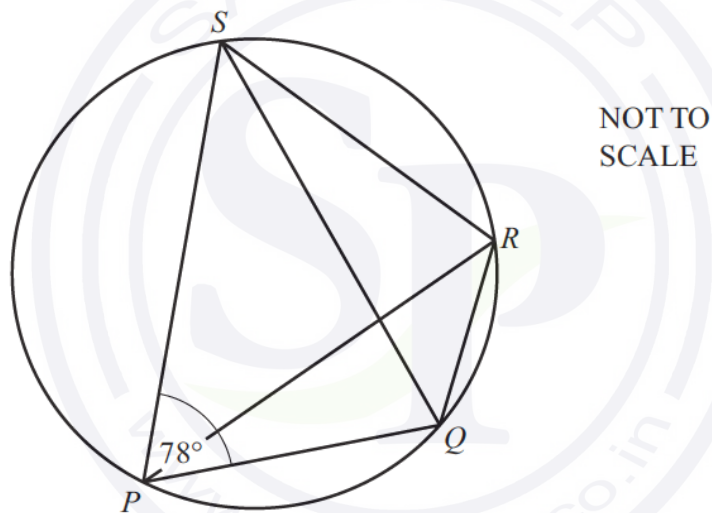
- (b) A, B and C lie on a circle centre O .
 Angle $AOC = 3y^\circ$ and angle $ABC = (4y + 4)^\circ$.

Find the value of y .



Answer(b) $y = \dots\dots\dots$ [4]

- (c)



In the cyclic quadrilateral $PQRS$, angle $SPQ = 78^\circ$.

- (i) Write down the geometrical reason why angle $QRS = 102^\circ$.

Answer(c)(i) $\dots\dots\dots$ [1]

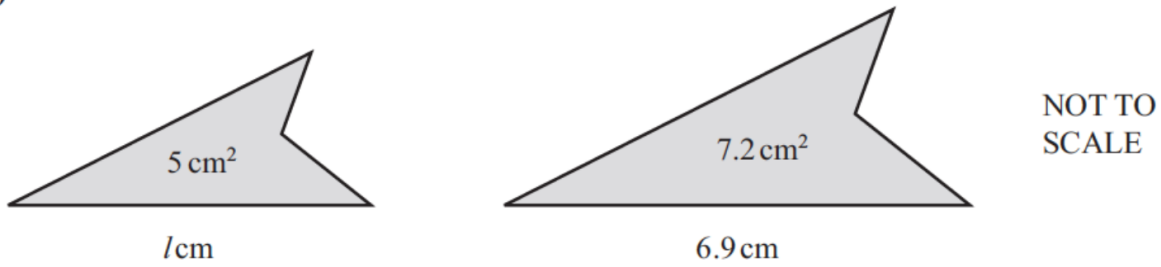
- (ii) Angle PRQ : Angle $PRS = 1 : 2$.

Calculate angle PQS .

Answer(c)(ii) Angle $PQS = \dots\dots\dots$ [3]

Continue on the next page..

(d)

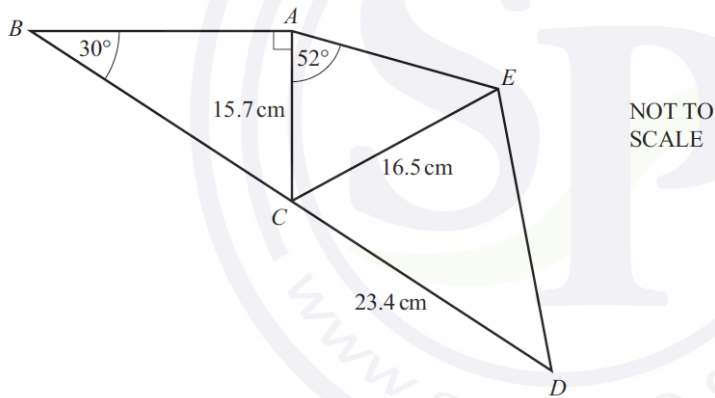


The diagram shows two similar figures.
The areas of the figures are 5 cm^2 and 7.2 cm^2 .
The lengths of the bases are $l \text{ cm}$ and 6.9 cm .

Calculate the value of l .

Answer(d) $l = \dots\dots\dots$ [3]

Question 4



In the diagram, BCD is a straight line and $ABDE$ is a quadrilateral.
Angle $BAC = 90^\circ$, angle $ABC = 30^\circ$ and angle $CAE = 52^\circ$.
 $AC = 15.7 \text{ cm}$, $CE = 16.5 \text{ cm}$ and $CD = 23.4 \text{ cm}$.

(a) Calculate BC .

Answer(a) $BC = \dots\dots\dots \text{ cm}$ [3]

(b) Use the sine rule to calculate angle AEC .
Show that it rounds to 48.57° , correct to 2 decimal places.

Answer(b)

[3]

Continue on the next page..

(c) (i) Show that angle $ECD = 40.6^\circ$, correct to 1 decimal place.

Answer(c)(i)

[2]

(ii) Calculate DE .

Answer(c)(ii) $DE = \dots\dots\dots$ cm [4]

(d) Calculate the area of the quadrilateral $ABDE$.

Answer(d) $\dots\dots\dots$ cm^2 [4]

Question 5

(a) One angle of an isosceles triangle is 48° .

Write down the possible pairs of values for the remaining two angles.

Answer(a) $\dots\dots\dots$ and $\dots\dots\dots$

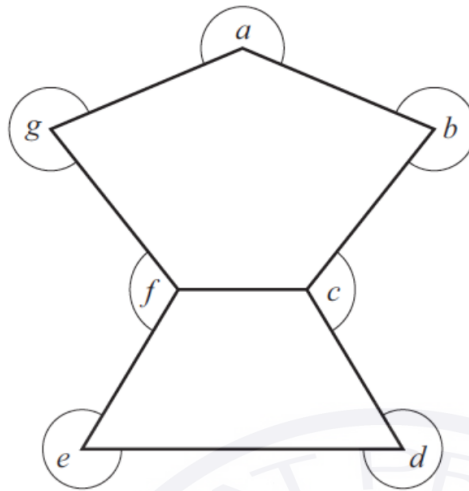
$\dots\dots\dots$ and $\dots\dots\dots$ [2]

(b) Calculate the sum of the interior angles of a pentagon.

Answer(b) $\dots\dots\dots$ [2]

Continue on the next page..

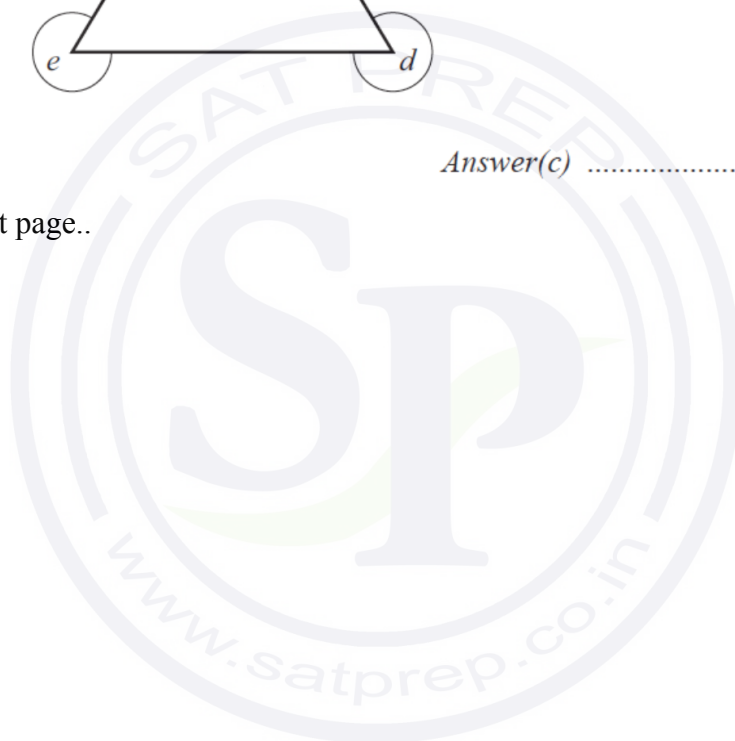
(c) Calculate the sum of the angles a, b, c, d, e, f and g shown in this diagram.



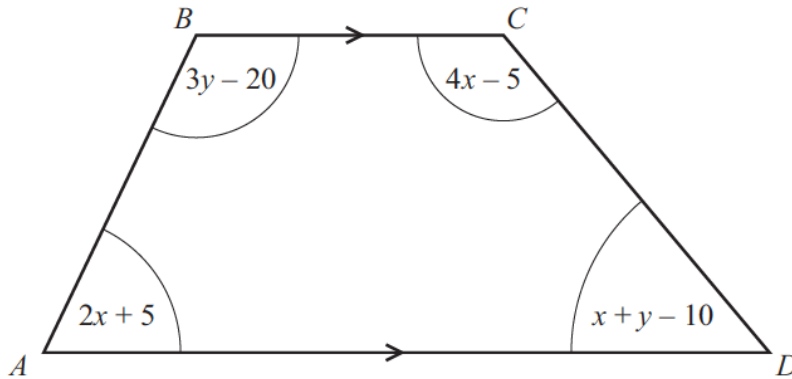
NOT TO
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Answer(c) [2]

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- (d) The trapezium, $ABCD$, has four angles as shown. All the angles are in degrees.



NOT TO SCALE

- (i) Show that $7x + 4y = 390$.

Answer(d)(i)

[1]

- (ii) Show that $2x + 3y = 195$.

Answer(d)(ii)

[1]

- (iii) Solve these simultaneous equations.

Answer(d)(iii) $x = \dots\dots\dots$

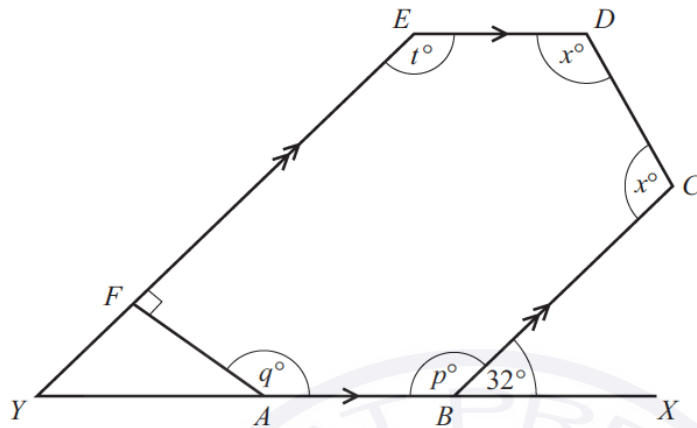
$y = \dots\dots\dots$ [4]

- (iv) Use your answer to **part (d)(iii)** to find the sizes of all four angles of the trapezium.

Answer(d)(iv) $\dots\dots\dots$, $\dots\dots\dots$, $\dots\dots\dots$, $\dots\dots\dots$ [1]

Question 6

(a)



NOT TO SCALE

$ABCDEF$ is a hexagon.
 AB is parallel to ED and BC is parallel to FE .
 YFE and $YABX$ are straight lines.
 Angle $CBX = 32^\circ$ and angle $EFA = 90^\circ$.

Calculate the value of

(i) p ,

Answer(a)(i) $p = \dots\dots\dots$ [1]

(ii) q ,

Answer(a)(ii) $q = \dots\dots\dots$ [2]

(iii) t ,

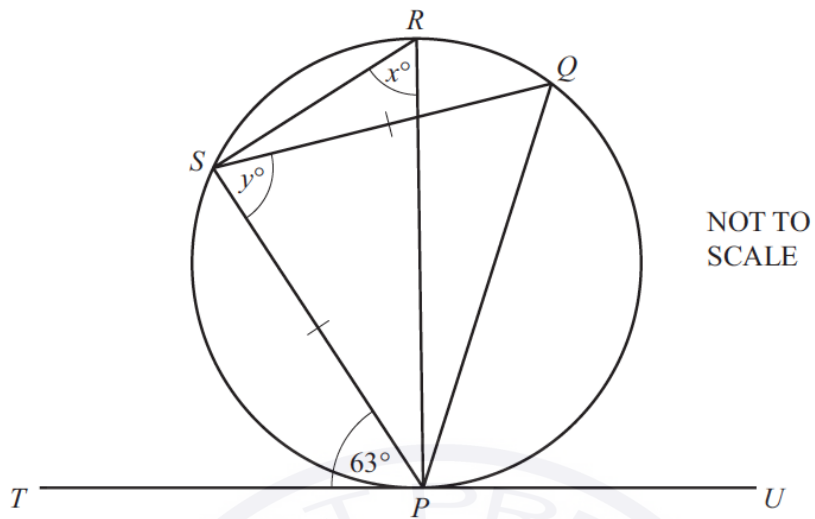
Answer(a)(iii) $t = \dots\dots\dots$ [1]

(iv) x .

Answer(a)(iv) $x = \dots\dots\dots$ [3]

Continue on the next page

(b)



P, Q, R and S are points on a circle and $PS = SQ$.
 PR is a diameter and TPU is the tangent to the circle at P .
Angle $SPT = 63^\circ$.

Find the value of

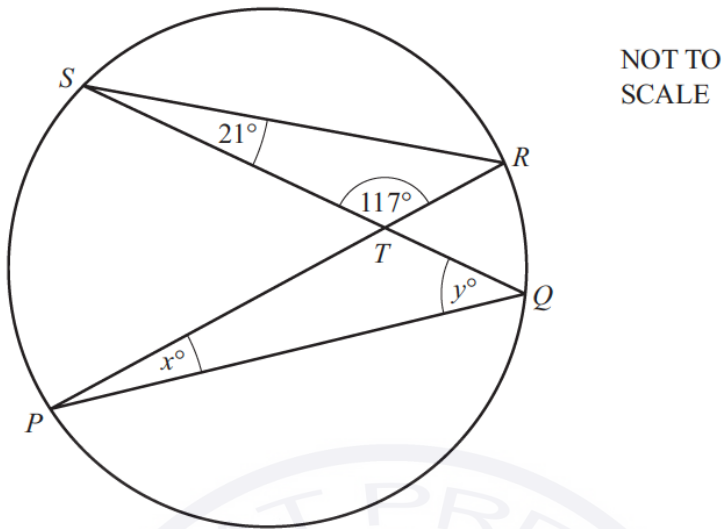
(i) x ,

Answer(b)(i) $x = \dots\dots\dots$ [2]

(ii) y .

Answer(b)(ii) $y = \dots\dots\dots$ [2]

Question 7



(a) The chords PR and SQ of the circle intersect at T .
Angle $RST = 21^\circ$ and angle $STR = 117^\circ$.

(i) Find the values of x and y .

Answer(a)(i) $x = \dots\dots\dots$

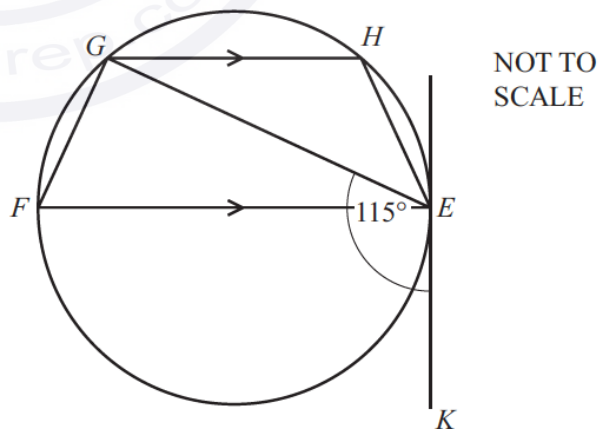
$y = \dots\dots\dots$ [2]

(ii) $SR = 8.23$ cm, $RT = 3.31$ cm and $PQ = 9.43$ cm.

Calculate the length of TQ .

Answer(a)(ii) $TQ = \dots\dots\dots$ cm [2]

(b) $EFGH$ is a cyclic quadrilateral.
 EF is a diameter of the circle.
 KE is the tangent to the circle at E .
 GH is parallel to FE and angle $KEG = 115^\circ$.

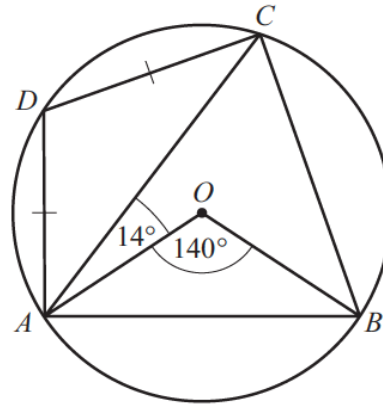


Calculate angle GEH .

Answer(b) Angle $GEH = \dots\dots\dots$ [4]

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- (c) A, B, C and D are points on the circle centre O .
 Angle $AOB = 140^\circ$ and angle $OAC = 14^\circ$.
 $AD = DC$.



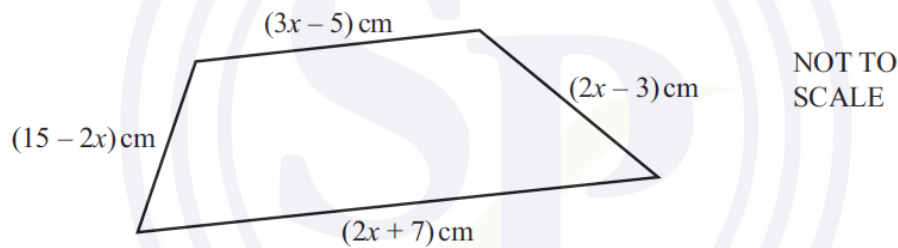
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Calculate angle ACD .

Answer(c) Angle $ACD = \dots\dots\dots$ [5]

Question 8

- (a)



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- (i) Write an expression, in terms of x , for the perimeter of the quadrilateral.
 Give your answer in its simplest form.

Answer(a)(i) $\dots\dots\dots$ cm [2]

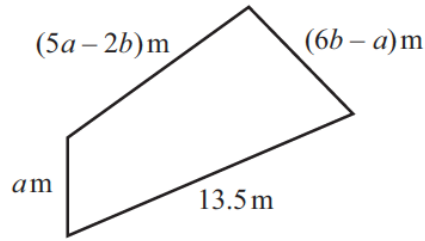
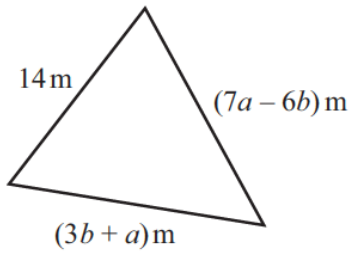
- (ii) The perimeter of the quadrilateral is 32 cm.

Find the length of the longest side of the quadrilateral.

Answer(a)(ii) $\dots\dots\dots$ cm [3]

Continue on the next page..

(b)



NOT TO
SCALE

The triangle has a perimeter of 32.5 m .

The quadrilateral has a perimeter of 39.75 m .

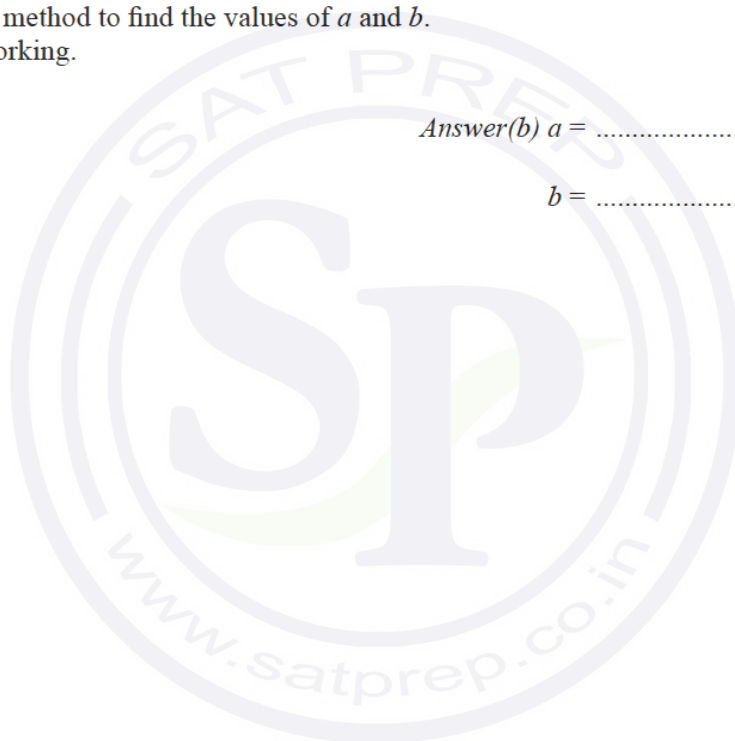
Write two equations in terms of a and b and simplify them.

Use an algebraic method to find the values of a and b .

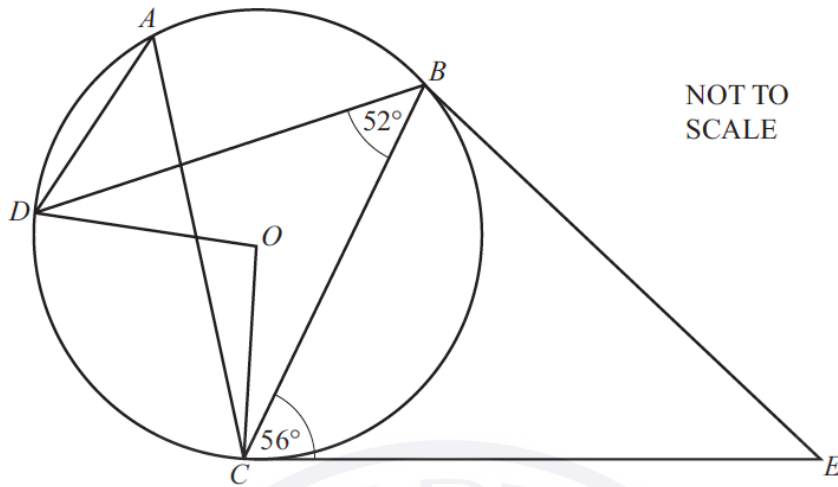
Show all your working.

Answer(b) $a = \dots\dots\dots$

$b = \dots\dots\dots$ [6]



Question 9



NOT TO SCALE

A, B, C and D are points on a circle, centre O .
 CE is a tangent to the circle at C .

(a) Find the sizes of the following angles and give a reason for each answer.

(i) Angle $DAC = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [2]

(ii) Angle $DOC = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [2]

(iii) Angle $BCO = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [2]

Answer(b)(i) $BE = \dots\dots\dots$ cm [4]

(ii) Calculate angle BEC .

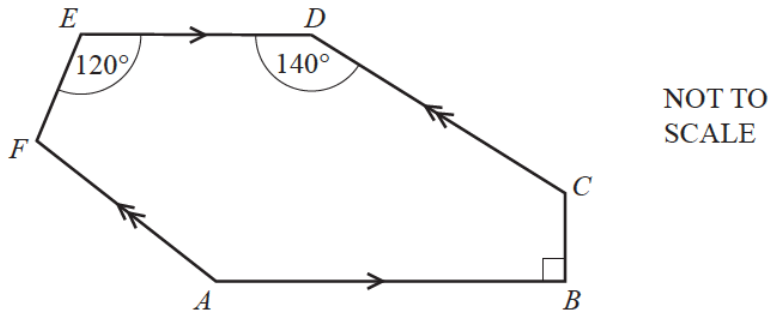
Answer(b)(ii) Angle $BEC = \dots\dots\dots$ [3]

(b) $CE = 8.9$ cm and $CB = 7$ cm.

(i) Calculate the length of BE .

Question 10

(a)

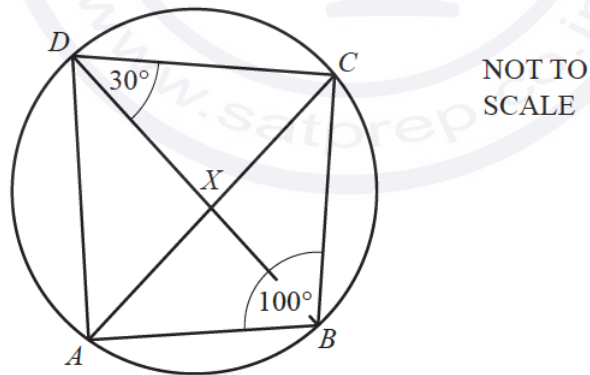


In the hexagon $ABCDEF$, AB is parallel to ED and AF is parallel to CD .
 Angle $ABC = 90^\circ$, angle $CDE = 140^\circ$ and angle $DEF = 120^\circ$.

Calculate angle EFA .

Answer(a) Angle $EFA = \dots\dots\dots$ [4]

(b)



In the cyclic quadrilateral $ABCD$, angle $ABC = 100^\circ$ and angle $BDC = 30^\circ$.
 The diagonals intersect at X .

Continue on the next page..

(i) Calculate angle ACB .

Answer(b)(i) Angle $ACB = \dots\dots\dots$ [2]

(ii) Angle $BXC = 89^\circ$.

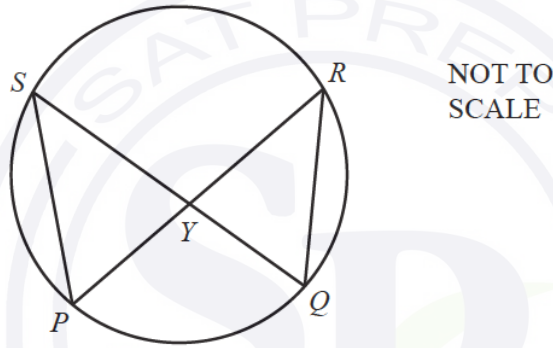
Calculate angle CAD .

Answer(b)(ii) Angle $CAD = \dots\dots\dots$ [2]

(iii) Complete the statement.

Triangles AXD and BXC are $\dots\dots\dots$ [1]

(c)



P, Q, R and S lie on a circle.
 PR and QS intersect at Y .
 $PS = 11$ cm, $QR = 10$ cm and the area of triangle $QRY = 23$ cm².

Calculate the area of triangle PYS .

Answer(c) $\dots\dots\dots$ cm² [2]

(d) A regular polygon has n sides.
 Each exterior angle is equal to $\frac{n}{10}$ degrees.

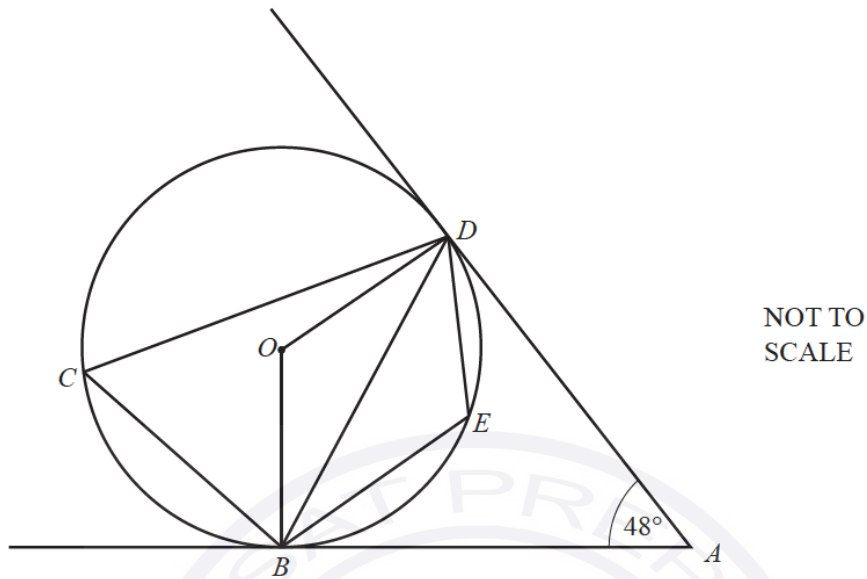
(i) Find the value of n .

Answer(d)(i) $n = \dots\dots\dots$ [3]

(ii) Find the size of an interior angle of this polygon.

Answer(d)(ii) $\dots\dots\dots$ [2]

Question 11



NOT TO SCALE

In the diagram, B, C, D and E lie on the circle, centre O .
 AB and AD are tangents to the circle.
 Angle $BAD = 48^\circ$.

(a) Find

(i) angle ABD ,

Answer(a)(i) Angle $ABD = \dots\dots\dots$ [1]

(ii) angle OBD ,

Answer(a)(ii) Angle $OBD = \dots\dots\dots$ [1]

(iii) angle BCD ,

Answer(a)(iii) Angle $BCD = \dots\dots\dots$ [2]

(iv) angle BED .

Answer(a)(iv) Angle $BED = \dots\dots\dots$ [1]

(b) The radius of the circle is 15 cm.

Calculate the area of triangle BOD .

Answer(b) $\dots\dots\dots$ cm^2 [2]

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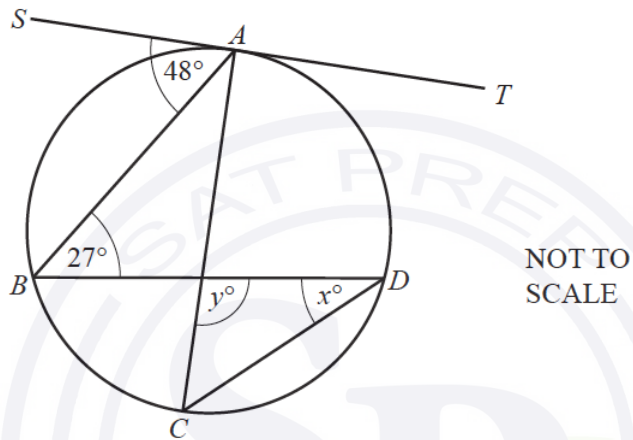
(c) Give a reason why $ABOD$ is a cyclic quadrilateral.

Answer(c)

..... [1]

Question 12

- (a) The points A, B, C and D lie on a circle.
 AC is a diameter of the circle.
 ST is the tangent to the circle at A .



Find the value of

(i) x ,

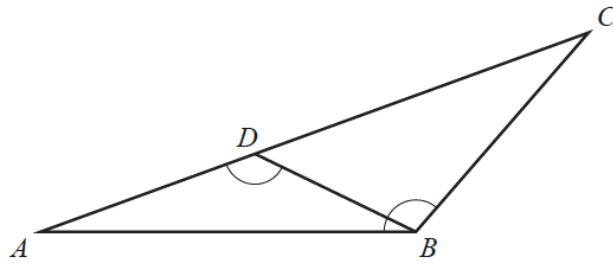
Answer(a)(i) $x =$ [2]

(ii) y .

Answer(a)(ii) $y =$ [2]

Question 13

(a)



NOT TO SCALE

In the diagram, D is on AC so that $\text{angle } ADB = \text{angle } ABC$.

(i) Show that $\text{angle } ABD$ is equal to $\text{angle } ACB$.

Answer(a)(i)

[2]

(ii) Complete the statement.

Triangles ABD and ACB are

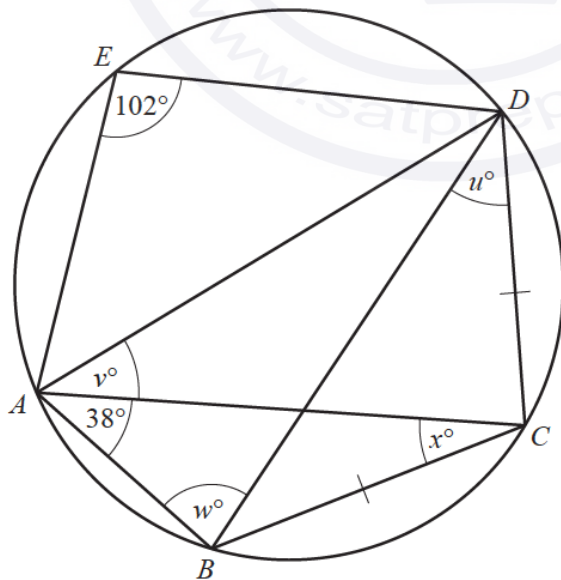
[1]

(iii) $AB = 12 \text{ cm}$, $BC = 11 \text{ cm}$ and $AC = 16 \text{ cm}$.

Calculate the length of BD .

Answer(a)(iii) $BD = \dots\dots\dots \text{ cm}$ [2]

(b)



NOT TO SCALE

Continue on the next page.

A, B, C, D and E lie on the circle.
Angle $AED = 102^\circ$ and angle $BAC = 38^\circ$.
 $BC = CD$.

Find the value of

(i) u ,

Answer(b)(i) $u = \dots\dots\dots$ [1]

(ii) v ,

Answer(b)(ii) $v = \dots\dots\dots$ [1]

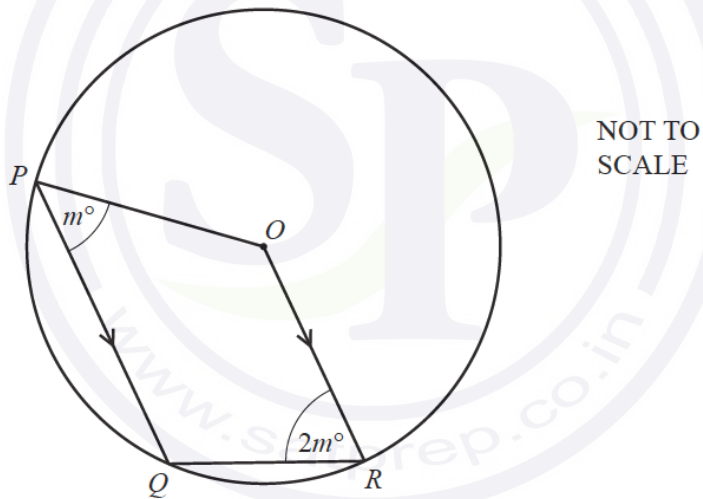
(iii) w ,

Answer(b)(iii) $w = \dots\dots\dots$ [1]

(iv) x .

Answer(b)(iv) $x = \dots\dots\dots$ [1]

(c)



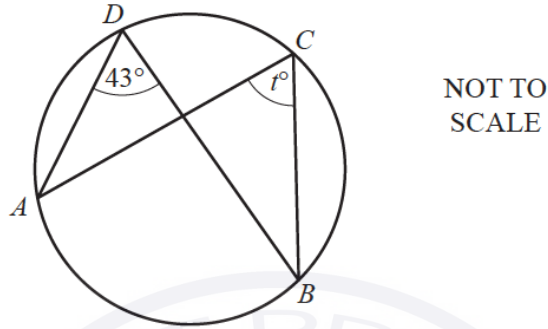
In the diagram, P, Q and R lie on the circle, centre O .
 PQ is parallel to OR .
Angle $QPO = m^\circ$ and angle $QRO = 2m^\circ$.

Find the value of m .

Answer(c) $m = \dots\dots\dots$ [5]

Question 14

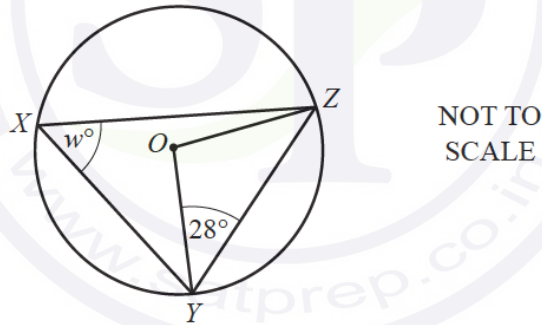
- (a) (i) A, B, C and D lie on the circumference of the circle.



Find the value of t .

Answer(a)(i) $t = \dots\dots\dots$ [1]

- (ii) X, Y and Z lie on the circumference of the circle, centre O .



Find the value of w , giving reasons for your answer.

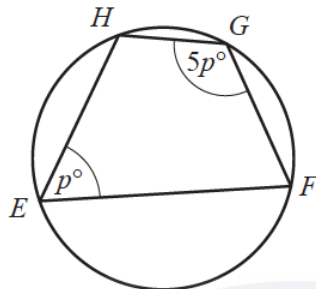
Answer(a)(ii) $w = \dots\dots\dots$ because $\dots\dots\dots$

$\dots\dots\dots$

$\dots\dots\dots$ [3]

Continue on the next page..

(iii) E, F, G and H lie on the circumference of the circle.



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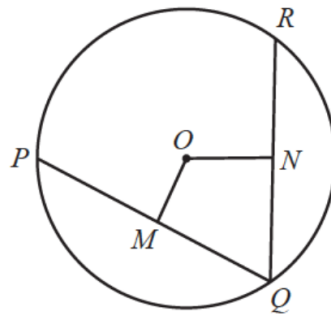
Find the value of p , giving a reason for your answer.

Answer(a)(iii) $p =$ because

..... [3]

Continue on the next page..

(b)



NOT TO
SCALE

The diagram shows a circle, centre O .
 PQ and QR are chords.
 OM is the perpendicular from O to PQ .

(i) Complete the statement.

$$PM : PQ = \dots : \dots$$

[1]

(ii) ON is the perpendicular from O to QR and $PQ = QR$.

Complete the statements to show that triangle OMQ is congruent to triangle ONQ .

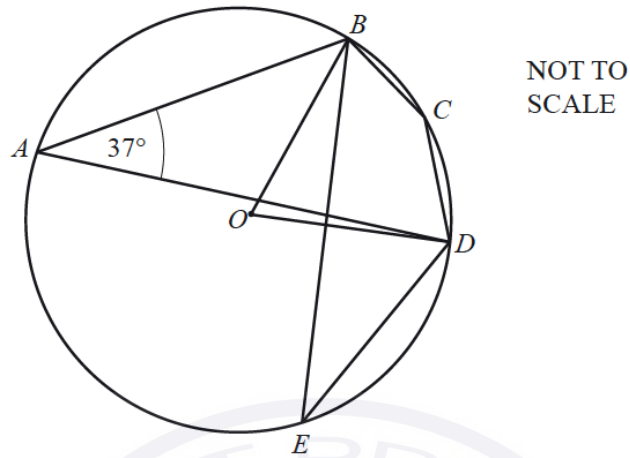
..... is a common side.

..... = because M is the midpoint of PQ and N is the midpoint of QR .

..... = because equal chords are equidistant from

[4]

Question 15



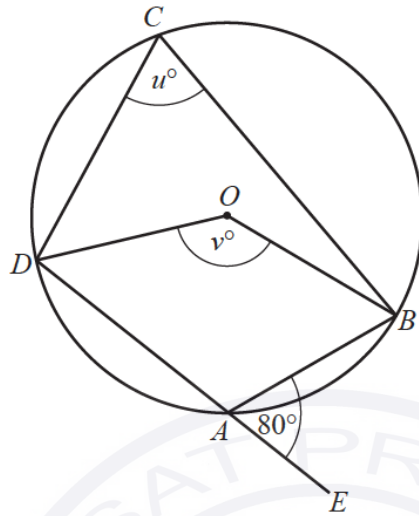
A, B, C, D and E are points on the circle, centre O .
Angle $BAD = 37^\circ$.

Complete the following statements.

- (a) Angle $BED = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [2]
- (b) Angle $BOD = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [2]
- (c) Angle $BCD = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [2]

Question 16

(a)



NOT TO SCALE

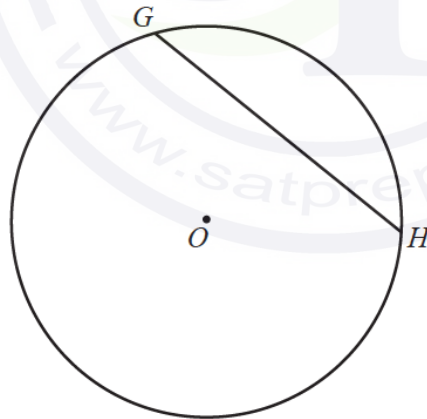
A, B, C and D lie on the circle, centre O .
 DAE is a straight line.

Find the value of u and the value of v .

$u = \dots\dots\dots$

$v = \dots\dots\dots [2]$

(b)



NOT TO SCALE

The diagram shows a circle, centre O , radius 8 cm.
 GH is a chord of length 10 cm.

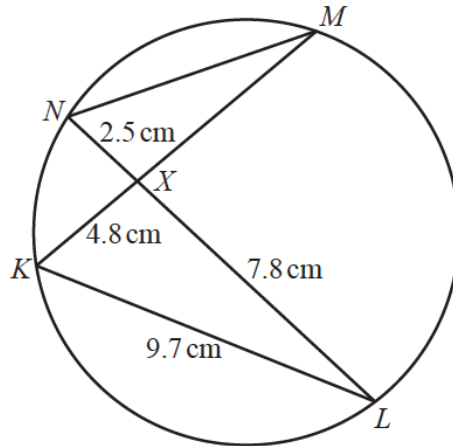
Calculate the length of the perpendicular from O to GH .

$\dots\dots\dots$ cm [3]

Continue on the next page..

- (c) K, L, M and N lie on the circle.
 KM and LN intersect at X .
 $KL = 9.7$ cm, $KX = 4.8$ cm,
 $LX = 7.8$ cm and $NX = 2.5$ cm.

Calculate MN .



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$MN = \dots\dots\dots$ cm [2]

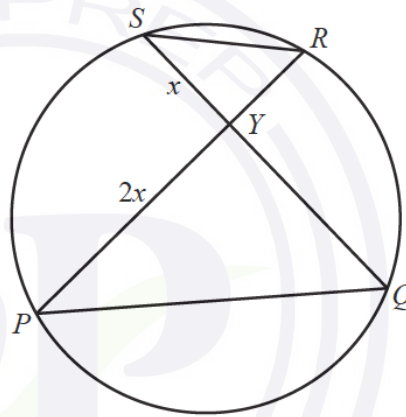
- (d) All lengths are in centimetres.

P, Q, R and S lie on the circle.
 PR and QS intersect at Y .
 $PY = 2x$ and $YS = x$.

The area of triangle $YRS = \frac{5}{12}x(x-1)$.

The area of triangle $YQP = x(x+1)$.

Find the value of x .

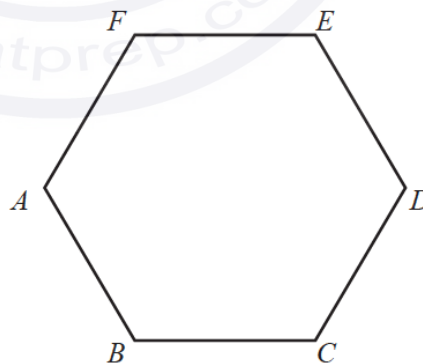


NOT TO SCALE

$x = \dots\dots\dots$ [4]

Question 17

- (a) The diagram shows a regular hexagon $ABCDEF$ of side 10 cm.



NOT TO SCALE

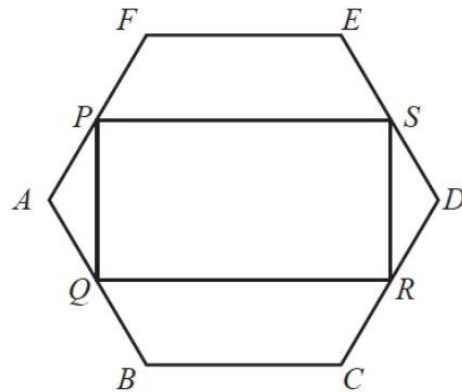
- (i) Show that angle $BAF = 120^\circ$.

[2]

Continue on the next page...

- (ii) The vertices of a rectangle $PQRS$ touch the sides FA , AB , CD and DE .

PS is parallel to FE and $AP = x$ cm.



NOT TO SCALE

Use trigonometry to find the length of PQ in terms of x .

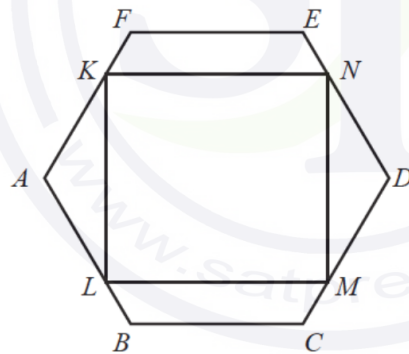
$PQ = \dots\dots\dots$ cm [3]

- (iii) $PF = (10 - x)$ cm.

Show that $PS = (20 - x)$ cm.

[3]

(b)



NOT TO SCALE

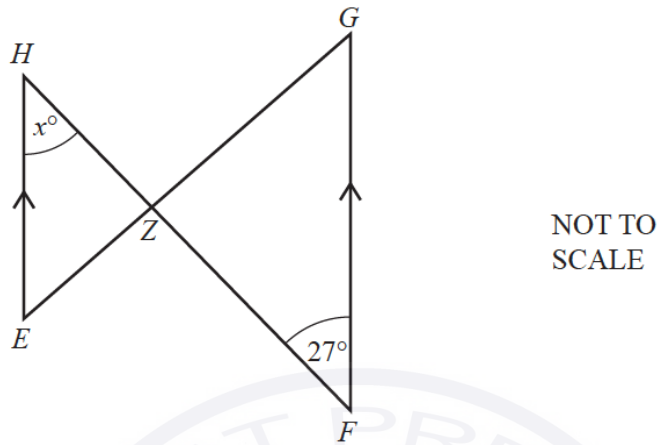
The diagram shows the vertices of a square $KLMN$ touching the sides of the same hexagon $ABCDEF$, with KN parallel to FE .

Use your results from **part (a)(ii)** and **part (a)(iii)** to find the length of a side of the square.

$\dots\dots\dots$ cm [4]

Question 18

(a)



In the diagram, EH is parallel to FG .
 The straight lines EG and FH intersect at Z .
 Angle $ZFG = 27^\circ$.

$EZ = \dots\dots\dots$ cm [2]

(b) The diagram shows points A, B, C and D on the circumference of a circle, centre O .
 AD is a straight line, $AB = BC$ and angle $OAB = 52^\circ$.

(i) Find the value of x .

$x = \dots\dots\dots$ [1]

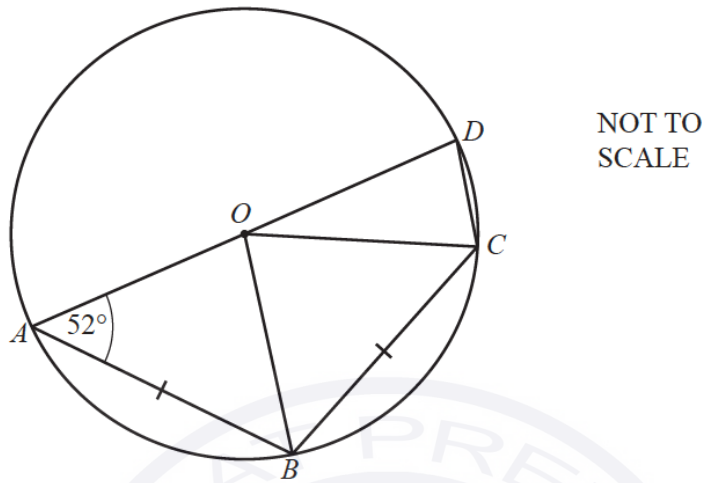
(ii) $EH = 5$ cm, $FG = 9$ cm and $ZG = 7$ cm.

Calculate EZ .

$EZ = \dots\dots\dots$ cm [2]

Continue on the next page..

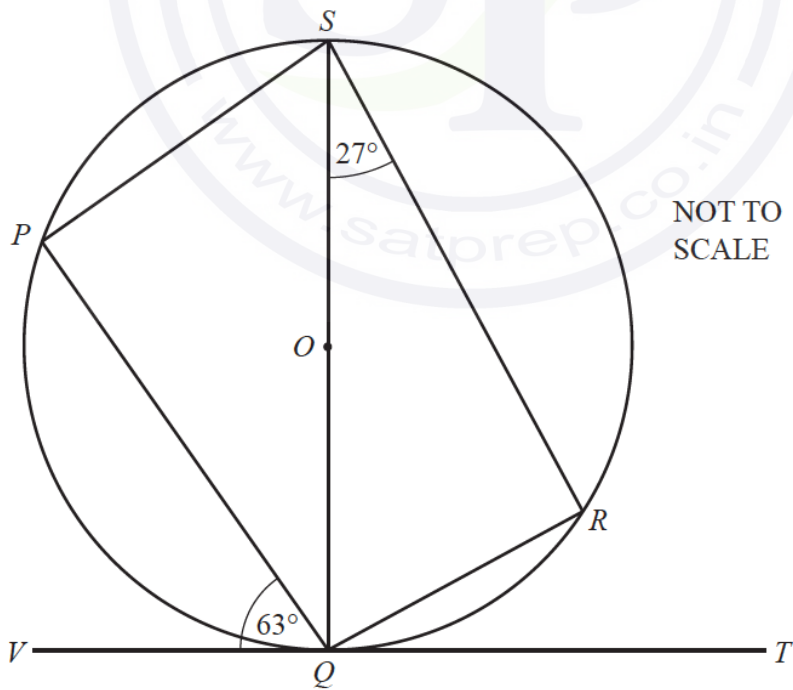
- (b) The diagram shows points A, B, C and D on the circumference of a circle, centre O . AD is a straight line, $AB = BC$ and angle $OAB = 52^\circ$.



Find angle ADC .

Angle $ADC = \dots\dots\dots [3]$

- (c) The diagram shows points P, Q, R and S on the circumference of a circle, centre O . VT is the tangent to the circle at Q .



Continue on the next page..

Complete the statements.

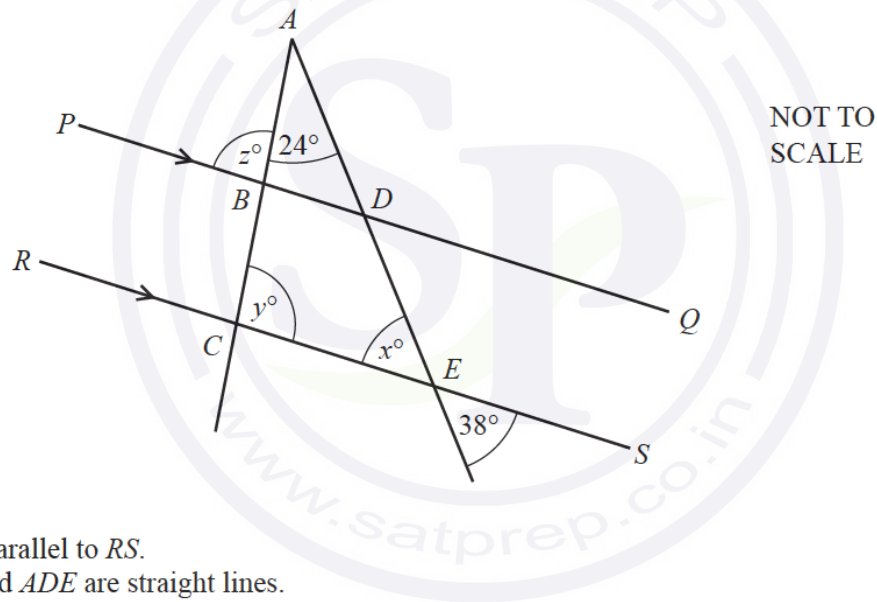
(i) Angle $QPS = \text{angle } QRS = \dots\dots\dots^\circ$ because $\dots\dots\dots$
 $\dots\dots\dots$ [2]

(ii) Angle $SQP = \dots\dots\dots^\circ$ because $\dots\dots\dots$
 $\dots\dots\dots$ [2]

(iii) Part (c)(i) and part (c)(ii) show that
 the cyclic quadrilateral $PQRS$ is a $\dots\dots\dots$ [1]

Question 19

(a)



PQ is parallel to RS .
 ABC and ADE are straight lines.

Find the values of x , y and z .

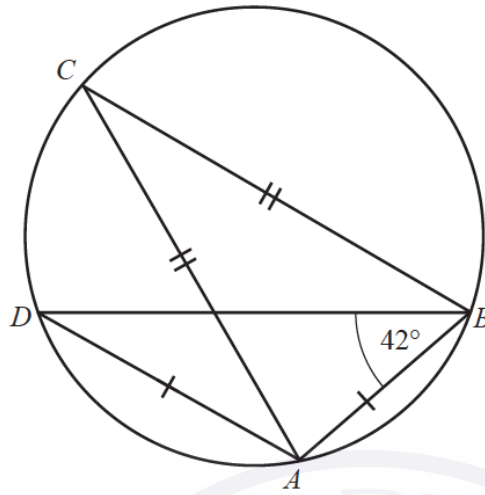
$x = \dots\dots\dots$

$y = \dots\dots\dots$

$z = \dots\dots\dots$ [3]

Continue on the next page..

(b)



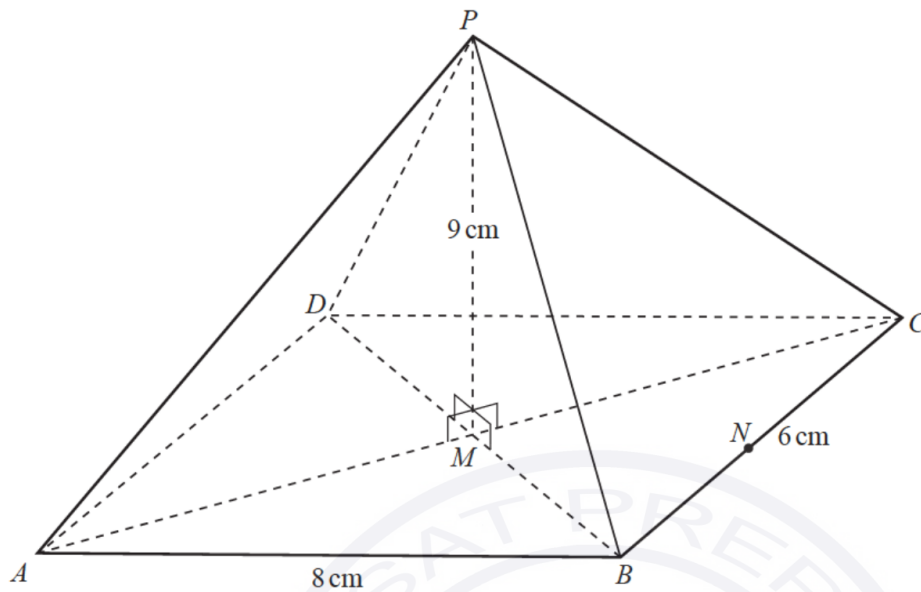
NOT TO
SCALE

The points A , B , C and D lie on the circumference of the circle.
 $AB = AD$, $AC = BC$ and angle $ABD = 42^\circ$.

Find angle CAB .

Angle $QRS = \dots\dots\dots$ [2]

Question 20



NOT TO SCALE

The diagram shows a pyramid on a rectangular base $ABCD$.
 AC and BD intersect at M and P is vertically above M .
 $AB = 8$ cm, $BC = 6$ cm and $PM = 9$ cm.

- (a) N is the midpoint of BC .

Calculate angle PNM .

- (b) Show that $BM = 5$ cm.

[1]

- (c) Calculate the angle between the edge PB and the base $ABCD$.

..... [2]

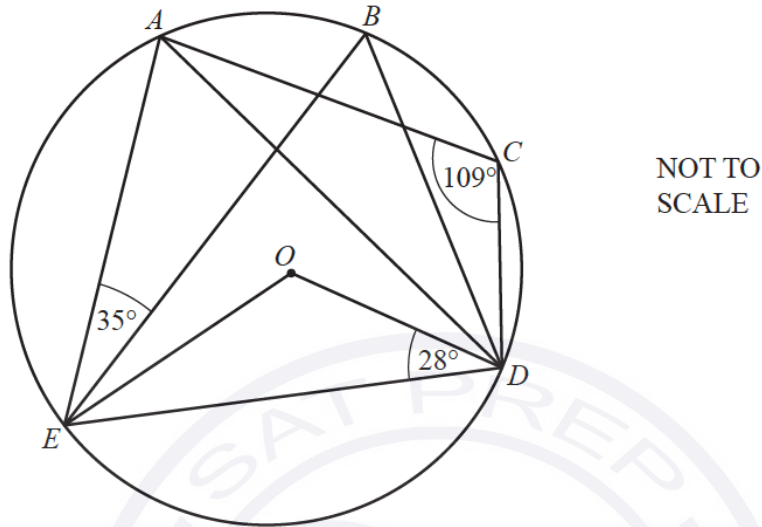
- (d) A point X is on PC so that $PX = 7.5$ cm.

Calculate BX .

$BX = \dots\dots\dots$ cm [6]

Question 21

(a)



A, B, C, D and E lie on the circle, centre O .
 Angle $AEB = 35^\circ$, angle $ODE = 28^\circ$ and angle $ACD = 109^\circ$.

(i) Work out the following angles, giving reasons for your answers.

(a) Angle $EBD = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$
 $\dots\dots\dots$ [3]

(b) Angle $EAD = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [2]

(ii) Work out angle BEO .

Angle $BEO = \dots\dots\dots$ [3]

(b) In a regular polygon, the interior angle is 11 times the exterior angle.

(i) Work out the number of sides of this polygon.
 $\dots\dots\dots$ [3]

(ii) Find the sum of the interior angles of this polygon.

..... [2]

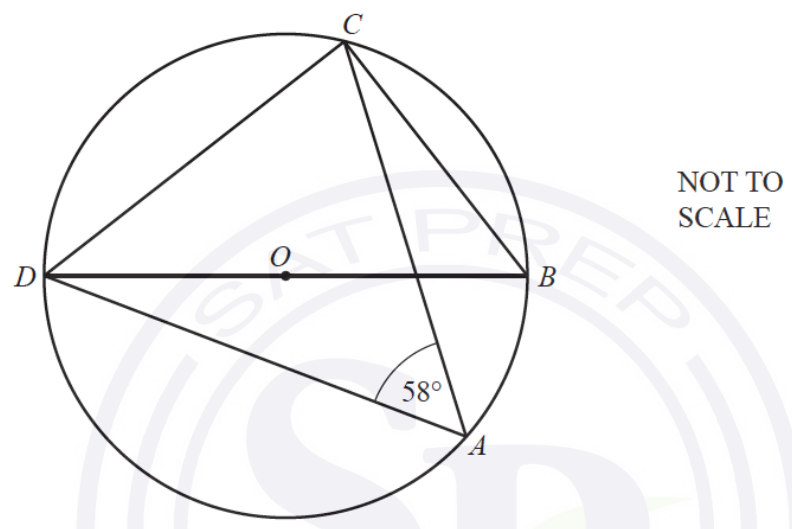
Question 22

(a) The exterior angle of a regular polygon is x° and the interior angle is $8x^\circ$.

Calculate the number of sides of the polygon.

..... [3]

(b)



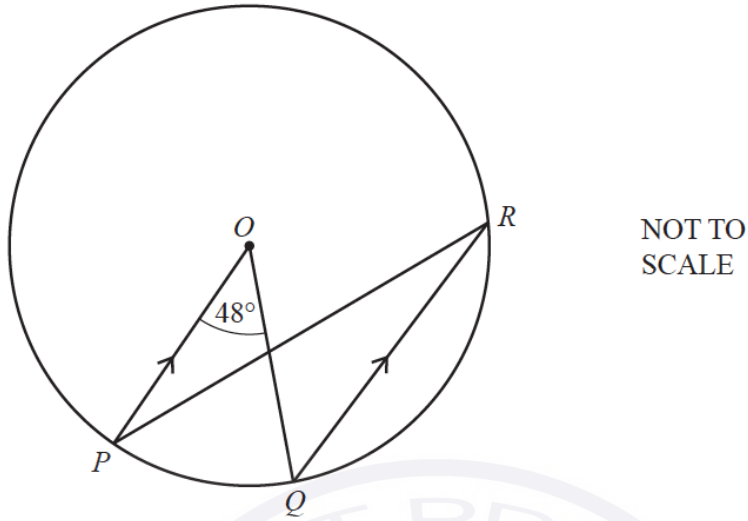
A, B, C and D are points on the circumference of the circle, centre O .
 DOB is a straight line and angle $DAC = 58^\circ$.

Find angle CDB .

Angle $CDB =$ [3]

Continue on the next page..

(c)



P , Q and R are points on the circumference of the circle, centre O .
 PO is parallel to QR and angle $POQ = 48^\circ$.

(i) Find angle OPR .

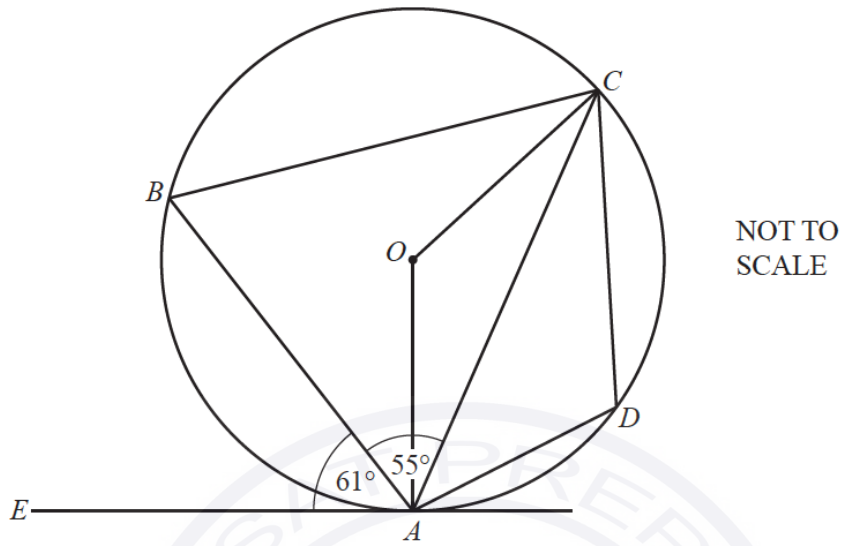
Angle $OPR = \dots\dots\dots$ [2]

(ii) The radius of the circle is 5.4 cm.

Calculate the length of the **major** arc PQ .

$\dots\dots\dots$ cm [3]

Question 23



In the diagram, A , B , C and D lie on the circle, centre O .
 EA is a tangent to the circle at A .
 Angle $EAB = 61^\circ$ and angle $BAC = 55^\circ$.

(a) Find angle BAO .

Angle $BAO = \dots\dots\dots$ [1]

(b) Find angle AOC .

Angle $AOC = \dots\dots\dots$ [2]

(c) Find angle ABC .

Angle $ABC = \dots\dots\dots$ [1]

(d) Find angle CDA .

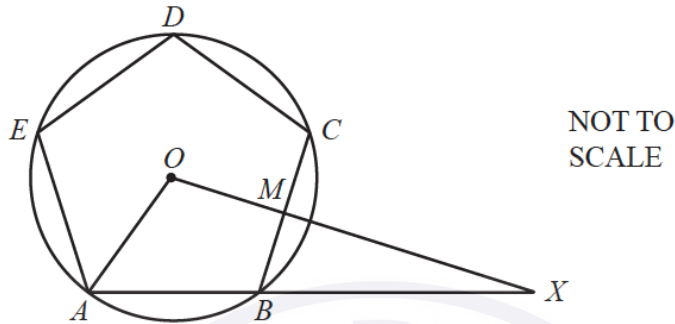
Angle $CDA = \dots\dots\dots$ [1]

Question 24

(a) Show that each interior angle of a regular pentagon is 108° .

[2]

(b)



The diagram shows a regular pentagon $ABCDE$.
 The vertices of the pentagon lie on a circle, centre O , radius 12 cm.
 M is the midpoint of BC .

(i) Find BM .

$BM = \dots\dots\dots$ cm [3]

(ii) OMX and ABX are straight lines.

(a) Find BX .

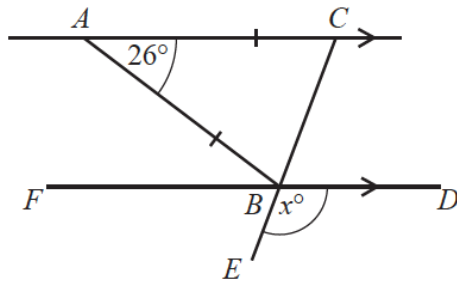
$BX = \dots\dots\dots$ cm [3]

(b) Calculate the area of triangle AOX .

$\dots\dots\dots$ cm^2 [3]

Question 25

(a)



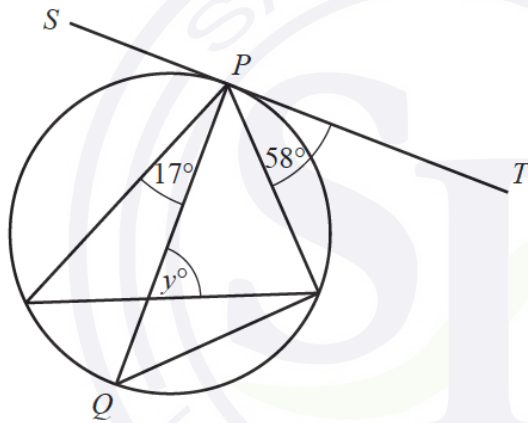
NOT TO SCALE

AC is parallel to FBD , ABC is an isosceles triangle and CBE is a straight line.

Find the value of x .

$x = \dots\dots\dots$ [3]

(b)



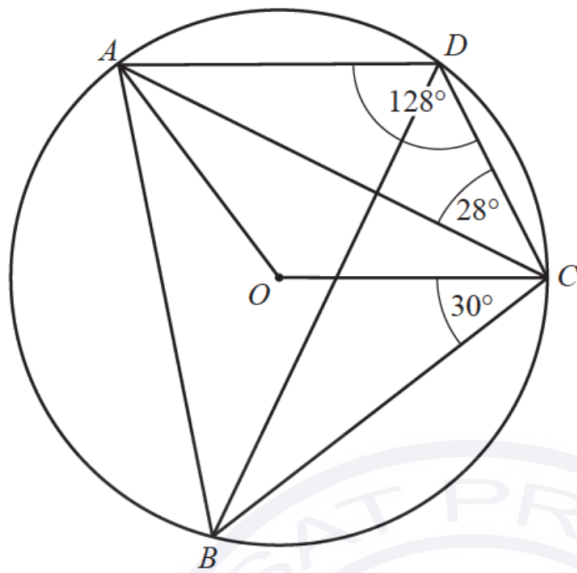
NOT TO SCALE

The diagram shows a circle with diameter PQ .
 SPT is a tangent to the circle at P .

Find the value of y .

$y = \dots\dots\dots$ [5]

Question 26



NOT TO SCALE

In the diagram, A , B , C and D lie on the circle, centre O .
 Angle $ADC = 128^\circ$, angle $ACD = 28^\circ$ and angle $BCO = 30^\circ$.

- (i) Show that obtuse angle $AOC = 104^\circ$.
 Give a reason for each step of your working.

[3]

- (ii) Find angle BAO .

Angle $BAO = \dots\dots\dots$ [2]

- (iii) Find angle ABD .

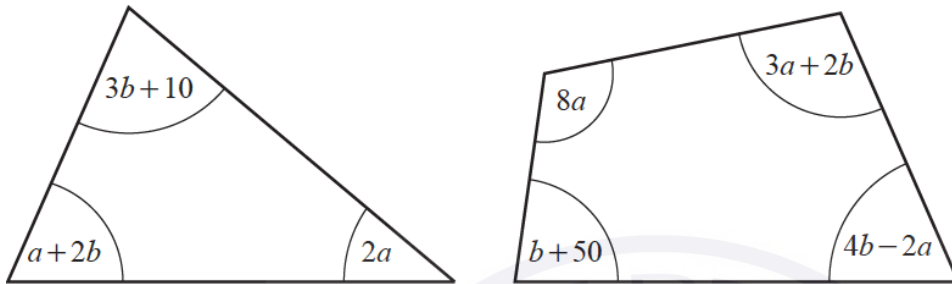
Angle $ABD = \dots\dots\dots$ [1]

- (iv) The radius, OC , of the circle is 9.6 cm.

Calculate the total perimeter of the sector $OADC$.

Question 27

The diagram shows a triangle and a quadrilateral.
All angles are in degrees.



NOT TO SCALE

(i) For the triangle, show that $3a+5b = 170$.

[1]

(ii) For the quadrilateral, show that $9a+7b = 310$.

[1]

(iii) Solve these simultaneous equations.
Show all your working.

$a = \dots\dots\dots$

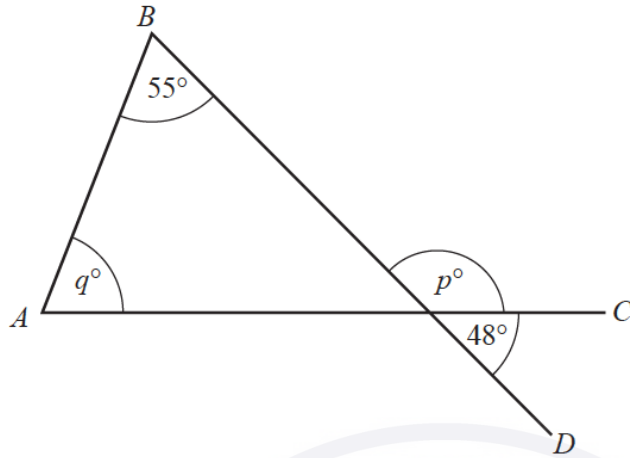
$b = \dots\dots\dots$ [3]

(iv) Find the size of the smallest angle in the triangle.

..... [1]

Question 28

(a)



NOT TO
SCALE

In the diagram, AC and BD are straight lines.

Find the value of p and the value of q .

$p =$

$q =$ [3]

(b) The angles of a quadrilateral are x° , $(x+5)^\circ$, $(2x-25)^\circ$ and $(x+10)^\circ$.

Find the value of x .

$x =$ [3]

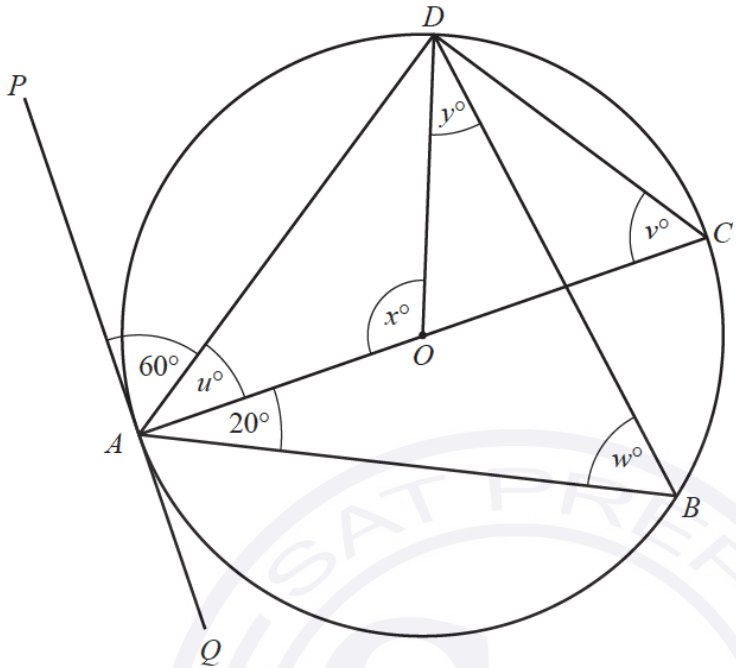
(c) A regular polygon has 72 sides.

Find the size of an interior angle.

..... [3]

Continue on the next page..

(d)



NOT TO SCALE

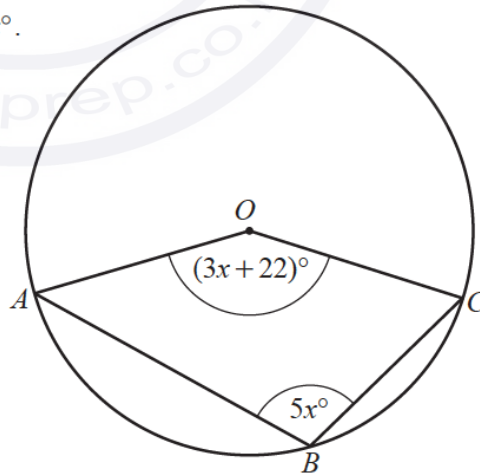
A, B, C and D lie on the circle, centre O , with diameter AC .
 PQ is a tangent to the circle at A .
 Angle $PAD = 60^\circ$ and angle $BAC = 20^\circ$.

Find the values of u, v, w, x and y .

$u = \dots\dots\dots$, $v = \dots\dots\dots$, $w = \dots\dots\dots$, $x = \dots\dots\dots$, $y = \dots\dots\dots$ [6]

(e) A, B and C lie on the circle, centre O .
 Angle $AOC = (3x + 22)^\circ$ and angle $ABC = 5x^\circ$.

Find the value of x .



NOT TO SCALE

$x = \dots\dots\dots$ [4]

Question 29

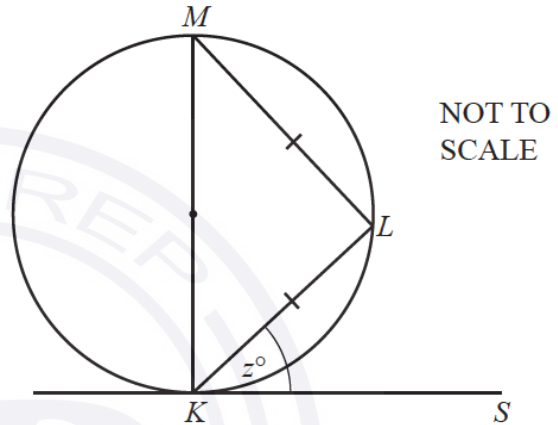
- (a) The interior angle of a regular polygon with n sides is 150° .

Calculate the value of n .

$n = \dots\dots\dots$ [2]

- (b) (i) K, L and M are points on the circle.
 KS is a tangent to the circle at K .
 KM is a diameter and triangle KLM is isosceles.

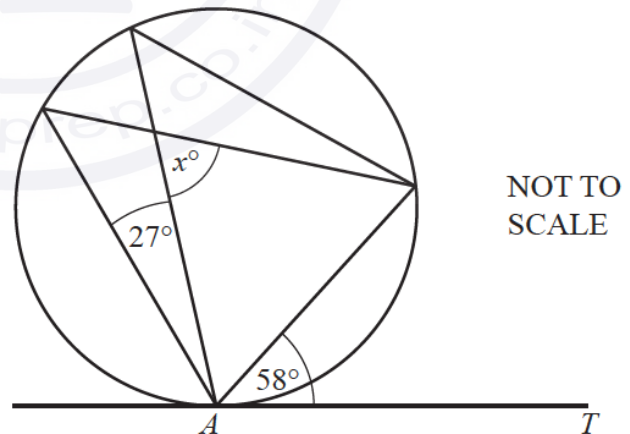
Find the value of z .



$z = \dots\dots\dots$ [2]

- (ii) AT is a tangent to the circle at A .

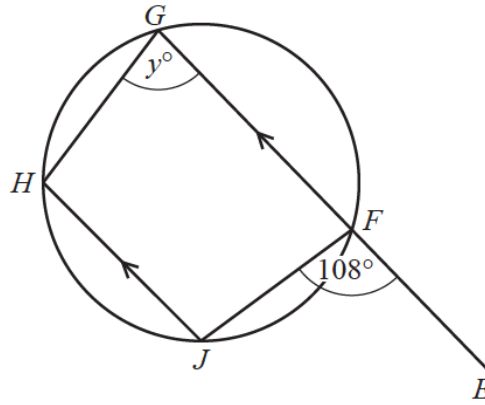
Find the value of x .



$x = \dots\dots\dots$ [2]

Continue on the next page..

(iii)



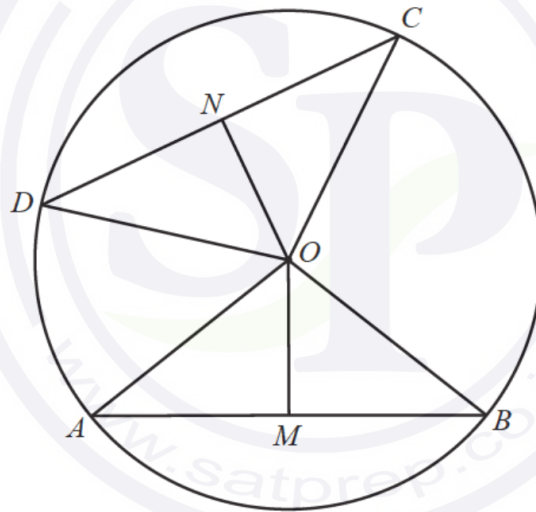
NOT TO SCALE

F, G, H and J are points on the circle.
 EFG is a straight line parallel to JH .

Find the value of y .

$y = \dots\dots\dots [2]$

(c)



NOT TO SCALE

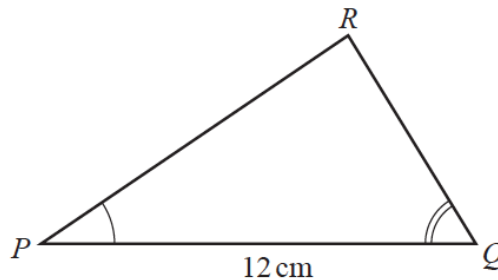
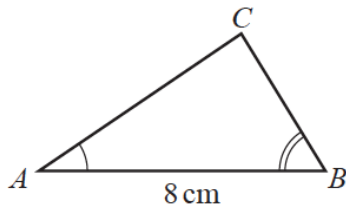
A, B, C and D are points on the circle, centre O .
 M is the midpoint of AB and N is the midpoint of CD .
 $OM = ON$

Explain, giving reasons, why triangle OAB is congruent to triangle OCD .

.....
.....
..... [3]

Question 30

(a)



NOT TO SCALE

Triangle ABC is mathematically similar to triangle PQR .
The area of triangle ABC is 16 cm^2 .

(i) Calculate the area of triangle PQR .

..... cm^2 [2]

(ii) The triangles are the cross-sections of prisms which are also mathematically similar.
The volume of the smaller prism is 320 cm^3 .

Calculate the length of the larger prism.

..... cm [3]

(b) A cylinder with radius 6 cm and height $h \text{ cm}$ has the same volume as a sphere with radius 4.5 cm .

Find the value of h .

[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

$h =$ [3]

(c) A solid metal cube of side 20 cm is melted down and made into 40 solid spheres, each of radius $r \text{ cm}$.

Find the value of r .

[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

$r =$ [3]

(d) A solid cylinder has radius $x \text{ cm}$ and height $\frac{7x}{2} \text{ cm}$.

The surface area of a sphere with radius $R \text{ cm}$ is equal to the total surface area of the cylinder.

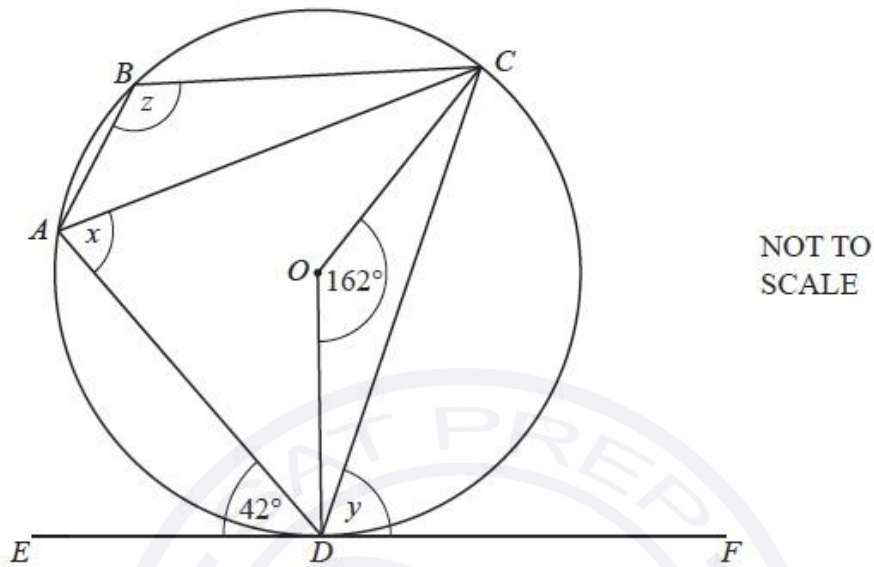
Find an expression for R in terms of x .

[The surface area, A , of a sphere with radius r is $A = 4\pi r^2$.]

$R =$ [3]

Question 31

(a)



A, B, C and D are points on the circle, centre O .
 EF is a tangent to the circle at D .
 Angle $ADE = 42^\circ$ and angle $COD = 162^\circ$.

Find the following angles, giving reasons for each of your answers.

(i) Angle x

$x = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [2]

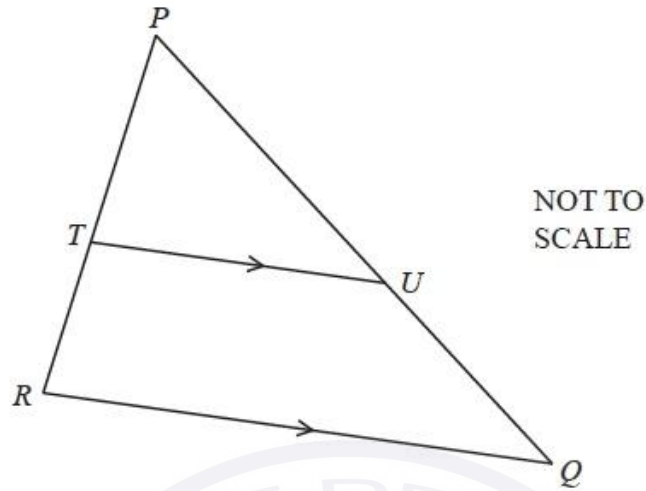
(ii) Angle y

$y = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [2]

(iii) Angle z

$z = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$
 $\dots\dots\dots$ [3]

(b)



PQR is a triangle.
 T is a point on PR and U is a point on PQ .
 RQ is parallel to TU .

- (i) Explain why triangle PQR is similar to triangle PUT .
Give a reason for each statement you make.

.....
.....
.....
..... [3]

- (ii) $PT : TR = 4 : 3$

- (a) Find the ratio $PU : PQ$.

..... : [1]

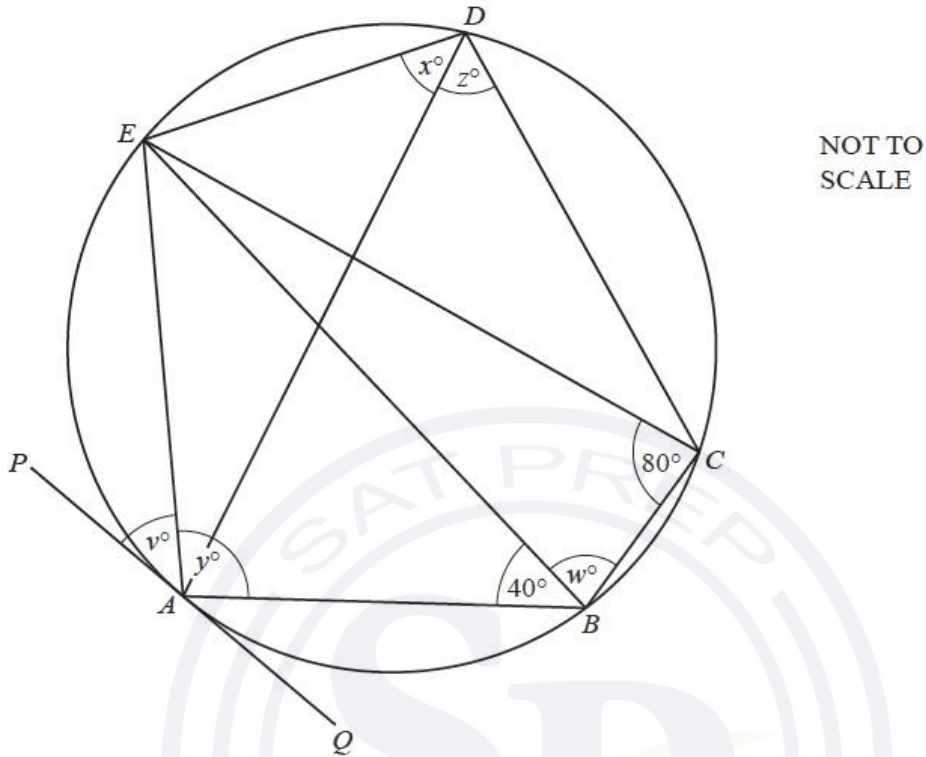
- (b) The area of triangle PUT is 20 cm^2 .

Find the area of the quadrilateral $QRTU$.

..... cm^2 [3]

Question 32

(a)

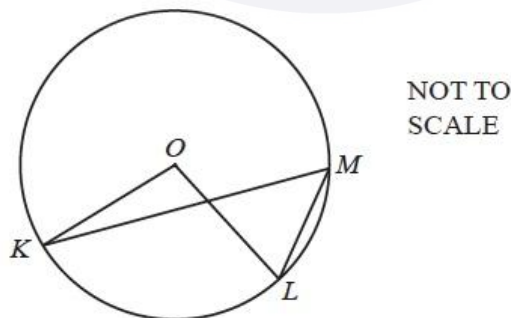


The points A, B, C, D and E lie on the circle.
 PAQ is a tangent to the circle at A and $EC = EB$.
 Angle $ECB = 80^\circ$ and angle $ABE = 40^\circ$.

Find the values of v, w, x, y and z .

$v = \dots\dots\dots w = \dots\dots\dots x = \dots\dots\dots y = \dots\dots\dots z = \dots\dots\dots$ [5]

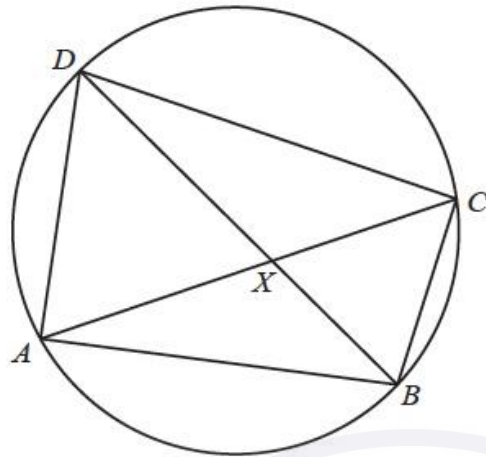
(b)



In the diagram, K, L and M lie on the circle, centre O .
 Angle $KML = 2x^\circ$ and reflex angle $KOL = 11x^\circ$.

Find the value of x .

(c)



NOT TO
SCALE

The diagonals of the cyclic quadrilateral $ABCD$ intersect at X .

- (i) Explain why triangle ADX is similar to triangle BCX .
Give a reason for each statement you make.

.....
.....
.....
..... [3]

- (ii) $AD = 10$ cm, $BC = 8$ cm, $BX = 5$ cm and $CX = 7$ cm.

- (a) Calculate DX .

$DX =$ cm [2]

- (b) Calculate angle BXC .

Angle $BXC =$ [4]

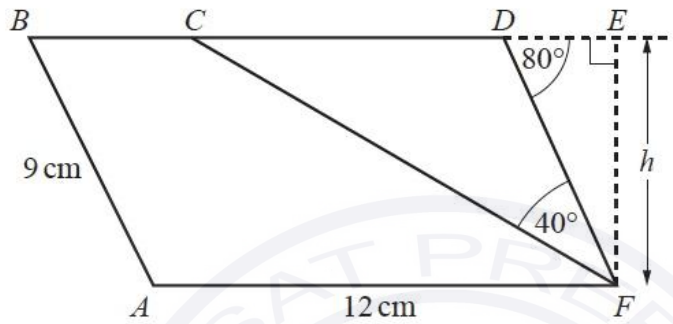
Question 33

(a) A rectangle measures 8.5 cm by 10.7 cm, both correct to 1 decimal place.

Calculate the upper bound of the perimeter of the rectangle.

..... cm [3]

(b)



NOT TO SCALE

ABDF is a parallelogram and *BCDE* is a straight line.
 $AF = 12$ cm, $AB = 9$ cm, angle $CFD = 40^\circ$ and angle $FDE = 80^\circ$.

(i) Calculate the height, h , of the parallelogram.

$h =$ cm [2]

(ii) Explain why triangle *CDF* is isosceles.

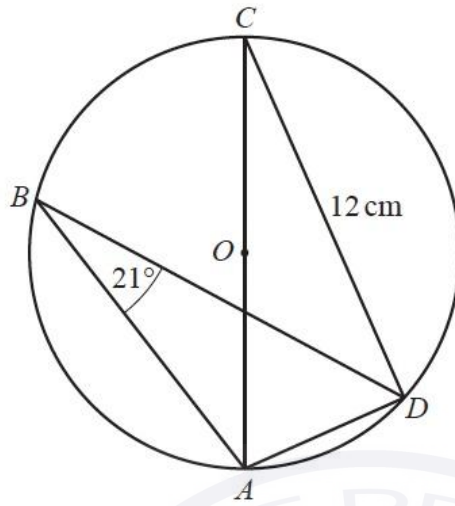
.....
 [2]

(iii) Calculate the area of the trapezium *ABCF*.

..... cm² [3]

Continue on next page...

(c)



NOT TO
SCALE

A, B, C and D are points on the circle, centre O .
Angle $ABD = 21^\circ$ and $CD = 12$ cm.

Calculate the area of the circle.

..... cm^2 [5]

(d)



NOT TO
SCALE

The diagram shows a square with side length 8 cm and a sector of a circle with radius 9.5 cm and sector angle x° .

The perimeter of the square is equal to the perimeter of the sector.

Calculate the value of x .

$x =$ [3]

Question 34

- (a) A box is a cuboid with length 45 cm, width 30 cm and height 42 cm.
The box is completely filled with 90.72 kg of sand.

Calculate the density of this sand in kg/m^3 .
[Density = mass \div volume]

..... kg/m^3 [3]

- (b) A bag contains 15000cm^3 of sand.
Some of this sand is used to completely fill a hole in the shape of a cylinder.
The hole is 30 cm deep and has radius 10 cm.

Calculate the percentage of the sand from the bag that is used.

.....% [3]

- (c) Sand costs \$98.90 per tonne.
This cost includes a tax of 15%.

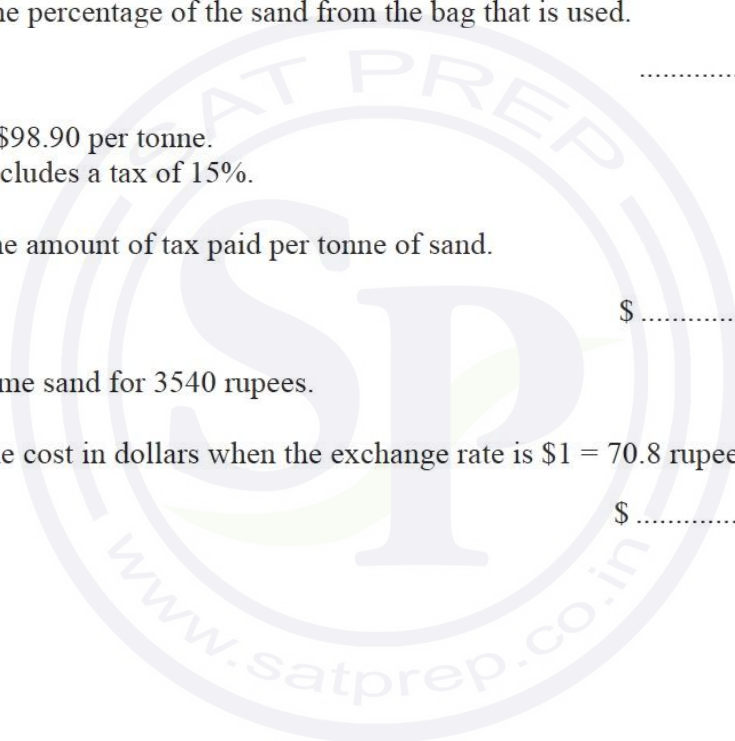
Calculate the amount of tax paid per tonne of sand.

\$ [3]

- (d) Raj buys some sand for 3540 rupees.

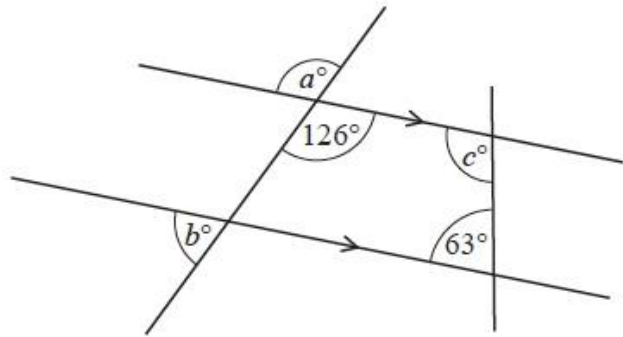
Calculate the cost in dollars when the exchange rate is \$1 = 70.8 rupees.

\$ [2]



Question 35

(a)



NOT TO SCALE

The diagram shows two straight lines intersecting two parallel lines.

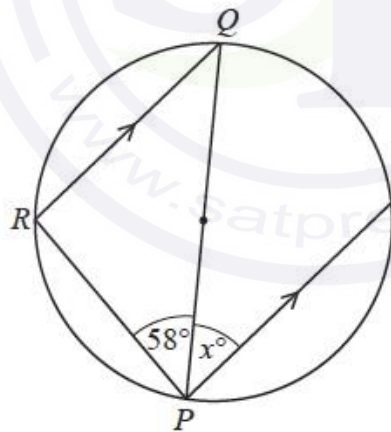
Find the values of a , b and c .

$a =$

$b =$

$c =$ [3]

(b)



NOT TO SCALE

Points R and S lie on a circle with diameter PQ .

RQ is parallel to PS .

Angle $RPQ = 58^\circ$.

Find the value of x , giving a geometrical reason for each stage of your working.

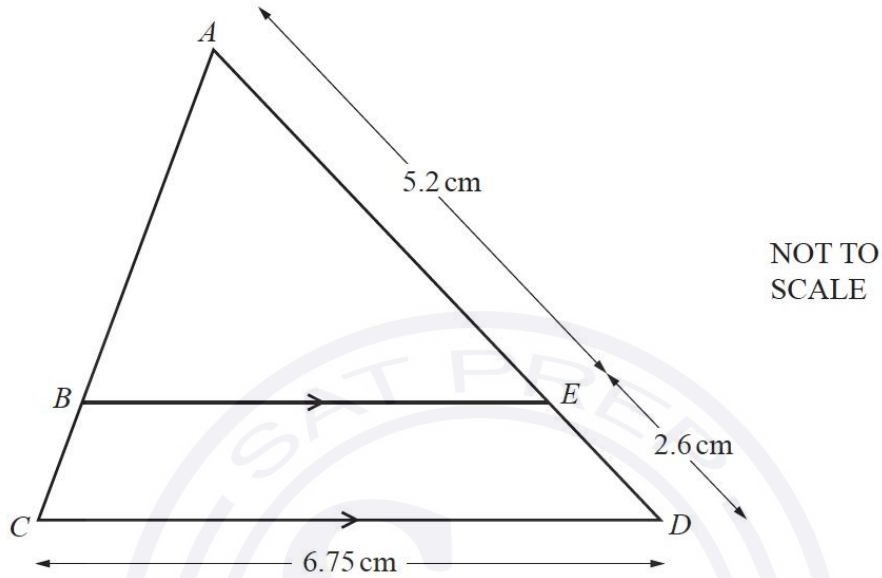
$x =$ [3]

Question 36

- (a) Find the size of an exterior angle of a regular polygon with 18 sides.

..... [2]

- (b)



In triangle ACD , B lies on AC and E lies on AD such that BE is parallel to CD .
 $AE = 5.2$ cm and $ED = 2.6$ cm.

Calculate BE .

$BE =$ cm [2]

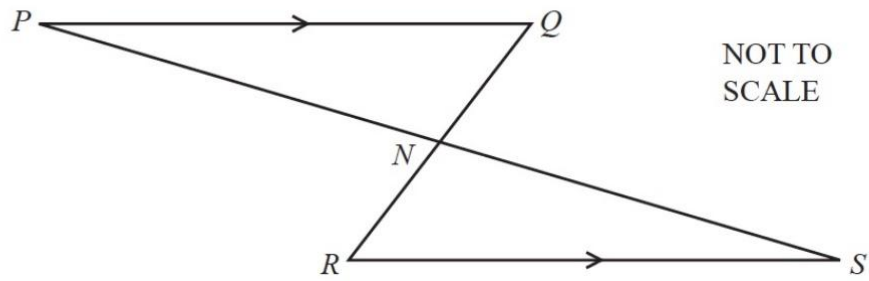
- (c) Two solids are mathematically similar.
 The smaller solid has height 2 cm and volume 32 cm³.
 The larger solid has volume 780 cm³.

Calculate the height of the larger solid.

..... cm [3]

Continue on the next page...

(d)



PQ is parallel to RS , PNS is a straight line and N is the midpoint of RQ .

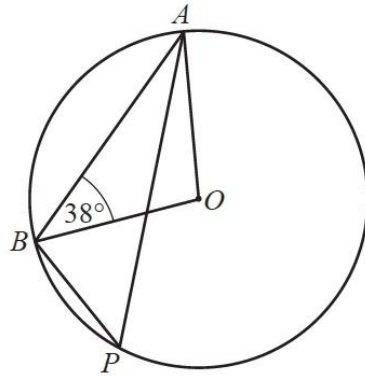
Explain, giving reasons, why triangle PQN is congruent to triangle SRN .

[4]



Question 37

(a)



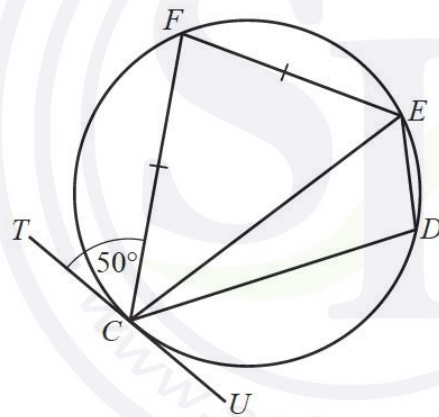
NOT TO SCALE

A, B and P are points on a circle, centre O and angle $OBA = 38^\circ$.

Find angle APB .

Angle $APB = \dots\dots\dots$ [3]

(b)



NOT TO SCALE

$CDEF$ is a cyclic quadrilateral and $FC = FE$.
 TU is a tangent to the circle at C and angle $TCF = 50^\circ$.

Find

(i) angle EFC ,

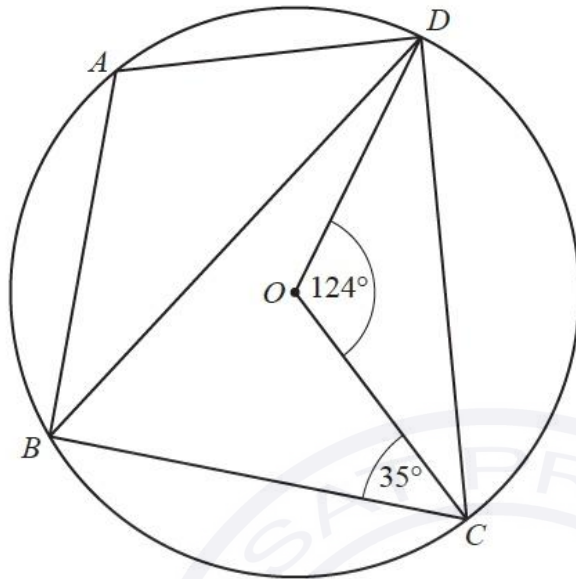
Angle $EFC = \dots\dots\dots$ [2]

(ii) angle CDE .

Angle $CDE = \dots\dots\dots$ [1]

Question 38

(a)



NOT TO SCALE

A, B, C and D are points on a circle, centre O .
 Angle $COD = 124^\circ$ and angle $BCO = 35^\circ$.

- (i) Work out angle CBD .
 Give a geometrical reason for your answer.

Angle $CBD = \dots\dots\dots$ because $\dots\dots\dots$

$\dots\dots\dots$ [2]

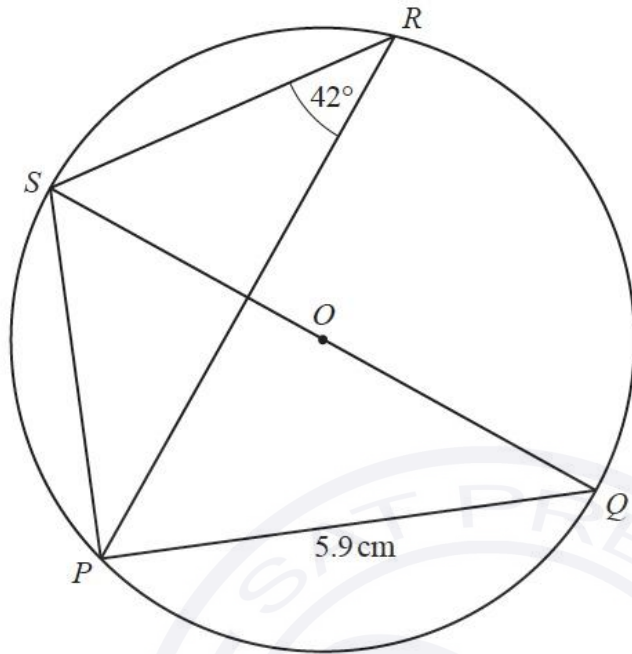
- (ii) Work out angle BAD .
 Give a geometrical reason for each step of your working.

Angle $BAD = \dots\dots\dots$ because $\dots\dots\dots$

$\dots\dots\dots$

$\dots\dots\dots$ [4]

(b)



NOT TO
SCALE

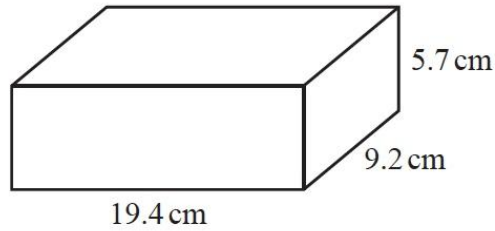
P , Q , R and S are points on a circle, centre O .
 QS is a diameter.
Angle $PRS = 42^\circ$ and $PQ = 5.9 \text{ cm}$.

Calculate the circumference of the circle.

..... cm [5]

Question 39

(a)



NOT TO SCALE

The diagram shows a brick in the shape of a cuboid.

(i) Calculate the total surface area of the brick.

..... cm^2 [3]

(ii) The density of the brick is 1.9 g/cm^3 .

Work out the mass of the brick.
Give your answer in kilograms.
[Density = mass \div volume]

..... kg [3]

(b) 9000 bricks are needed to build a house.
200 bricks cost \$175.

Work out the cost of the bricks needed to build 5 houses.

\$ [3]

(c) Saskia builds a wall using 1500 bricks.
She can build at the rate of 40 bricks each hour.
She works for 9 hours each day.
Saskia starts work on 6 July and works every day until the wall is completed.

Find the date when she completes the wall.

..... [3]

(d) Rafa has a cylindrical tank.
The cylinder has a height of 105 cm and a diameter of 45 cm.

Calculate the capacity of the tank in litres.

..... litres [3]

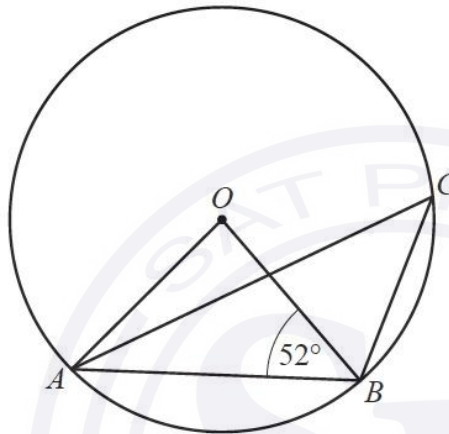
Question 40

- (a) The interior angle of a regular polygon is 156° .

Calculate the number of sides of this polygon.

..... [2]

- (b)



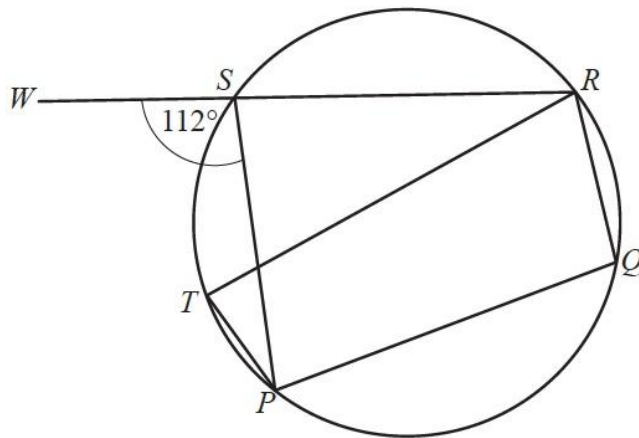
NOT TO
SCALE

A , B and C lie on a circle, centre O .
Angle $OBA = 52^\circ$.

Calculate angle ACB .

Angle $ACB =$ [2]

(c)



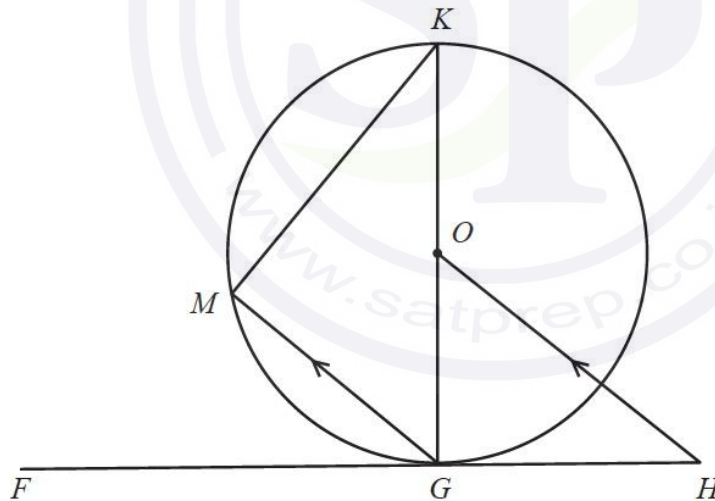
NOT TO SCALE

P, Q, R, S and T lie on a circle.
 WSR is a straight line and angle $WSP = 112^\circ$.

Calculate angle PTR .

Angle $PTR = \dots\dots\dots$ [2]

(d)



NOT TO SCALE

G, K and M lie on a circle, centre O .
 FGH is a tangent to the circle at G and MG is parallel to OH .

Show that triangle GKM is mathematically similar to triangle OHG .
Give a geometrical reason for each statement you make.

.....

..... [4]

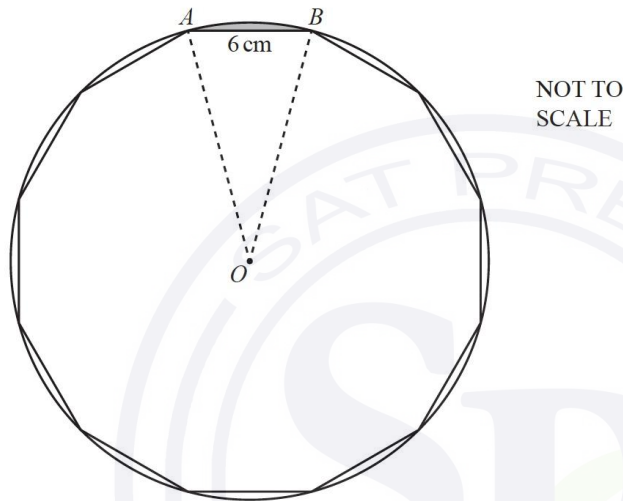
Question 41

A regular 12-sided polygon has side length 6 cm.

- (a) Show that one interior angle of the polygon is 150° .

[1]

- (b) The polygon is enclosed by a circle, centre O , so that each vertex touches the circumference of the circle.



- (i) Show that the radius, AO , of the circle is 11.6 cm, correct to 1 decimal place.

[3]

..... cm [2]

..... cm^3 [3]

- (ii) Calculate

- (a) the circumference of the circle,

..... cm [2]

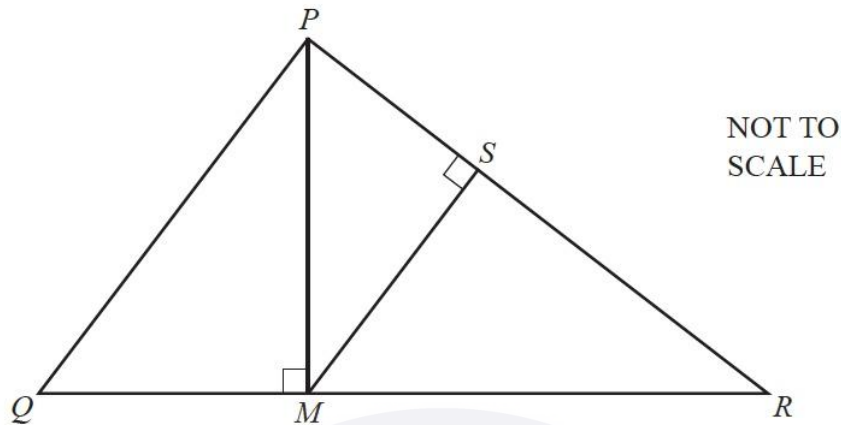
- (b) the perimeter of the shaded **minor** segment formed by the chord AB .

- (c) The regular 12-sided polygon is the cross-section of a prism of length 2 cm.

Calculate the volume of the prism.

Question 42

(a)

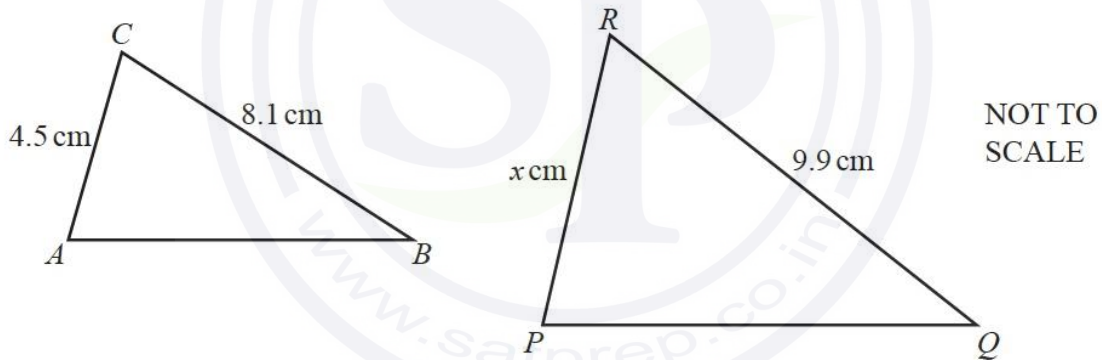


In triangle PQR , M lies on QR and S lies on PR .

Explain, giving reasons, why triangle PMR is similar to triangle MSR .

..... [3]

(b)



Triangle ABC is similar to triangle PQR .

(i) Find the value of x .

Continue on the next page...

$x =$ [2]

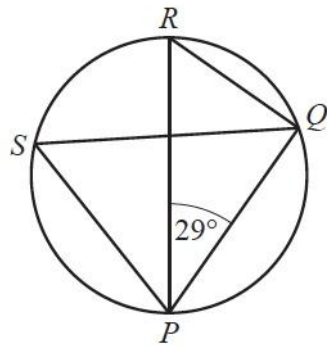
(ii) The area of triangle PQR is 25 cm^2 .

Calculate the area of triangle ABC .

..... cm^2 [2]

Question 43

(a)



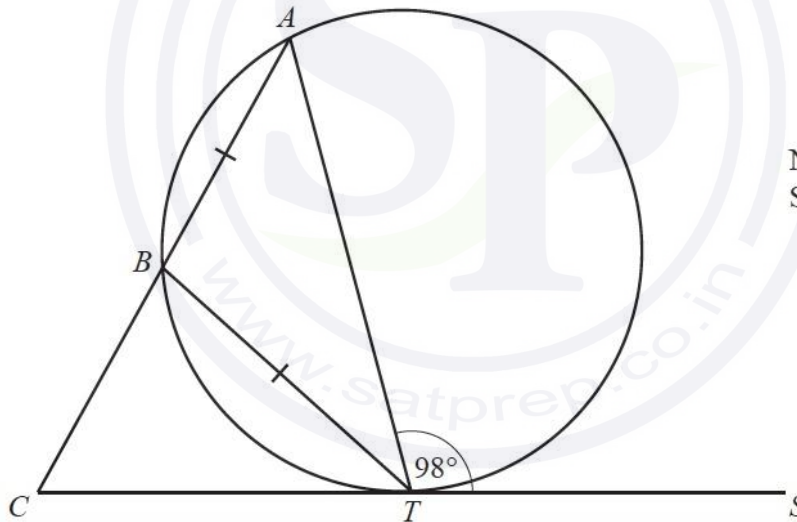
NOT TO SCALE

The points P , Q , R and S lie on a circle with diameter PR .

Work out the size of angle PSQ , giving a geometrical reason for each step of your working.

..... [3]

(b)



NOT TO SCALE

Continue on the next page...

The points A , B and T lie on a circle and CTS is a tangent to the circle at T .

ABC is a straight line and $AB = BT$.

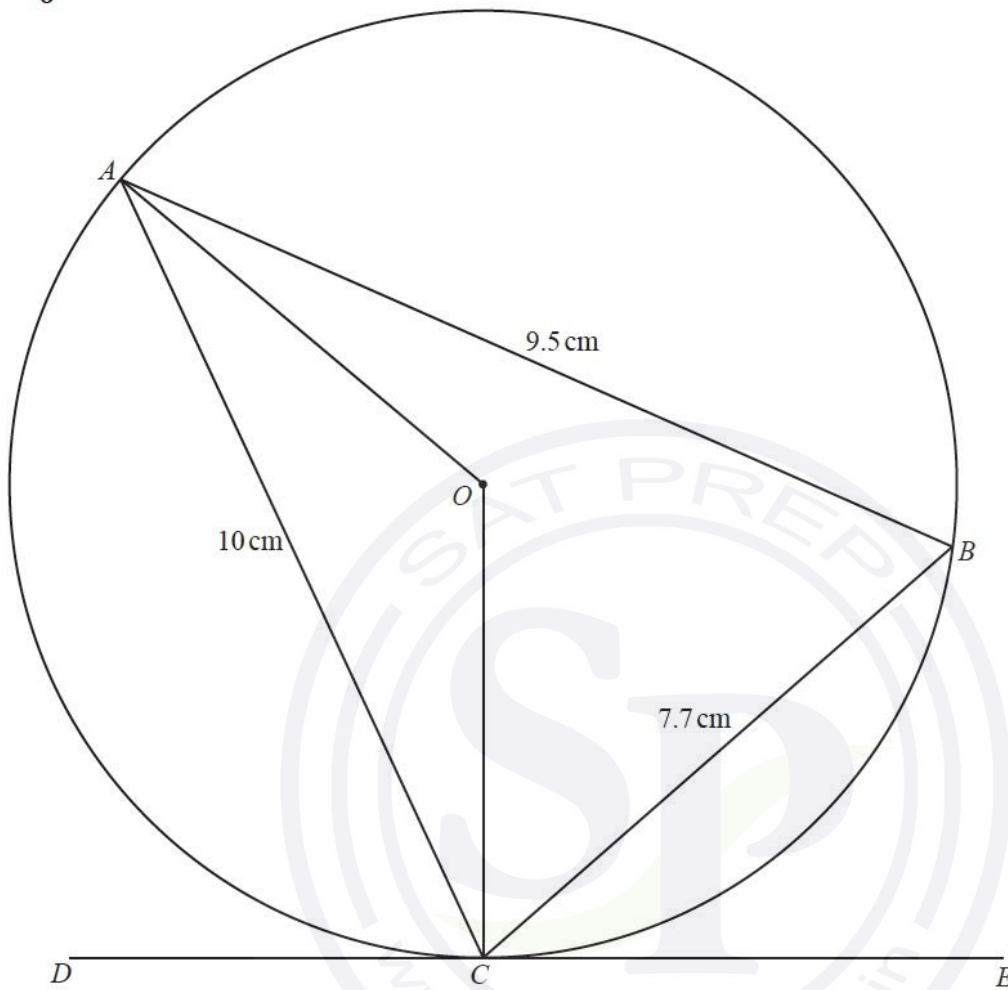
Angle $ATS = 98^\circ$.

Work out the size of angle ACT .

Angle $ACT = \dots\dots\dots$ [4]

Question 44

8



NOT TO SCALE

A , B and C are points on the circle, centre O .
 DE is a tangent to the circle at C .
 $AC = 10$ cm, $AB = 9.5$ cm and $BC = 7.7$ cm.

(a) Show that angle $ABC = 70.2^\circ$, correct to 1 decimal place.

[4]

Continue on the next page...

(b) Find

(i) angle AOC

Angle $AOC = \dots\dots\dots$ [1]

(ii) angle ACO

Angle $ACO = \dots\dots\dots$ [1]

(iii) angle ACD .

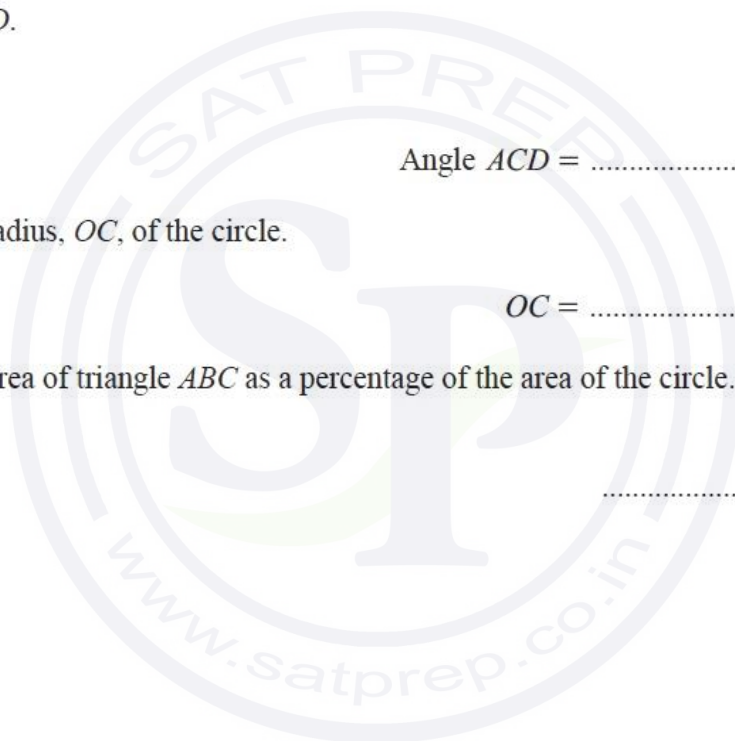
Angle $ACD = \dots\dots\dots$ [1]

(c) Calculate the radius, OC , of the circle.

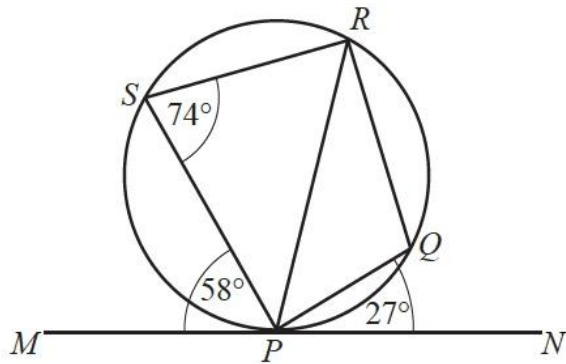
$OC = \dots\dots\dots$ cm [3]

(d) Calculate the area of triangle ABC as a percentage of the area of the circle.

$\dots\dots\dots\%$ [4]



Question 45



NOT TO
SCALE

P , Q , R and S lie on a circle.
 MPN is a tangent to the circle at P .
 Angle $MPS = 58^\circ$, angle $PSR = 74^\circ$ and angle $QPN = 27^\circ$.

(i) Find angle PRS .

Angle $PRS = \dots\dots\dots$ [1]

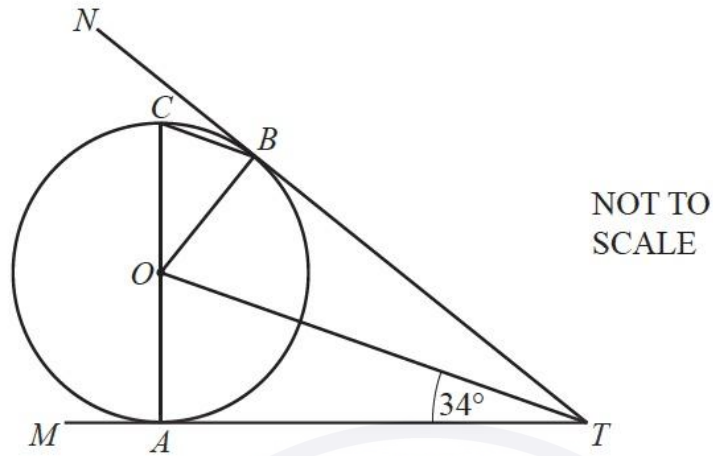
(ii) Find angle PQR .

Angle $PQR = \dots\dots\dots$ [1]

(iii) Find angle RPQ .

Angle $RPQ = \dots\dots\dots$ [2]

Question 46



A, B and C lie on a circle, centre O , with diameter AC .
 TAM and TBN are tangents to the circle and angle $ATO = 34^\circ$.

Using values and geometrical reasons, complete these statements to show that CB is parallel to OT .

In triangles AOT and BOT , OT is common.
 Angle $OAT =$ angle $OBT = 90^\circ$ because

.....

$AT = BT$ because

.....

Triangle AOT is congruent to triangle BOT because of congruence criterion

Angle $AOT =$ angle $BOT = 56^\circ$ because angles in a triangle add up to 180° .

Angle $BOC =$ $^\circ$ because

Angle $OBC =$ $^\circ$ because

.....

CB is parallel to OT because

[6]

Question 47

- (a) The scale drawing shows two sides, AB and BC , of a field. The scale is 5 centimetres represents 200 metres.



- (i) Measure angle ABC .

Angle $ABC = \dots\dots\dots$ [1]

- (ii) X is a point on BC .
 $BX = 332$ m.

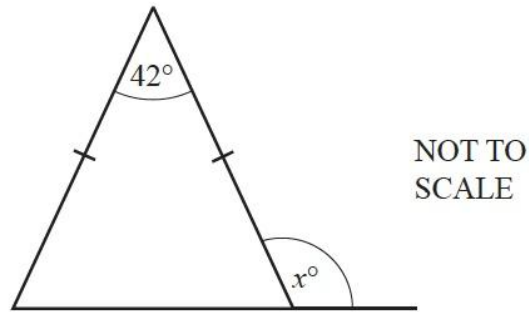
Mark the point X on the diagram. [2]

- (iii) Find the scale in the form $1 : n$.

1: $\dots\dots\dots$ [2]

Question 48

(a)



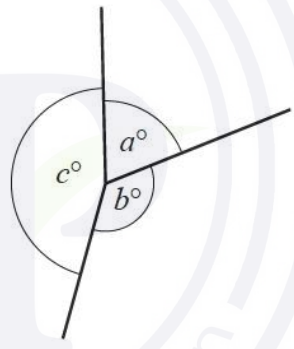
The diagram shows an isosceles triangle with the base extended.

Find the value of x .

$x = \dots\dots\dots [3]$

(b) The diagram shows three lines meeting at a point.
The ratio $a : b : c = 3 : 4 : 5$.

Find the value of c .



NOT TO SCALE

$c = \dots\dots\dots [3]$

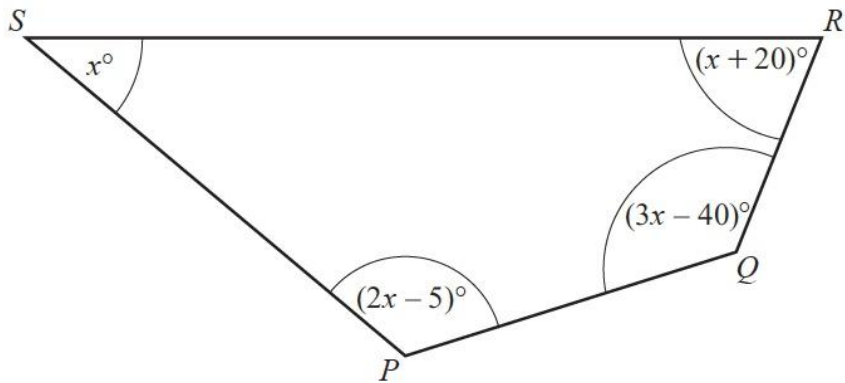
(c) A regular pentagon has an exterior angle, d .
A regular hexagon has an interior angle, h .

Find the fraction $\frac{d}{h}$.

Give your answer in its simplest form.

$\dots\dots\dots [4]$

(d)

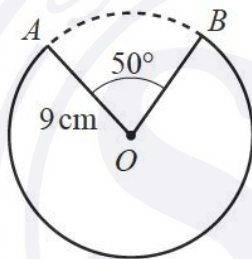


NOT TO SCALE

Show that $PQRS$ is a cyclic quadrilateral.

[5]

(e)



NOT TO SCALE

The diagram shows a circle of radius 9 cm , centre O .
The minor sector AOB , with sector angle 50° , is removed from the circle.

Calculate the length of the major arc AB .

..... cm [3]