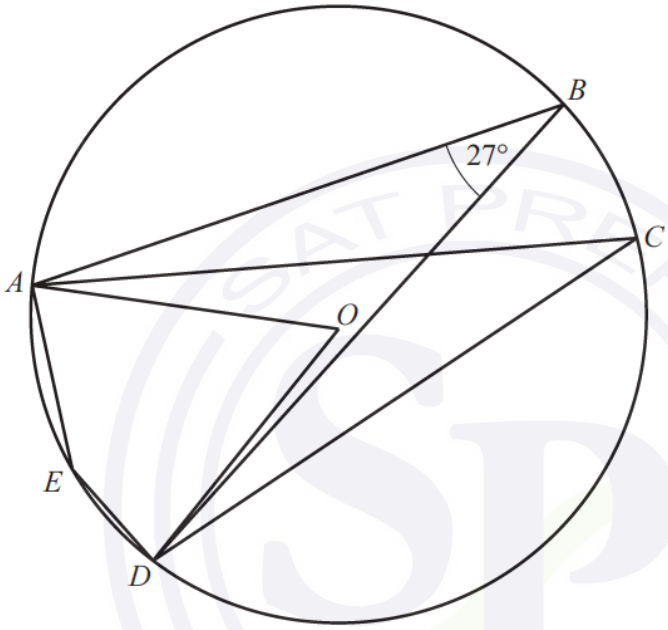
Extended Mathematics
Topic : Geometry
Year :May 2013 -May 2024
Paper -4
Questions Booklet

Question 1

(a)



NOT TO SCALE

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

Find

(i) angle ACD,

Answer(a)(i) Angle ACD = ... [1]

(ii) angle AOD,

Answer(a)(ii) Angle AOD = ... [1]

(iii) angle AED.

Answer(a)(iii) Angle AED = ... [1]

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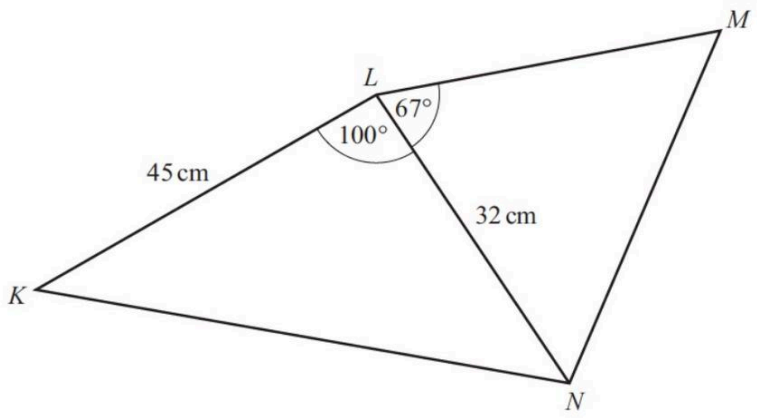
(b)



NOT TO SCALE

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

(i) Calculate the length KN.

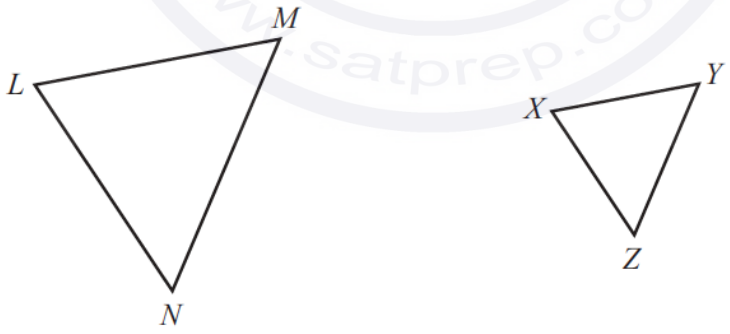
Answer(b)(i) $KN =$ ..... cm [4]

(ii) The area of triangle LMN is $324\,\text{cm}^2$.

Calculate the length LM.

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

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



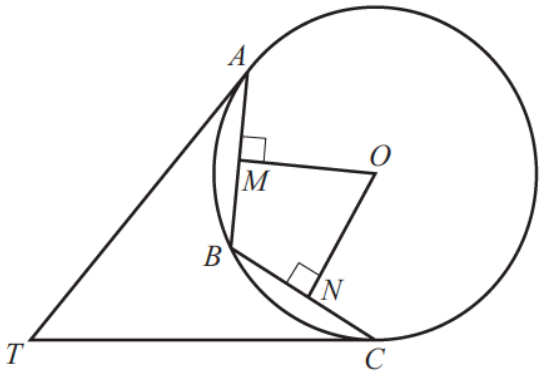
NOT TO SCALE

$XZ = 16$ cm and the area of triangle LMN is $324\,\text{cm}^2$.

Calculate the area of triangle XYZ.

Answer(b)(iii) ..... cm^2 [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) ..... cm^2 [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 $MOB = 39°$, 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.

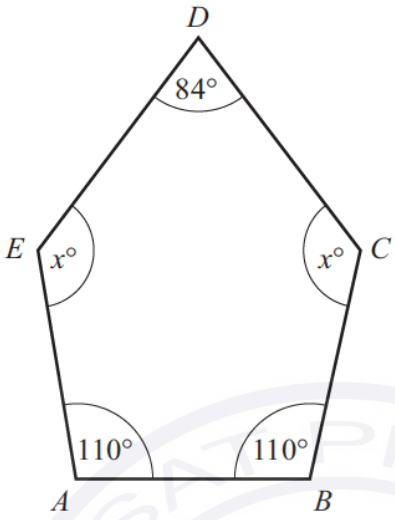
Explain clearly why triangle ATB is congruent to triangle CTB.

Answer(e)

[3]

Question 3

(a)



NOT TO SCALE

In the pentagon $ABCDE$, angle EAB = angle ABC = 110° and angle CDE = 84°.
Angle BCD = angle DEA = x°.

(i) Calculate the value of x.

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

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

Answer(a)(ii) Angle CBD = ... [1]

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

Answer(a)(iii) Angle ADB = ... [1]

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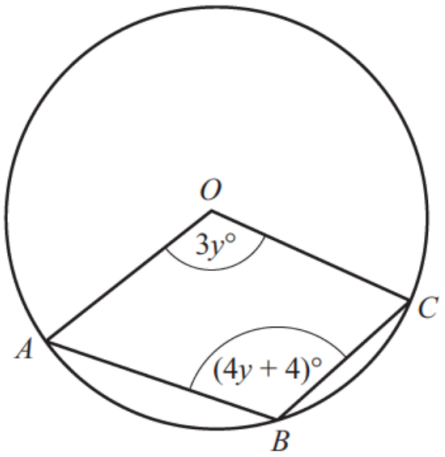
(b) A, B and C lie on a circle centre O.
Angle $AOC = 3y°$ and angle $ABC = (4y + 4)°$.

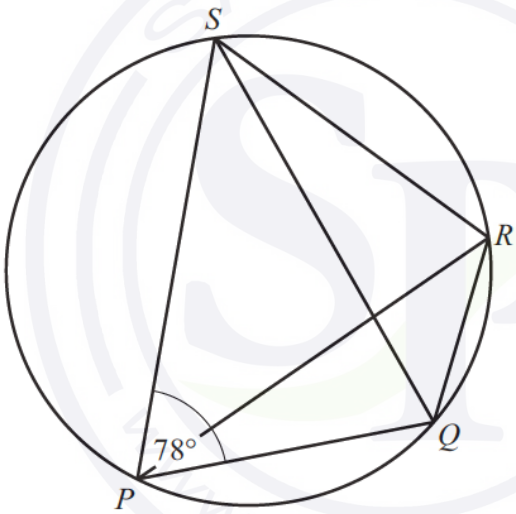
Find the value of y.



NOT TO SCALE

Answer(b) $y =$ ..... [4]

(c)



NOT TO SCALE

In the cyclic quadrilateral $PQRS$, angle $SPQ = 78°$.

(i) Write down the geometrical reason why angle $QRS = 102°$.

Answer(c)(i) ..... [1]

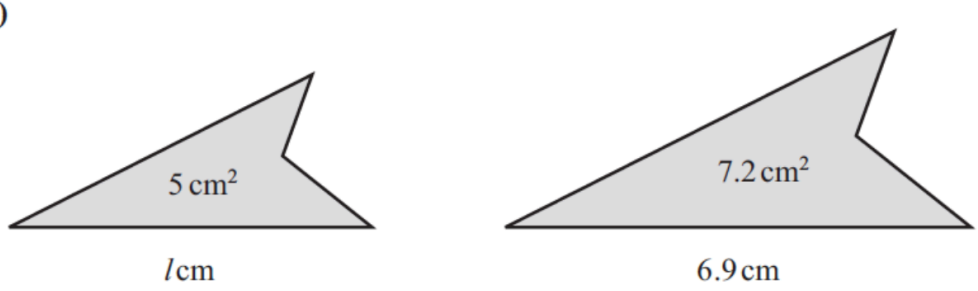
(ii) Angle PRQ : Angle $PRS = 1 : 2$.

Calculate angle PQS.

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

Continue on the next page..

(d)

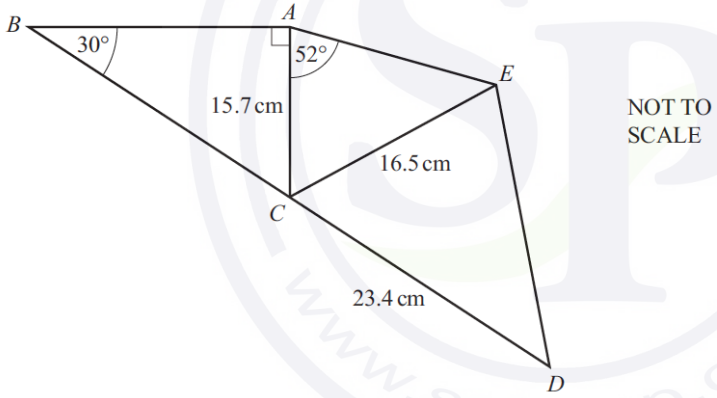


The diagram shows two similar figures.
The areas of the figures are $5\,cm^2$ and $7.2\,cm^2$.
The lengths of the bases are l cm and 6.9 cm.

Calculate the value of l.

Answer(d) l = ... [3]

Question 4



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

(a) Calculate BC.

Answer(a) BC = ... 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 $ECD = 40.6°$, correct to 1 decimal place.

Answer(c)(i)

[2]

(ii) Calculate DE.

Answer(c)(ii) DE = ... cm [4]

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

Answer(d) ..... 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) ..... and .....

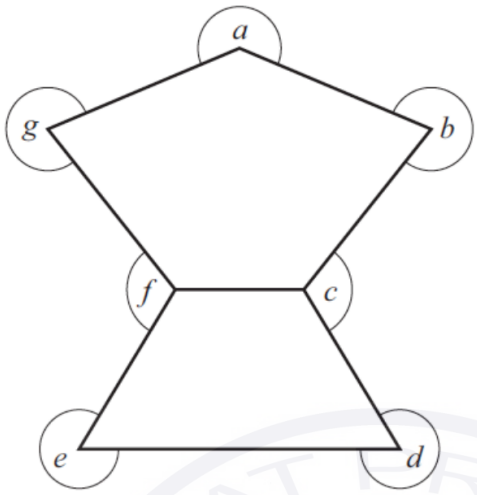
..... and ..... [2]

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

Answer(b) ..... [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
SCALE

Answer(c) ..... [2]

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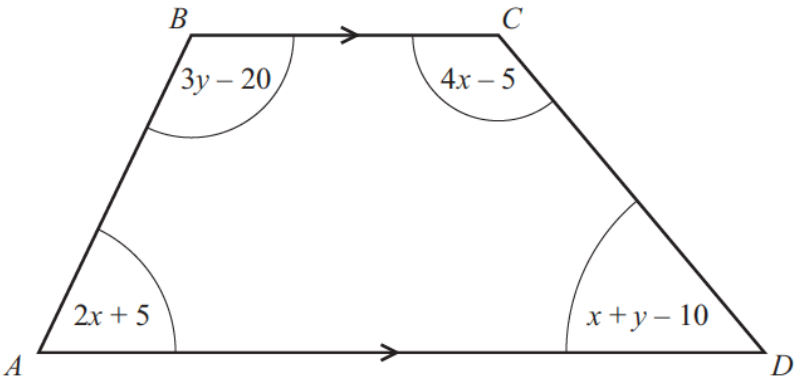
(d) The trapezium, $ABCD$, has four angles as shown.
All the angles are in degrees.



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) $x =$ .....

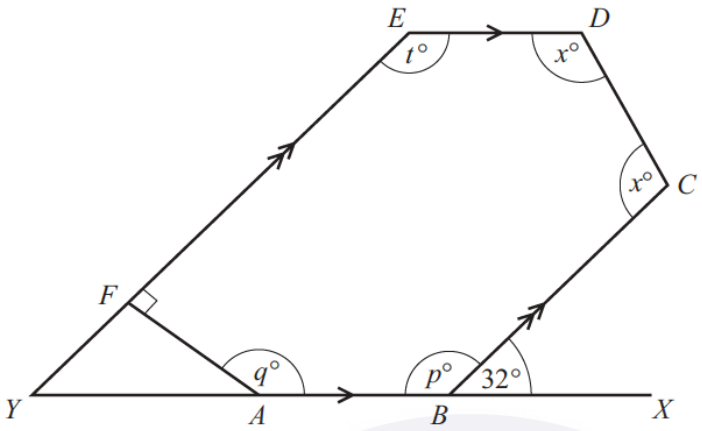
$y =$ ..... [4]

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

Answer(d)(iv) ..... , ... , ... , ... [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° and angle *EFA* = 90°.

Calculate the value of

(i) p,

Answer(a)(i) p = ... [1]

(ii) q,

Answer(a)(ii) q = ... [2]

(iii) t,

Answer(a)(iii) t = ... [1]

(iv) x.

Answer(a)(iv) x = ... [3]

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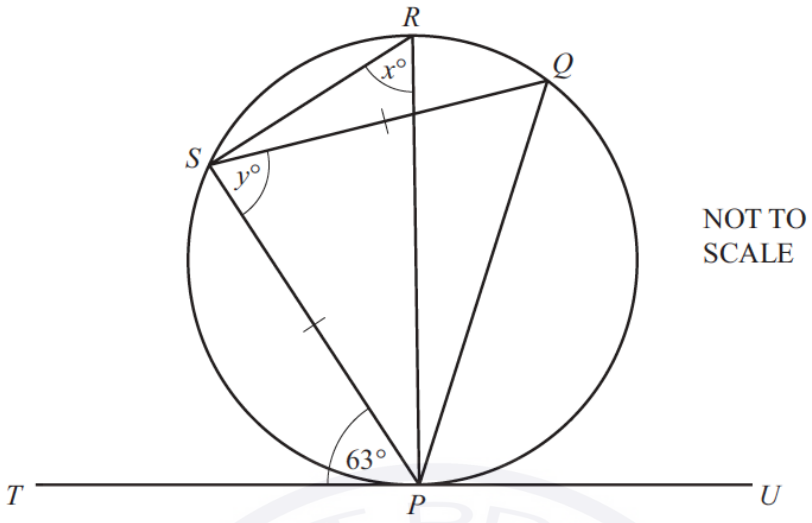
(b)



NOT TO SCALE

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 $SPT = 63°$.

Find the value of

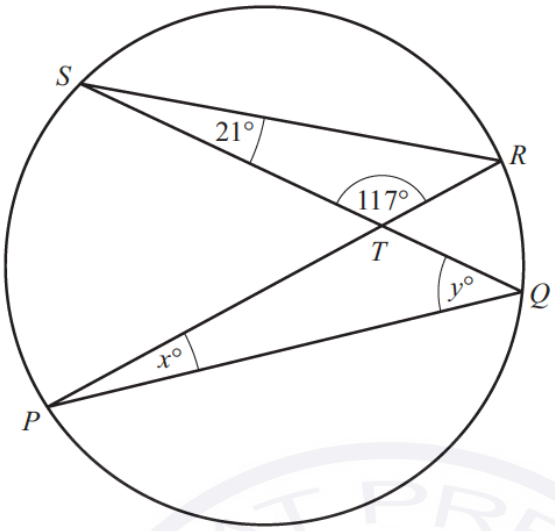
(i) x,

Answer(b)(i) x = ... [2]

(ii) y.

Answer(b)(ii) y = ... [2]

Question 7



NOT TO SCALE

(a) The chords *PR* and *SQ* of the circle intersect at *T*.
Angle *RST* = 21° and angle *STR* = 117°.

(i) Find the values of *x* and *y*.

Answer(a)(i) *x* = ...

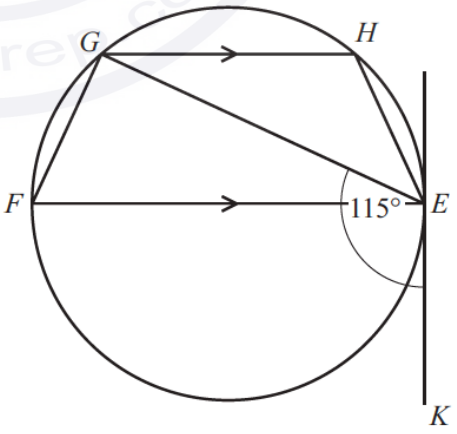
y = ... [2]

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

Calculate the length of *TQ*.

Answer(a)(ii) *TQ* = ... 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°.



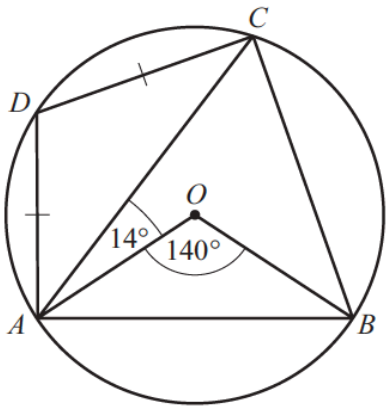
NOT TO SCALE

Calculate angle *GEH*.

Answer(b) Angle *GEH* = ... [4]

Continue on the next page..

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



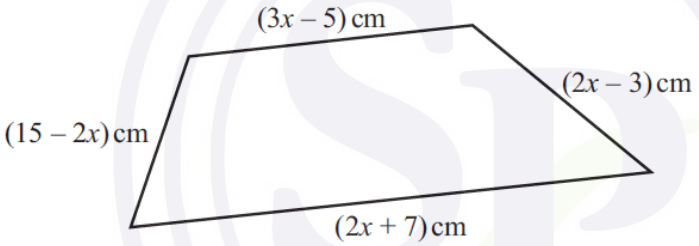
NOT TO SCALE

Calculate angle ACD.

Answer(c) Angle ACD = ... [5]

Question 8

(a)



NOT TO SCALE

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

Answer(a)(i) ..... cm [2]

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

Find the length of the longest side of the quadrilateral.

Answer(a)(ii) ..... cm [3]

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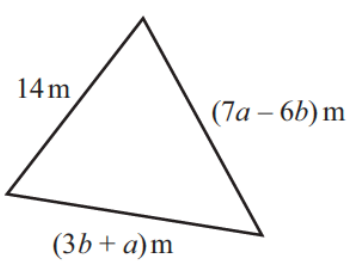
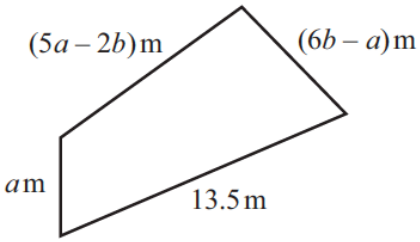
(b)





NOT TO SCALE

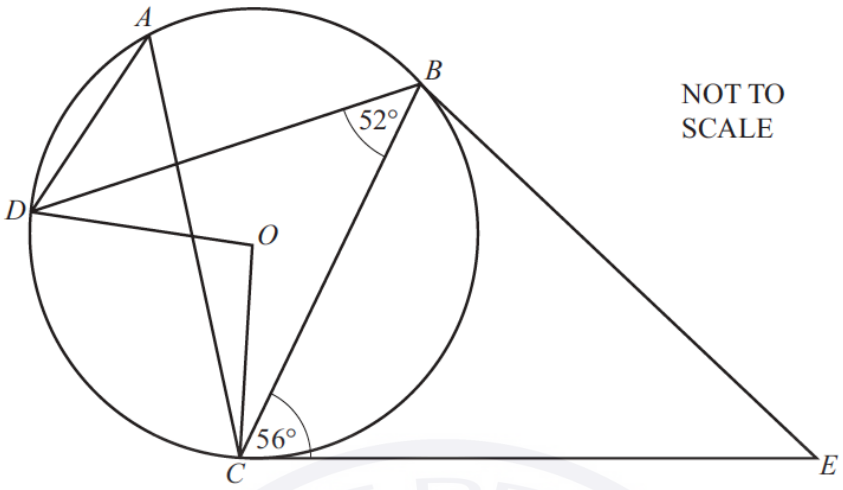
The triangle has a perimeter of 32.5 m.
The quadrilateral has a perimeter of 39.75 m.

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 = ...

b = ... [6]

Question 9



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 = ... because .....

..... [2]

(ii) Angle DOC = ... because .....

..... [2]

(iii) Angle BCO = ... because .....

..... [2]

Answer(b)(i) BE = ... cm [4]

(ii) Calculate angle BEC.

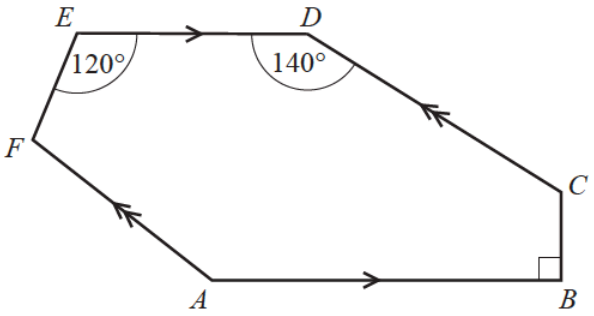
Answer(b)(ii) Angle BEC = ... [3]

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

(i) Calculate the length of BE.

Question 10

(a)



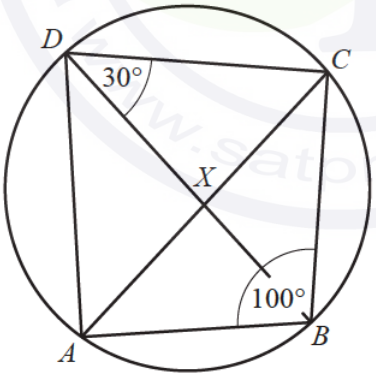
NOT TO SCALE

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

Calculate angle EFA.

Answer(a) Angle EFA = ... [4]

(b)



NOT TO SCALE

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

Continue on the next page..

(i) Calculate angle ACB.

Answer(b)(i) Angle ACB = ... [2]

(ii) Angle $BXC = 89°$.

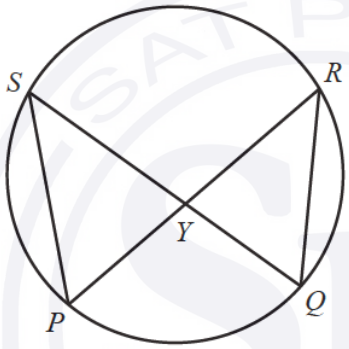
Calculate angle CAD.

Answer(b)(ii) Angle CAD = ... [2]

(iii) Complete the statement.

Triangles AXD and BXC are ..... . [1]

(c)



NOT TO SCALE

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 $QRY = 23$ cm^2.

Calculate the area of triangle PYS.

Answer(c) ..... cm^2 [2]

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

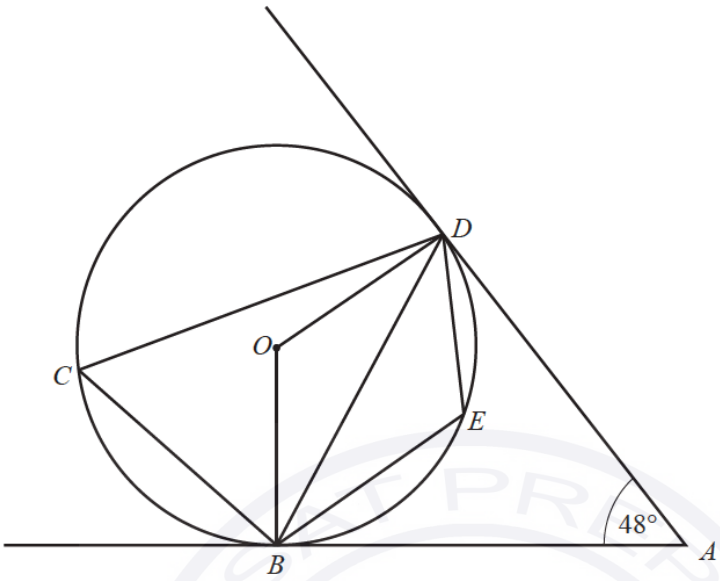
(i) Find the value of n.

Answer(d)(i) n = ... [3]

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

Answer(d)(ii) ..... [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 $BAD = 48°$.

(a) Find

(i) angle ABD,

Answer(a)(i) Angle ABD = ... [1]

(ii) angle OBD,

Answer(a)(ii) Angle OBD = ... [1]

(iii) angle BCD,

Answer(a)(iii) Angle BCD = ... [2]

(iv) angle BED.

Answer(a)(iv) Angle BED = ... [1]

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

Calculate the area of triangle BOD.

Answer(b) ..... cm^2 [2]

Continue on the next page..

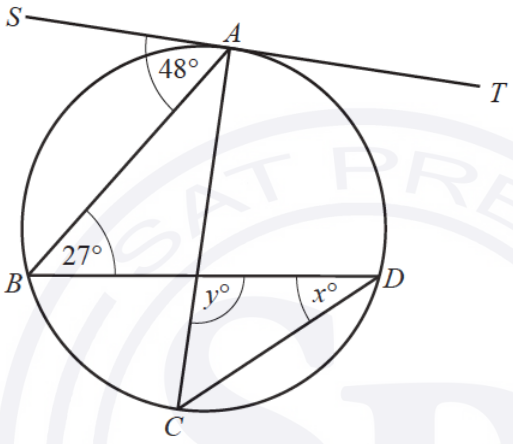
(c) Give a reason why $ABOD$ is a cyclic quadrilateral.

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.



NOT TO SCALE

Find the value of

(i) x,

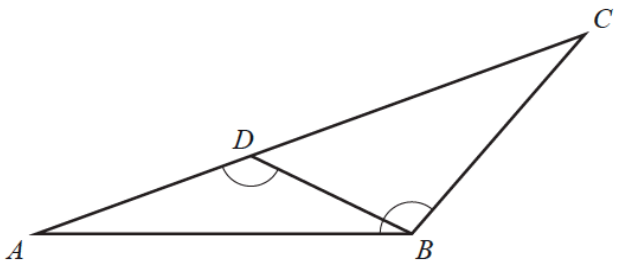
Answer(a)(i) x = ... [2]

(ii) y.

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

Question 13

(a)



NOT TO SCALE

In the diagram, D is on AC so that angle ADB = angle ABC.

(i) Show that angle ABD is equal to angle ACB.

Answer(a)(i)

[2]

(ii) Complete the statement.

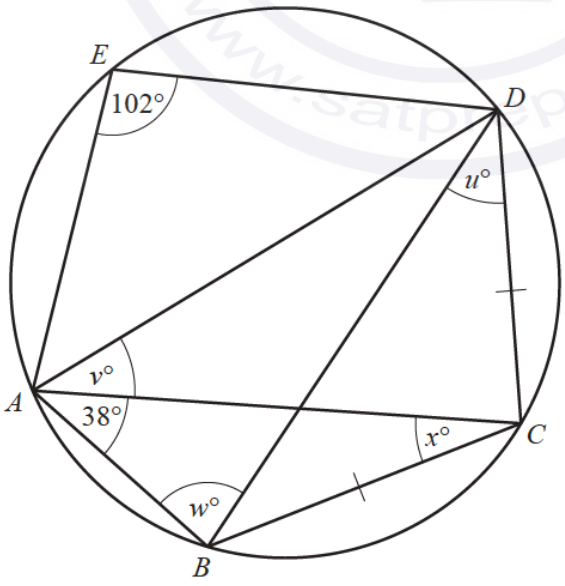
Triangles ABD and ACB are ..... . [1]

(iii) $AB = 12$ cm, $BC = 11$ cm and $AC = 16$ cm.

Calculate the length of BD.

Answer(a)(iii) BD = ... cm [2]

(b)



NOT TO SCALE

Continue on the next page..

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

Find the value of

(i) u,

Answer(b)(i) u = ... [1]

(ii) v,

Answer(b)(ii) v = ... [1]

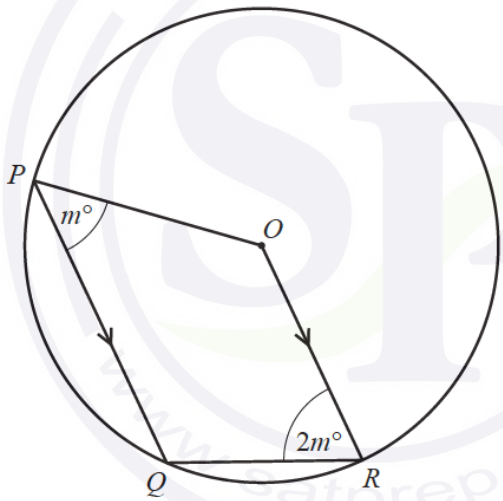
(iii) w,

Answer(b)(iii) w = ... [1]

(iv) x.

Answer(b)(iv) x = ... [1]

(c)



NOT TO SCALE

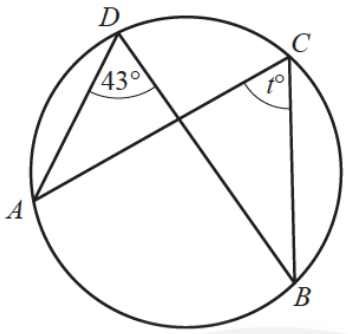
In the diagram, P, Q and R lie on the circle, centre O.
PQ is parallel to OR.
Angle $QPO = m°$ and angle $QRO = 2m°$.

Find the value of m.

Answer(c) m = ... [5]

Question 14

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

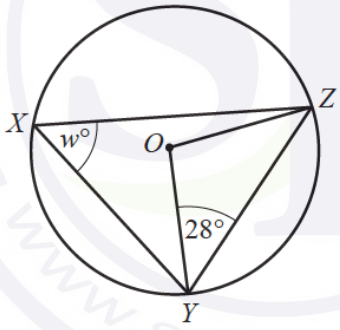


NOT TO SCALE

Find the value of t.

Answer(a)(i) t = ... [1]

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



NOT TO SCALE

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

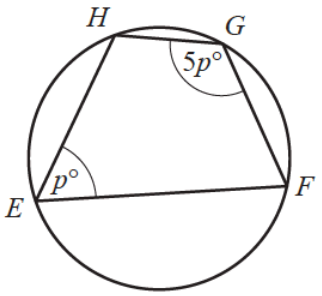
Answer(a)(ii) w = ... because .....

.....

..... [3]

Continue on the next page..

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



NOT TO SCALE

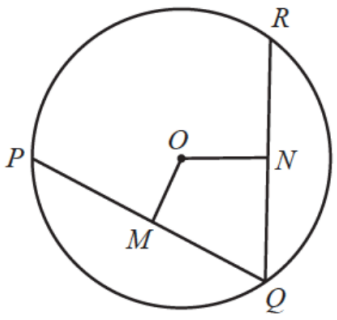
Find the value of p, giving a reason for your answer.

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.

$PM : PQ$ = ... : ..... [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.

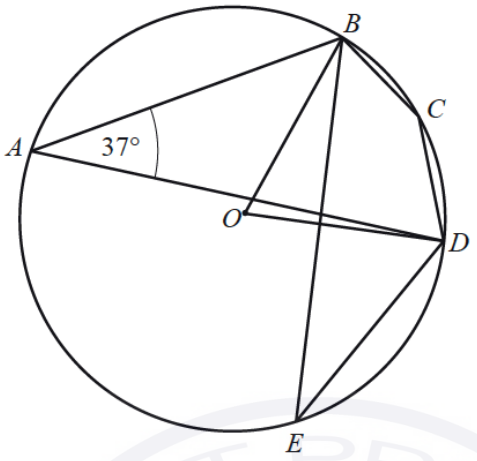
..... is a common side.

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

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

[4]

Question 15



NOT TO SCALE

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

Complete the following statements.

(a) Angle BED = ... because .....

..... [2]

(b) Angle BOD = ... because .....

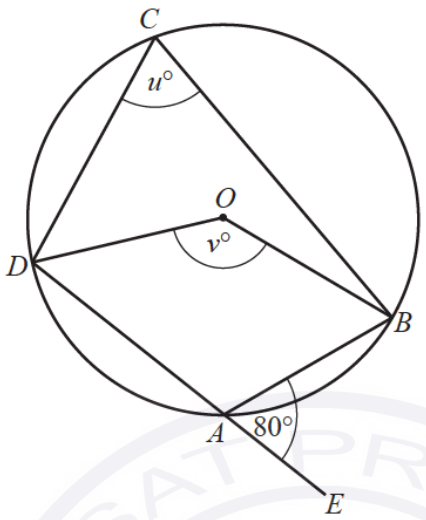
..... [2]

(c) Angle BCD = ... because .....

..... [2]

Question 16

(a)



NOT TO SCALE

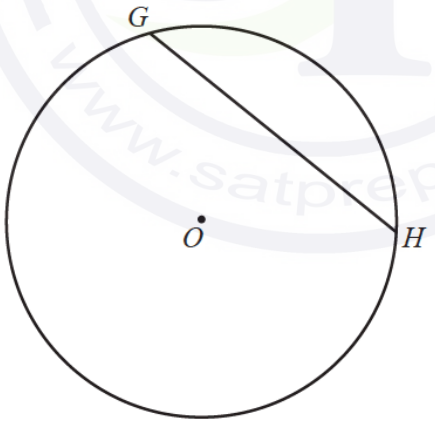
A, B, C and D lie on the circle, centre O.
DAE is a straight line.

Find the value of u and the value of v.

$u =$ .....

$v =$ ..... [2]

(b)



NOT TO SCALE

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

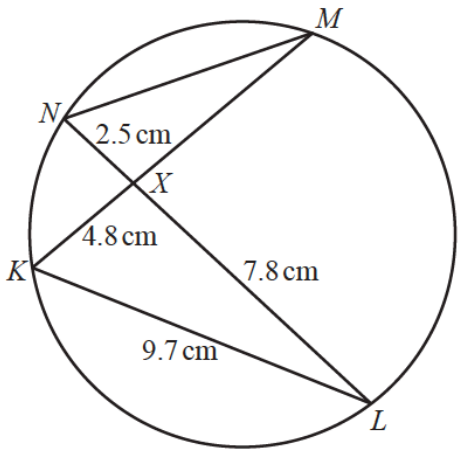
Calculate the length of the perpendicular from O to GH.

..... 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*.



NOT TO SCALE

MN = ... cm [2]

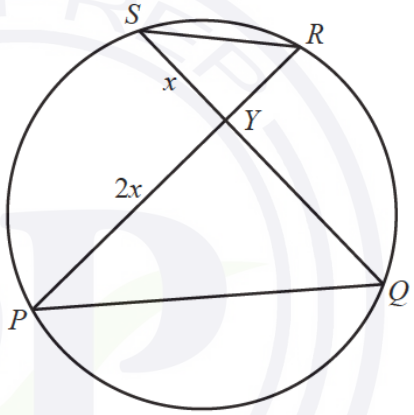
(d) All lengths are in centimetres.

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

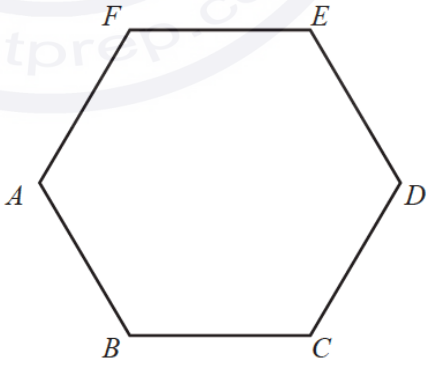


NOT TO SCALE

x = ... [4]

Question 17

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



NOT TO SCALE

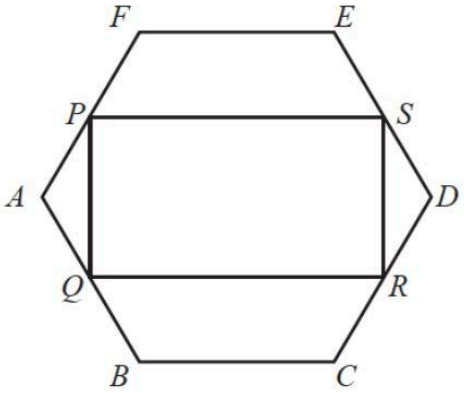
(i) Show that angle *BAF* = 120°.

[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.

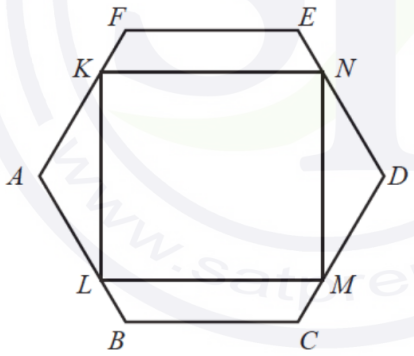
$PQ =$ ..... cm [3]

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

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

[3]

(b)



NOT TO SCALE

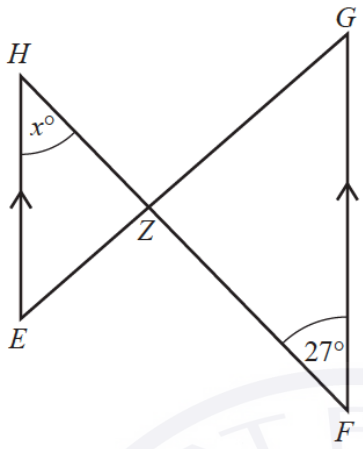
The diagram shows the vertices of a square $KLMN$ touching the sides of the same hexagon $ABCDEF$, with KN parallel to FE.

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

..... cm [4]

Question 18

(a)



NOT TO SCALE

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

$EZ =$ ..... 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 $OAB = 52°$.

(i) Find the value of x.

$x =$ ..... [1]

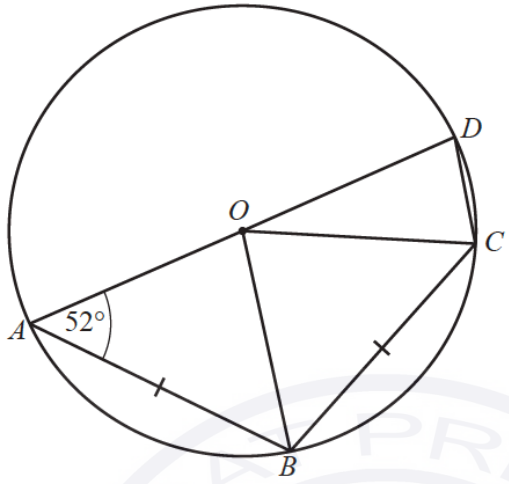
(ii) $EH = 5$ cm, $FG = 9$ cm and $ZG = 7$ cm.

Calculate EZ.

$EZ =$ ..... 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 $OAB = 52°$.

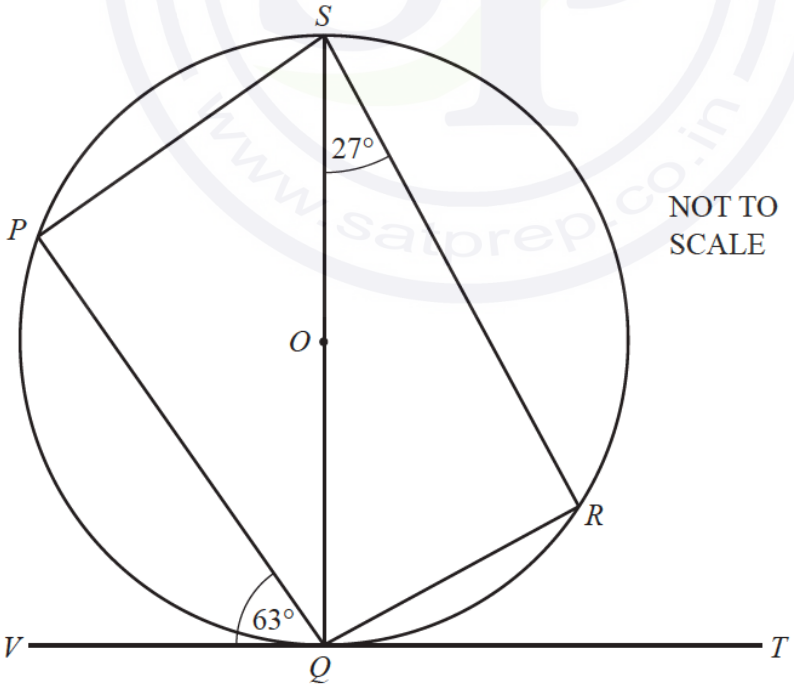


NOT TO SCALE

Find angle ADC.

Angle ADC = ... [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.



NOT TO SCALE

Continue on the next page..

Complete the statements.

(i) Angle QPS = angle QRS = ... ° because .....

..... [2]

(ii) Angle SQP = ... ° because .....

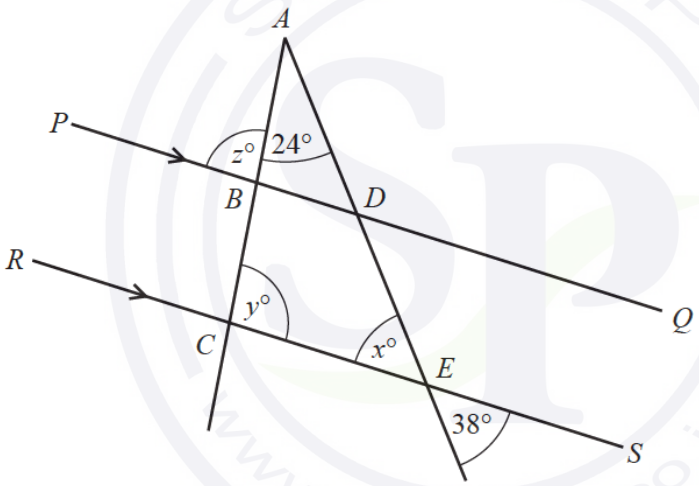
..... [2]

(iii) **Part (c)(i)** and **part (c)(ii)** show that

the cyclic quadrilateral $PQRS$ is a ..... [1]

Question 19

(a)



NOT TO SCALE

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

Find the values of x, y and z.

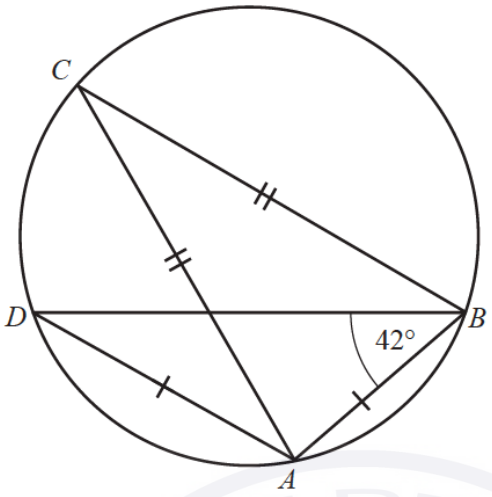
x = ...

y = ...

z = ... [3]

Continue on the next page..

(b)



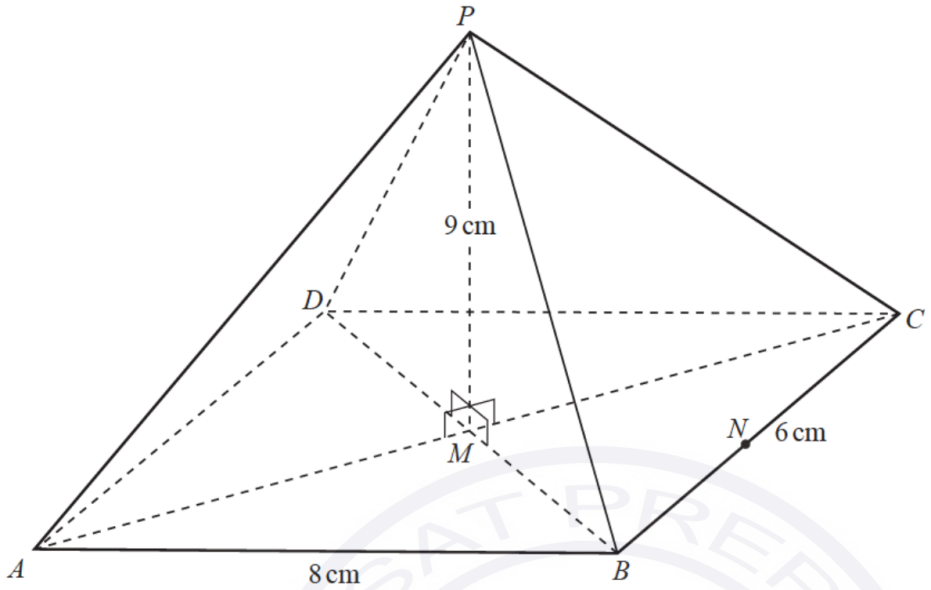
NOT TO SCALE

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

Find angle CAB.

Angle QRS = ... [2]

Question 20



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]

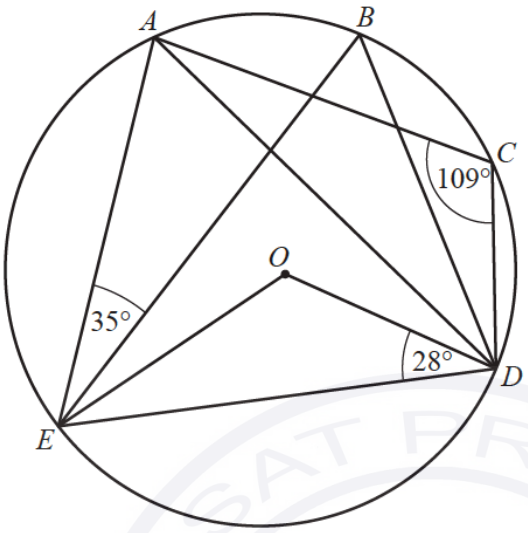
(d) A point X is on PC so that $PX = 7.5$ cm.

Calculate BX.

$BX =$ ..... cm [6]

Question 21

(a)



NOT TO SCALE

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

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

(a) Angle EBD = ... because .....

.....

..... [3]

(b) Angle EAD = ... because .....

..... [2]

(ii) Work out angle BEO.

Angle BEO = ... [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.

..... [3]

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

..... [2]

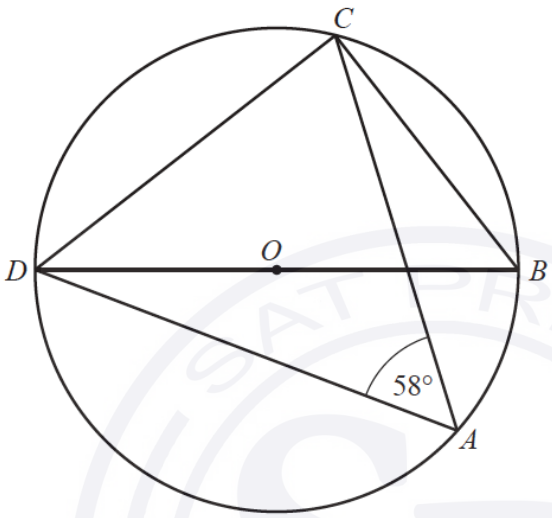
Question 22

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

Calculate the number of sides of the polygon.

.....[3]

(b)



NOT TO SCALE

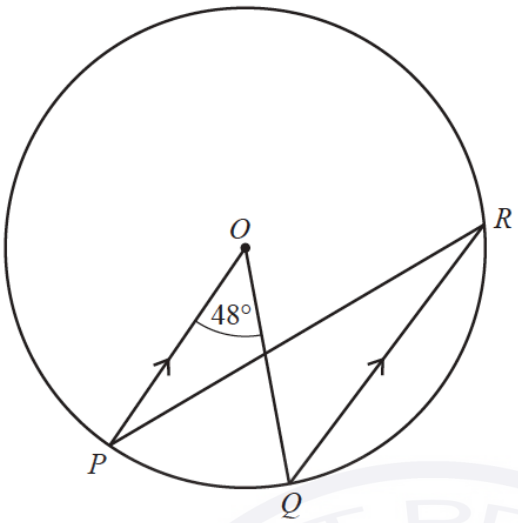
A, B, C and D are points on the circumference of the circle, centre O.
DOB is a straight line and angle $DAC = 58°$.

Find angle CDB.

Angle CDB = ... [3]

Continue on the next page..

(c)



NOT TO SCALE

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

(i) Find angle OPR.

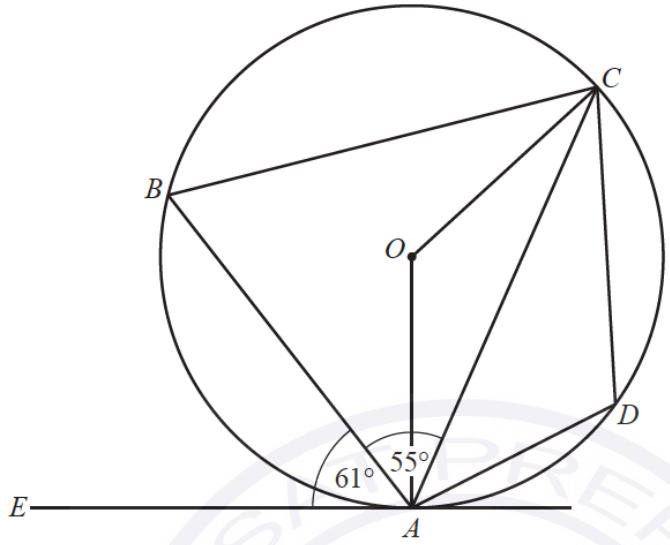
Angle OPR = ... [2]

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

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

..... cm [3]

Question 23



NOT TO SCALE

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

(a) Find angle BAO.

Angle BAO = ... [1]

(b) Find angle AOC.

Angle AOC = ... [2]

(c) Find angle ABC.

Angle ABC = ... [1]

(d) Find angle CDA.

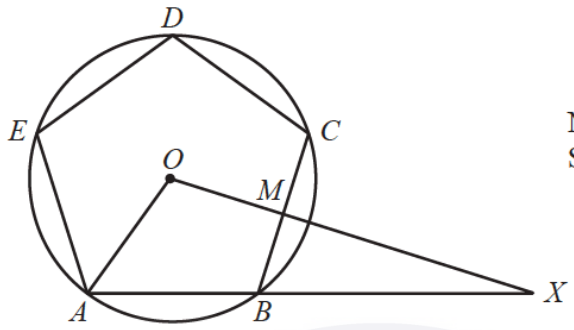
Angle CDA = ... [1]

Question 24

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

[2]

(b)



NOT TO SCALE

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.

$BM =$ ..... cm [3]

(ii) OMX and ABX are straight lines.

(a) Find BX.

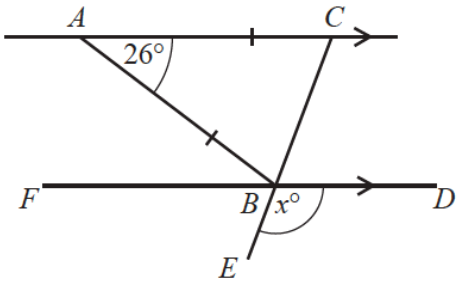
$BX =$ ..... cm [3]

(b) Calculate the area of triangle AOX.

..... cm^2 [3]

Question 25

(a)



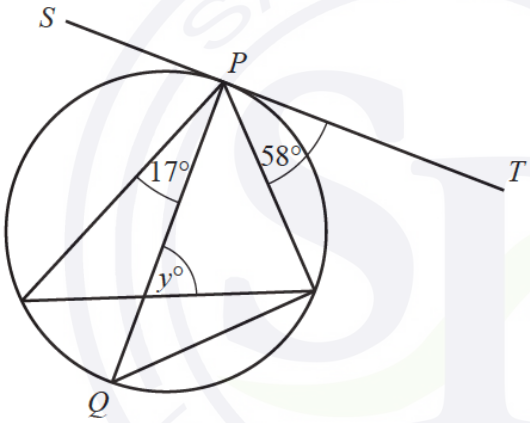
NOT TO SCALE

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

Find the value of x.

$x =$ ..... [3]

(b)



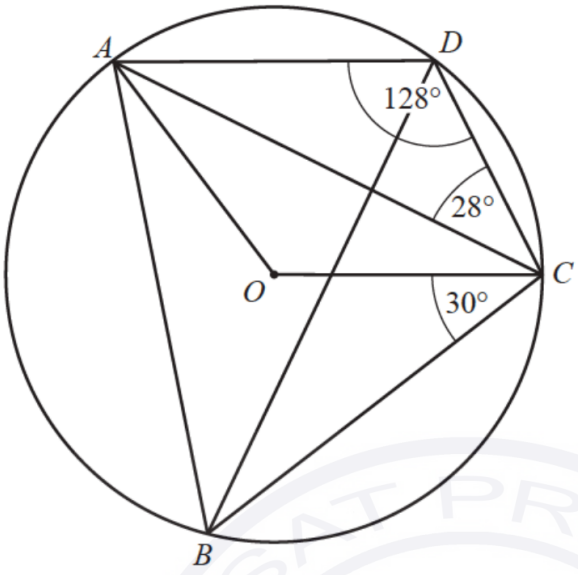
NOT TO SCALE

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

Find the value of y.

$y =$ ..... [5]

Question 26



NOT TO SCALE

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

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

[3]

(ii) Find angle BAO.

Angle BAO = ... [2]

(iii) Find angle ABD.

Angle ABD = ... [1]

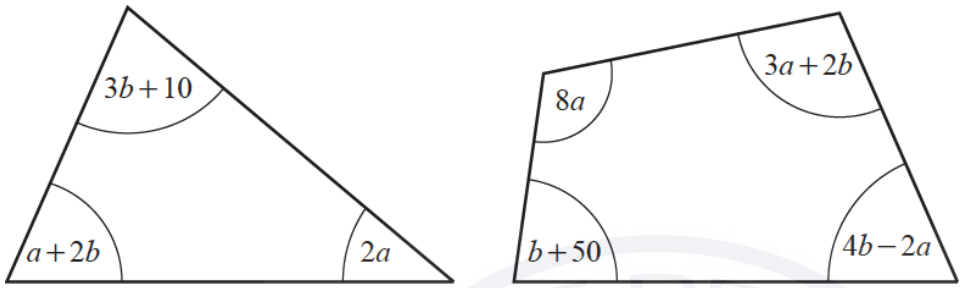
(iv) The radius, OC, of the circle is 9.6 cm.

Calculate the total perimeter of the sector $OADC$.

..... cm [3]

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.

$a =$ .....

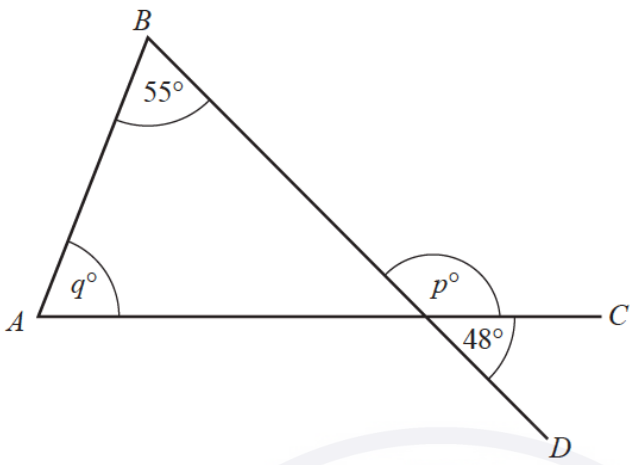
$b =$ ..... [3]

(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 $x°$, $(x+5)°$, $(2x-25)°$ and $(x+10)°$.

Find the value of x.

$x =$ ..... [3]

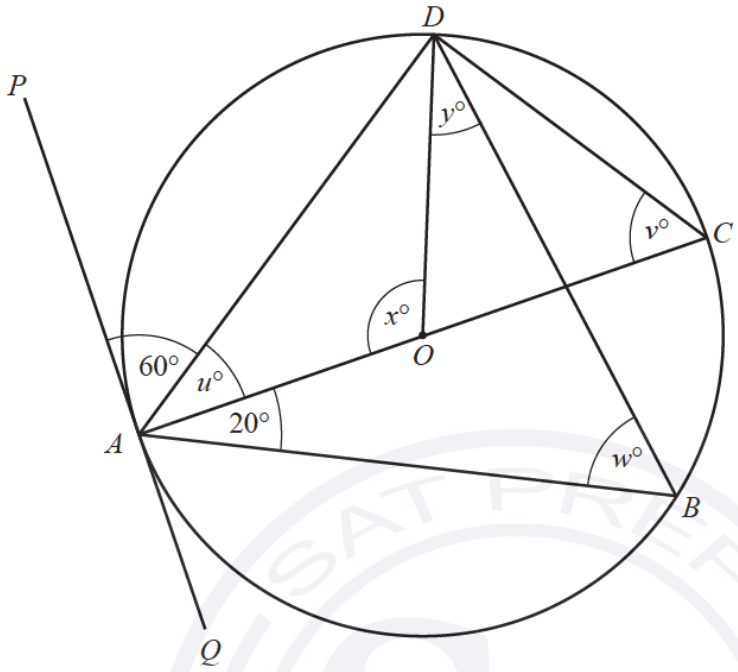
(c) A regular polygon has 72 sides.

Find the size of an interior angle.

..... [3]

Continue on the next page..

(d)



NOT TO SCALE

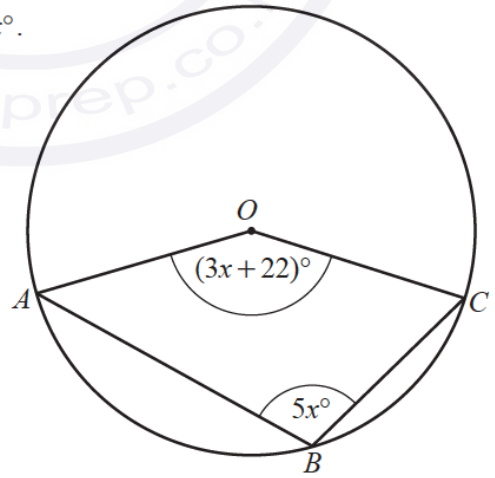
A, B, C and D lie on the circle, centre O, with diameter AC.
PQ is a tangent to the circle at A.
Angle $PAD = 60°$ and angle $BAC = 20°$.

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

$u =$ ....., $v =$ ....., $w =$ ....., $x =$ ....., $y =$ ..... [6]

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

Find the value of x.



NOT TO SCALE

$x =$ ..... [4]

Question 29

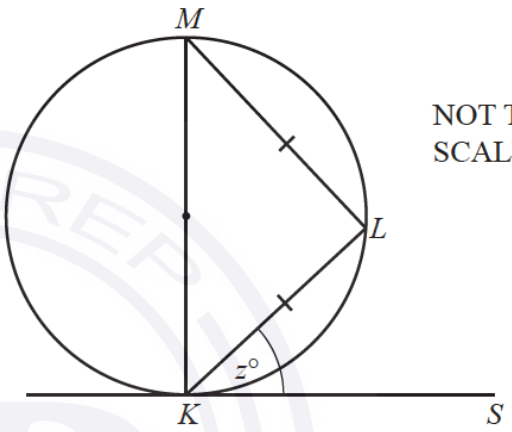
(a) The interior angle of a regular polygon with n sides is 150°.

Calculate the value of n.

$n =$ ..... [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.

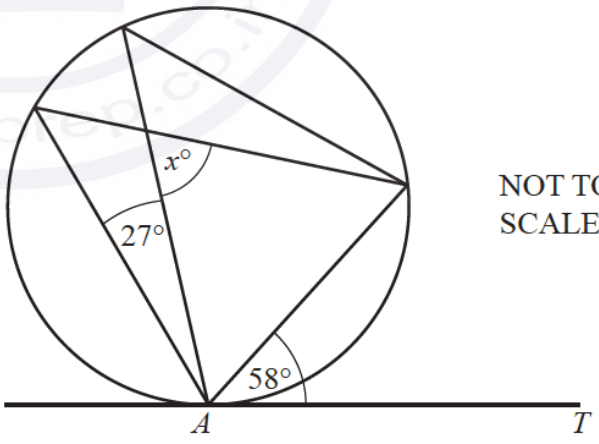


NOT TO SCALE

$z =$ ..... [2]

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

Find the value of x.

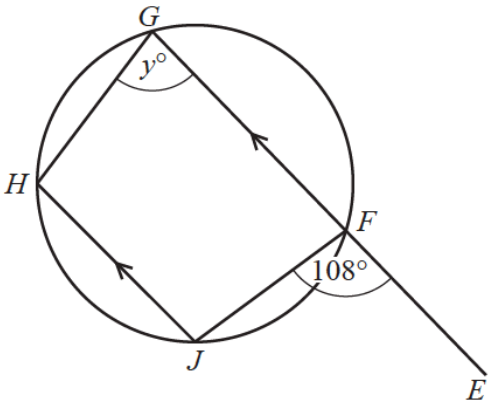


NOT TO SCALE

$x =$ ..... [2]

Continue on the next page..

(iii)



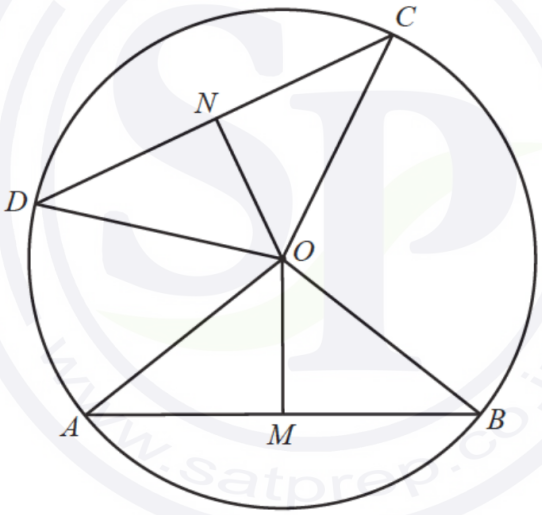
NOT TO SCALE

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

Find the value of y.

y = ... [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.

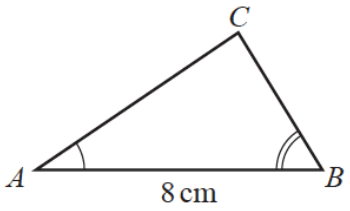
.....

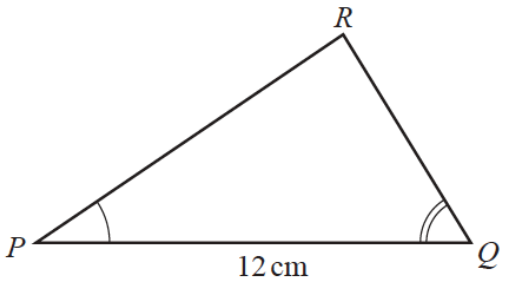
.....

..... [3]

Question 30

(a)





NOT TO SCALE

Triangle ABC is mathematically similar to triangle PQR.
The area of triangle ABC is $16\,\text{cm}^2$.

(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 $320\,\text{cm}^3$.

Calculate the length of the larger prism.

..... cm [3]

(b) A cylinder with radius 6 cm and height h 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 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 cm and height $\frac{7x}{2}$ cm.
The surface area of a sphere with radius R cm is equal to the total surface area of the cylinder.

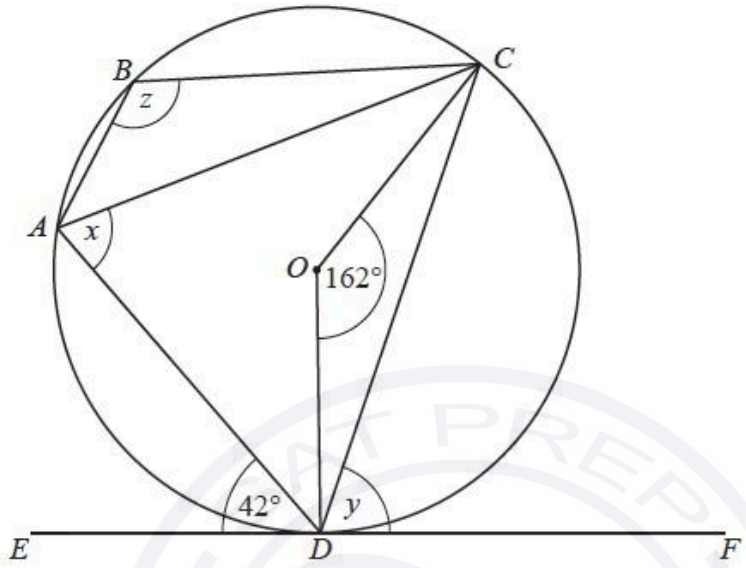
Find an expression for R in terms of x.

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

R = ... [3]

Question 31

(a)



NOT TO SCALE

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

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

(i) Angle x

$x =$ ..... because .....

..... [2]

(ii) Angle y

$y =$ ..... because .....

..... [2]

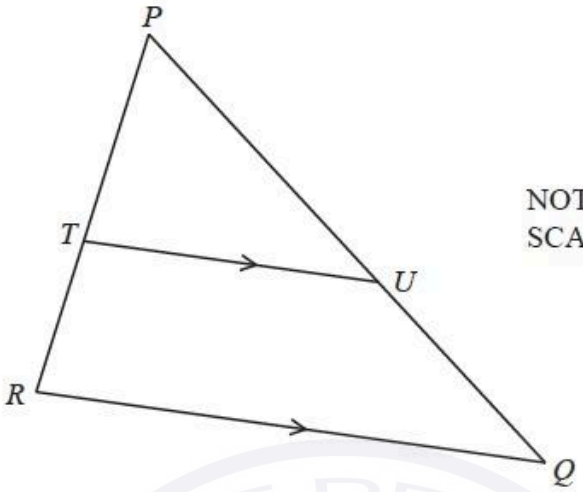
(iii) Angle z

$z =$ ..... because .....

.....

..... [3]

(b)



NOT TO SCALE

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]

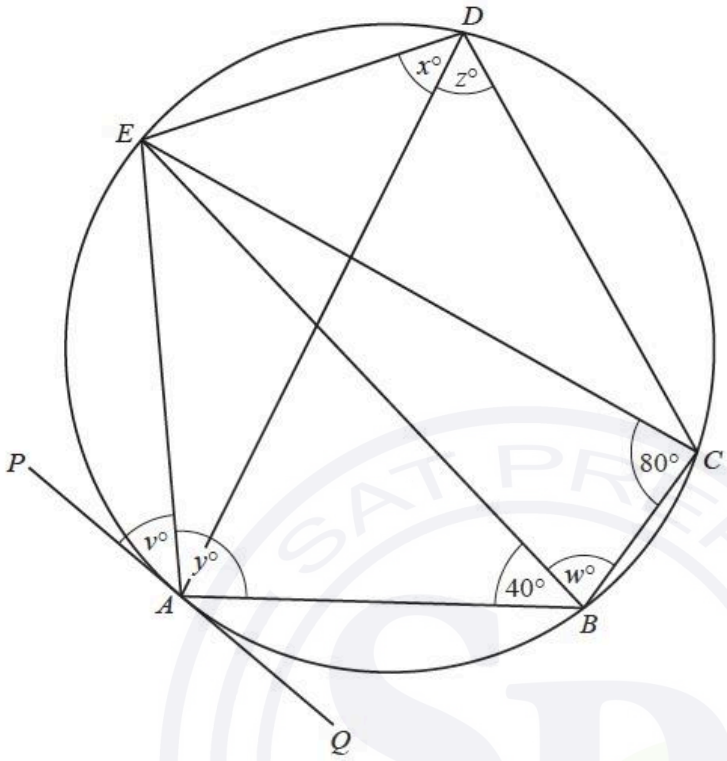
(b) The area of triangle PUT is $20\,\text{cm}^2$.

Find the area of the quadrilateral $QRTU$.

..... cm^2 [3]

Question 32

(a)

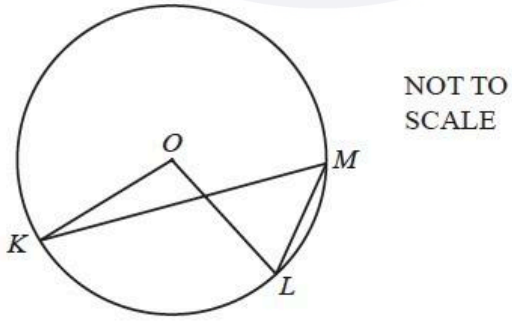


The points A, B, C, D and E lie on the circle.
PAQ is a tangent to the circle at A and $EC = EB$.
Angle $ECB = 80°$ and angle $ABE = 40°$.

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

$v =$ ..... $w =$ ..... $x =$ ..... $y =$ ..... $z =$ ..... [5]

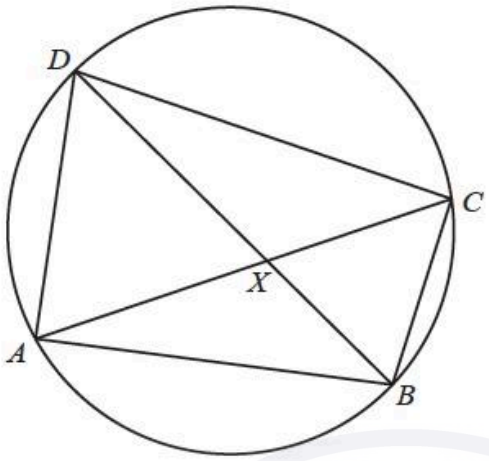
(b)



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

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) $AD = 10\,\text{cm}$, $BC = 8\,\text{cm}$, $BX = 5\,\text{cm}$ and $CX = 7\,\text{cm}$.

(a) Calculate DX.

$DX =$ ..... cm [2]

(b) Calculate angle BXC.

Angle $BXC =$ ..... [4]

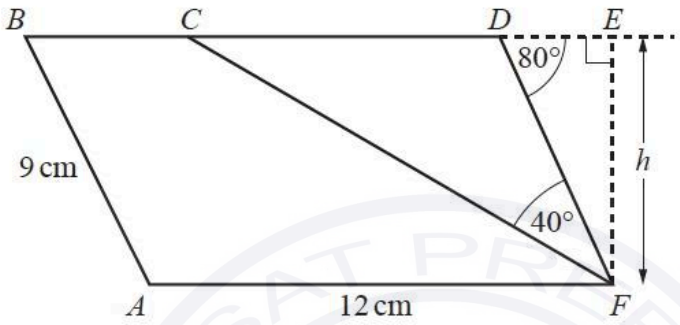
Question 33

(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° and angle *FDE* = 80°.

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

h = ... cm [2]

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

.....

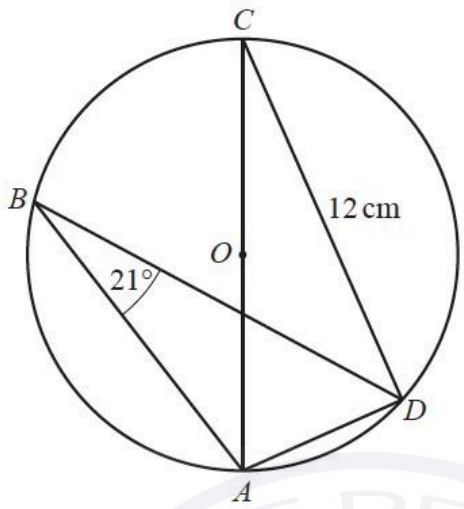
..... [2]

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

..... cm^2 [3]

Continue on next page…

(c)



NOT TO SCALE

A, B, C and D are points on the circle, centre O.
Angle $ABD = 21°$ 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 ÷ volume]

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

(b) A bag contains 15000 cm^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]

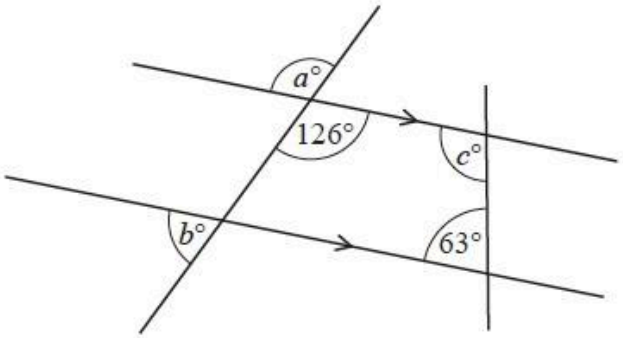
(d) Raj buys some sand for 3540 rupees.

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.

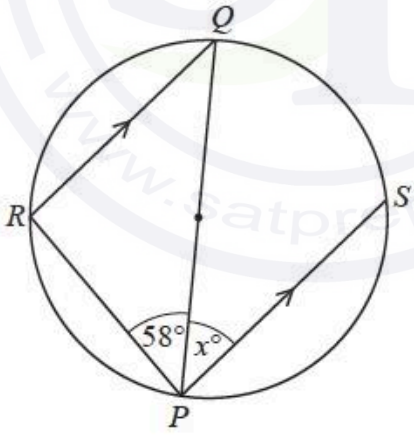
Find the values of a, b and c.

$a =$ .....

$b =$ .....

$c =$ ..... [3]

(b)



NOT TO SCALE

Points R and S lie on a circle with diameter PQ.
RQ is parallel to PS.
Angle $RPQ = 58°$.

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

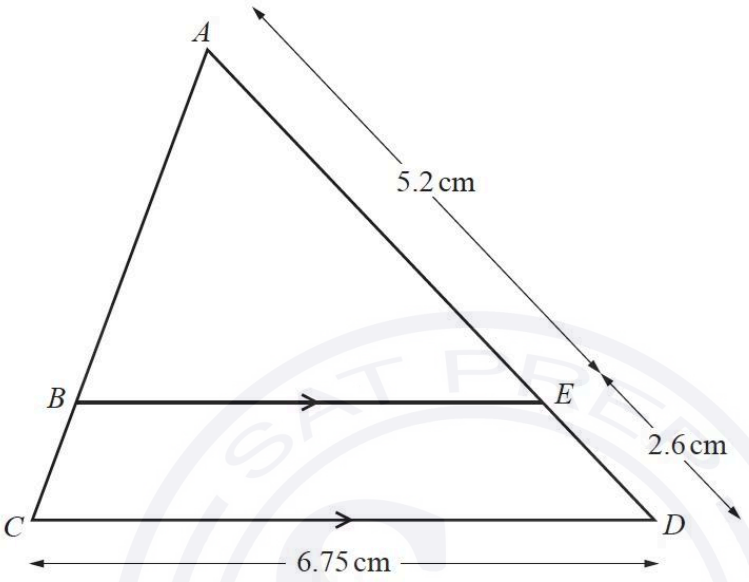
$x =$ ..... [3]

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]

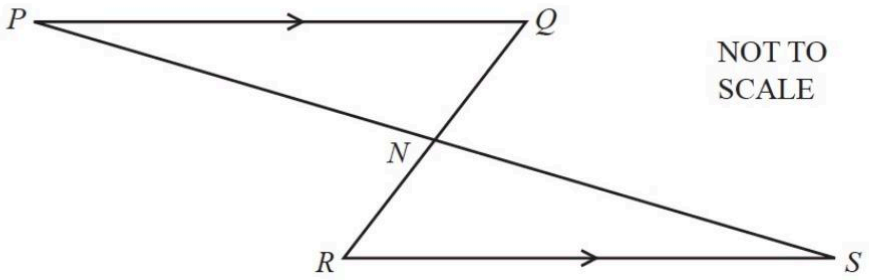
(c) Two solids are mathematically similar.
The smaller solid has height 2 cm and volume 32 cm^3.
The larger solid has volume 780 cm^3.

Calculate the height of the larger solid.

..... cm [3]

Continue on the next page…

(d)



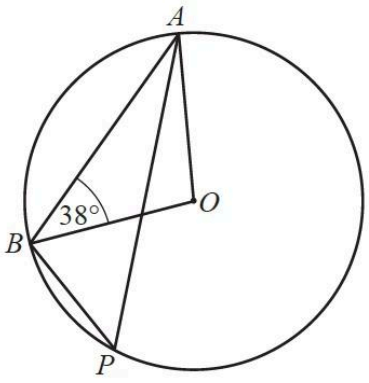
PQ is parallel to RS, PNS is a straight line and N is the midpoint of RQ.

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

[4]

Question 37

(a)



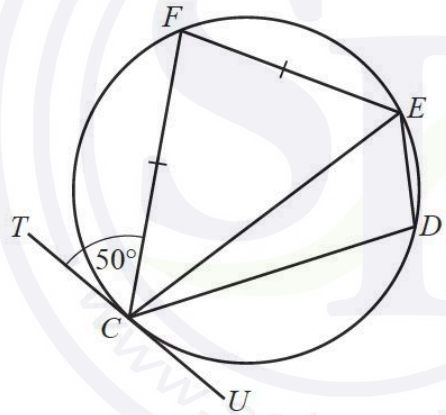
NOT TO SCALE

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

Find angle APB.

Angle APB = ... [3]

(b)



NOT TO SCALE

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

Find

(i) angle EFC,

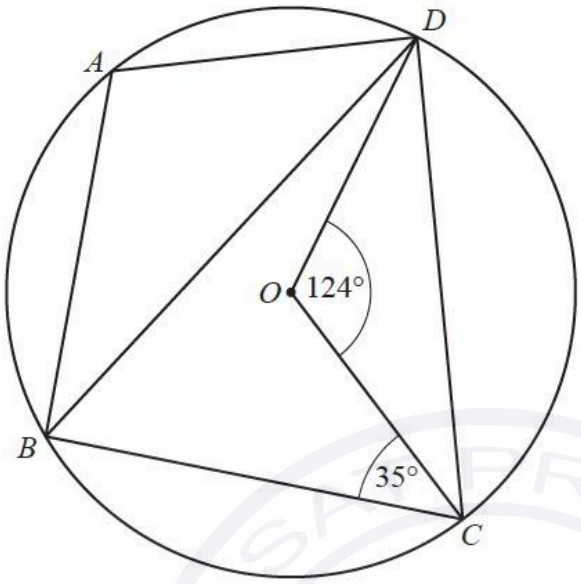
Angle EFC = ... [2]

(ii) angle CDE.

Angle CDE = ... [1]

Question 38

(a)



NOT TO SCALE

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

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

Angle CBD = ... because .....

..... [2]

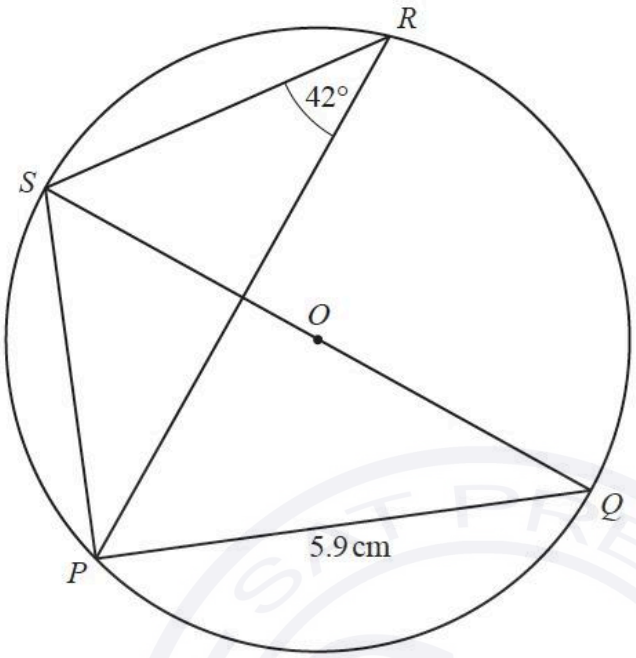
(ii) Work out angle BAD.
Give a geometrical reason for each step of your working.

Angle BAD = ... because .....

.....

..... [4]

(b)



NOT TO SCALE

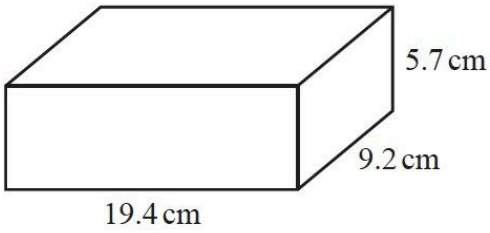
P, Q, R and S are points on a circle, centre O.
QS is a diameter.
Angle $PRS = 42°$ and $PQ = 5.9$ cm.

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 ÷ 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]

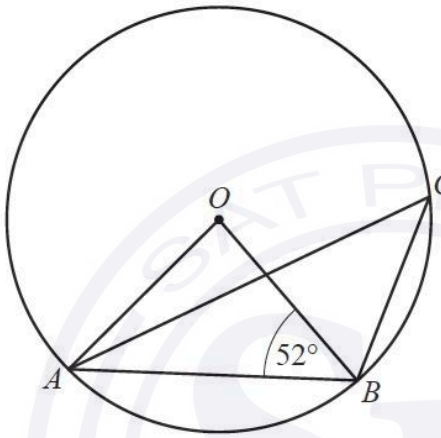
Question 40

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

Calculate the number of sides of this polygon.

..... [2]

(b)



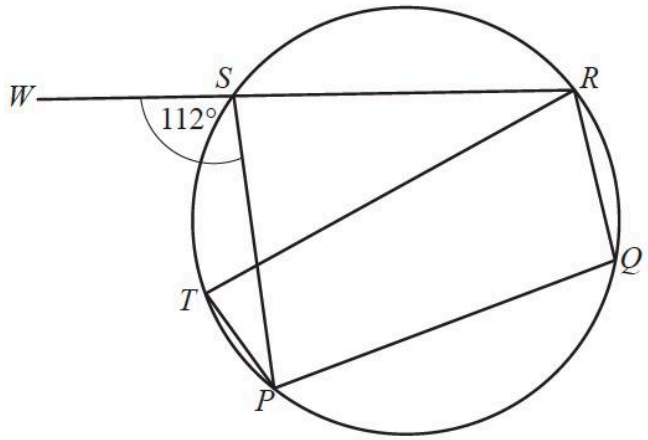
NOT TO SCALE

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

Calculate angle ACB.

Angle ACB = ... [2]

(c)



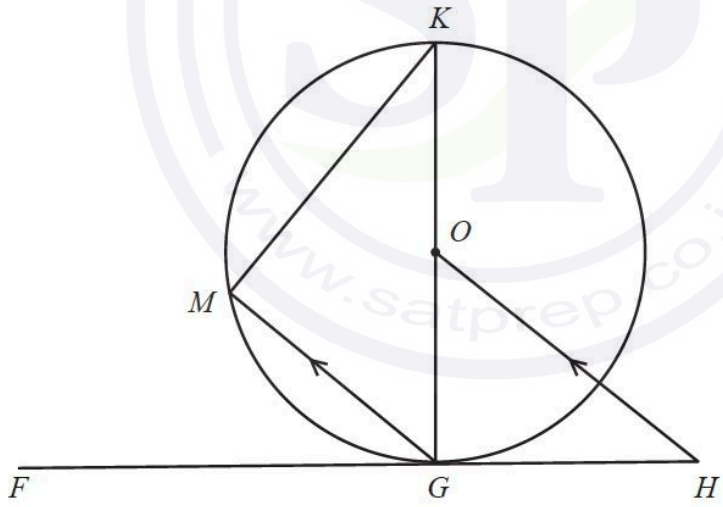
NOT TO SCALE

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

Calculate angle PTR.

Angle PTR = ... [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]

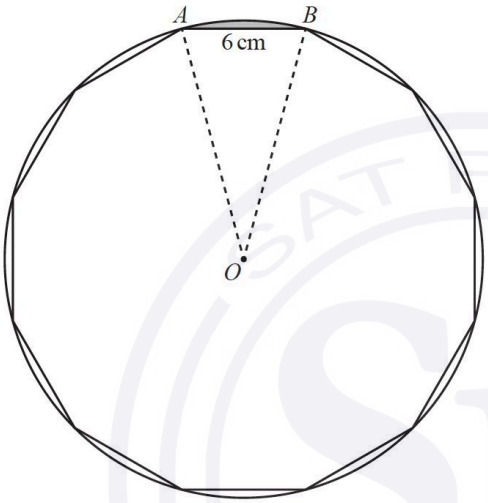
Question 41

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.



NOT TO SCALE

(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]

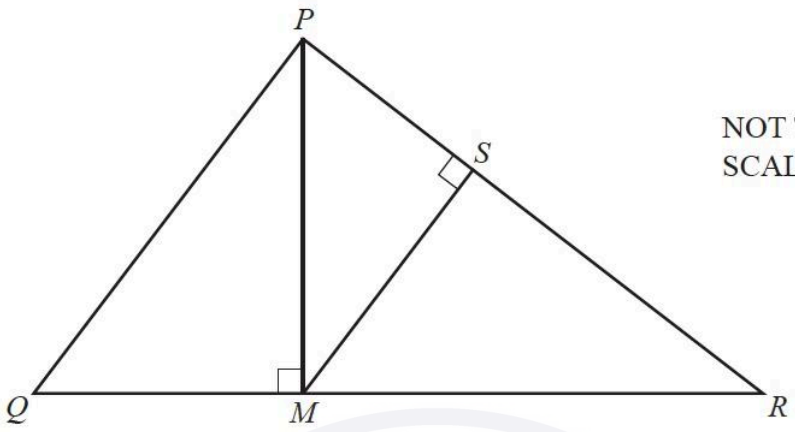
(b) the perimeter of the shaded **minor** segment formed by the chord AB.

(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)



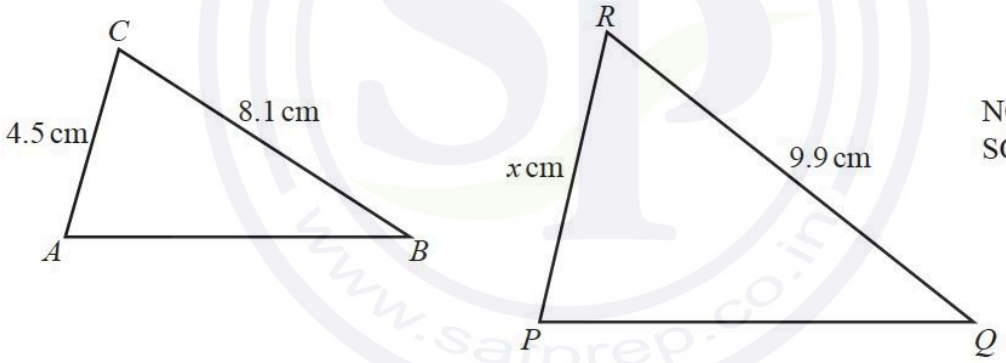
NOT TO SCALE

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)



NOT TO SCALE

Triangle ABC is similar to triangle PQR.

(i) Find the value of x.

Continue on the next page…

$x =$ ..... [2]

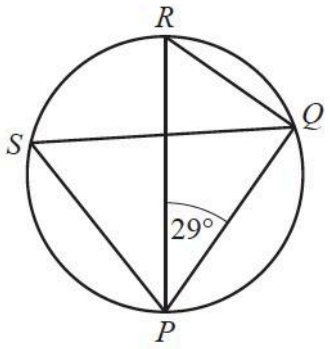
(ii) The area of triangle PQR is $25\,\text{cm}^2$.

Calculate the area of triangle ABC.

..... cm^2 [2]

Question 43

(a)



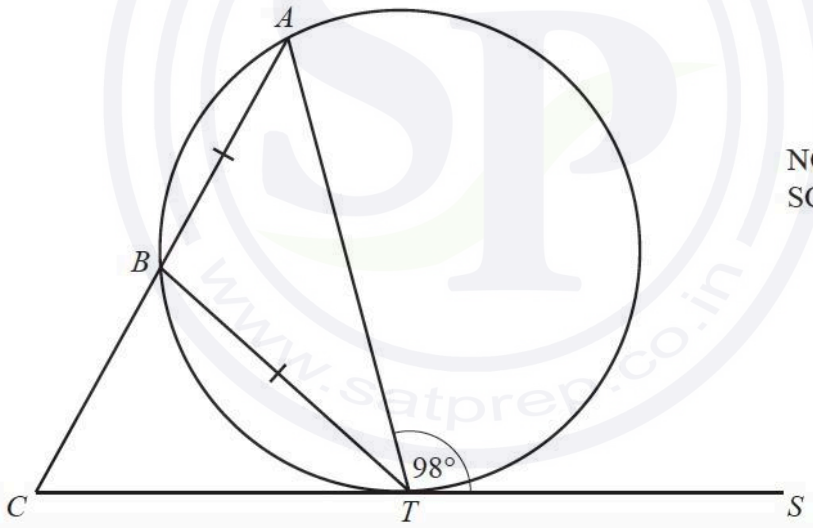
NOT TO SCALE

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…

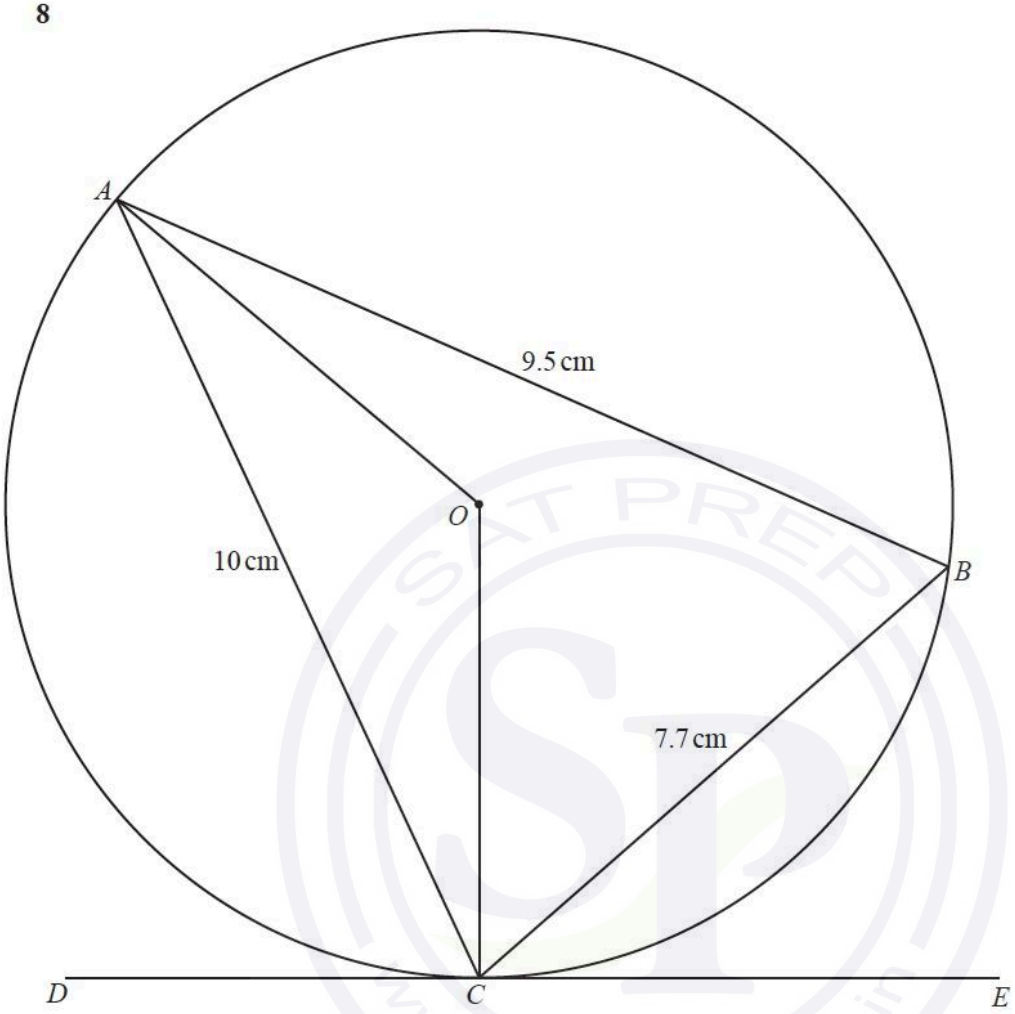
The points A, B and T lie on a circle and CTS is a tangent to the circle at T.
ABC is a straight line and $AB = BT$.
Angle $ATS = 98°$.

Work out the size of angle ACT.

Angle $ACT =$ ..... [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.
$AC = 10\,\text{cm}$, $AB = 9.5\,\text{cm}$ and $BC = 7.7\,\text{cm}$.

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

[4]

Continue on the next page…

(b) Find

(i) angle AOC

Angle AOC = ... [1]

(ii) angle ACO

Angle ACO = ... [1]

(iii) angle ACD.

Angle ACD = ... [1]

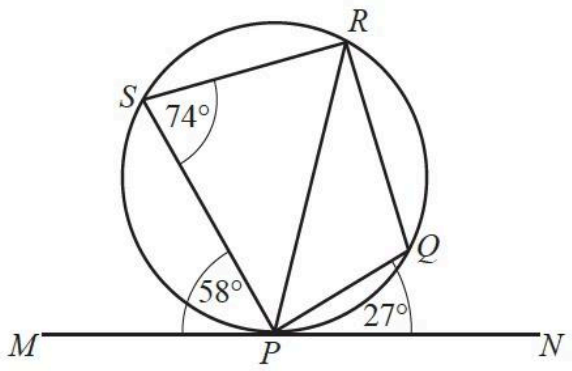
(c) Calculate the radius, OC, of the circle.

OC = ... cm [3]

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

.....% [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 $MPS = 58°$, angle $PSR = 74°$ and angle $QPN = 27°$.

(i) Find angle PRS.

Angle PRS = ... [1]

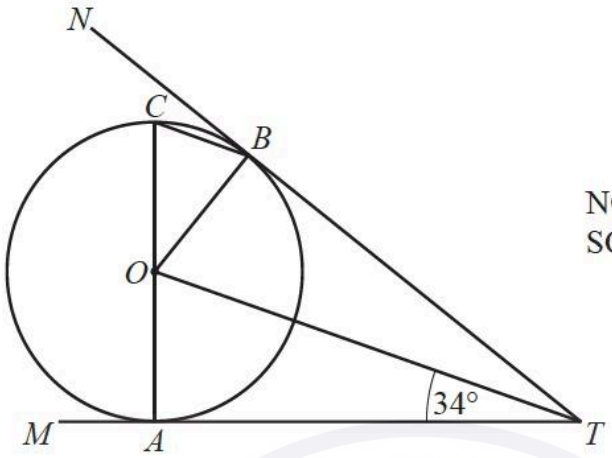
(ii) Find angle PQR.

Angle PQR = ... [1]

(iii) Find angle RPQ.

Angle RPQ = ... [2]

Question 46



NOT TO SCALE

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

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 $OBT = 90°$ because .....

.....

$AT = BT$ because .....

.....

Triangle AOT is congruent to triangle BOT because of congruence criterion .....

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

Angle BOC = ... ° because .....

Angle OBC = ... ° 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.

Scale: 5 cm to 200 m

(i) Measure angle ABC.

Angle ABC = ... [1]

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

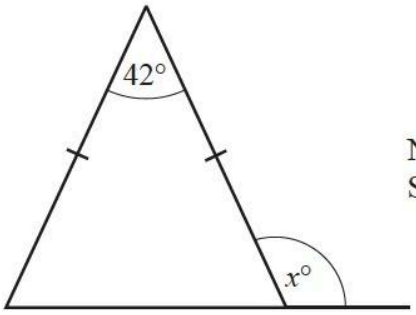
Mark the point X on the diagram. [2]

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

1: ..... [2]

Question 48

(a)



NOT TO SCALE

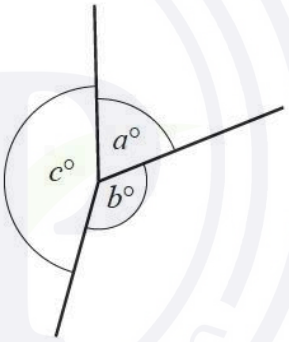
The diagram shows an isosceles triangle with the base extended.

Find the value of x.

$x =$ ..... [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 = ... [3]

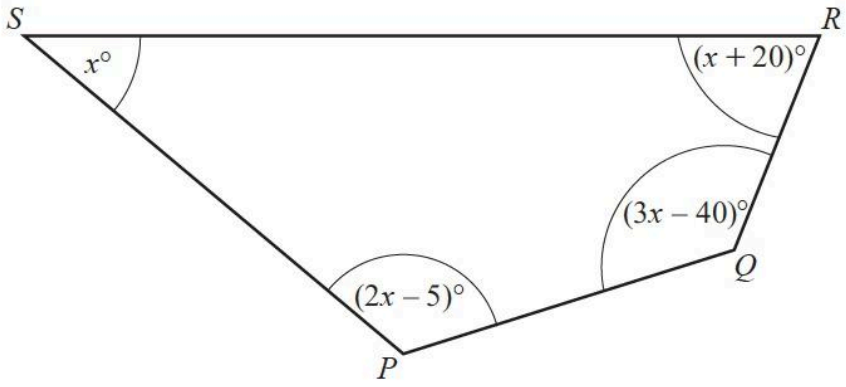
(c) A regular pentagon has an exterior angle, d.
A regular hexagon has an interior angle, h.

Find the fraction $\frac{d}{h}$.
Give your answer in its simplest form.

..... [4]

Continue on the next page…

(d)

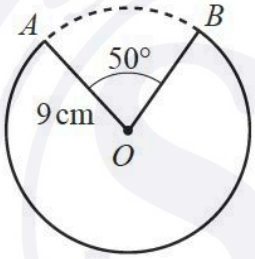


NOT TO SCALE

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*.

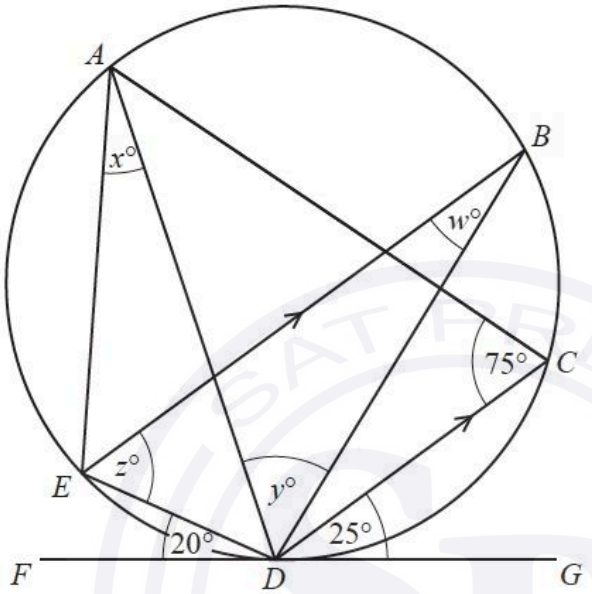
..... cm [3]

Question 49

(a) Find the size of one interior angle of a regular 10-sided polygon.

..... [2]

(b)



NOT TO SCALE

The points A, B, C, D and E lie on a circle.
FG is a tangent to the circle at D.
EB is parallel to DC.

Find the value of each of w, x, y and z.

$w =$ .....

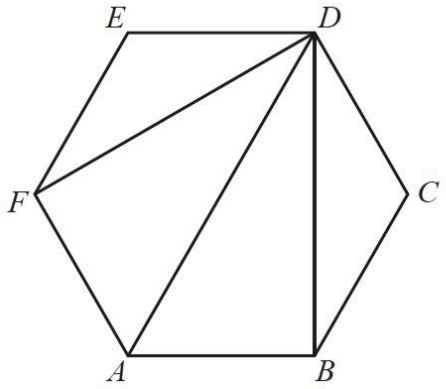
$x =$ .....

$y =$ .....

$z =$ ..... [5]

Question 50

(a)



NOT TO SCALE

ABCDEF is a regular hexagon.
DF, *DA* and *DB* are diagonals.

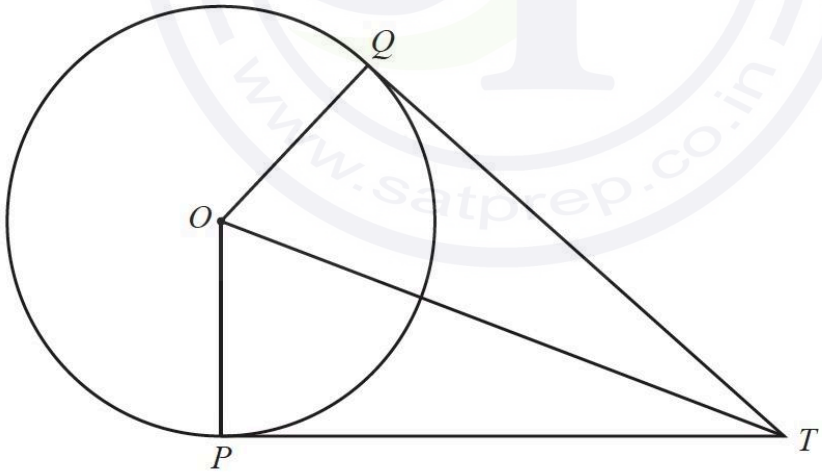
Complete the following statements using three different triangles.

Triangle *DEF* is congruent to triangle .....

Triangle ..... is congruent to triangle .....

[2]

(b)



NOT TO SCALE

Continue on the next page…

P and Q are points on the circle with centre O.
TP and TQ are tangents to the circle from the point T.

Complete the following statements and reasons.

In triangles OPT and OQT

OP = ... because each is a radius of the circle

OT is a common side

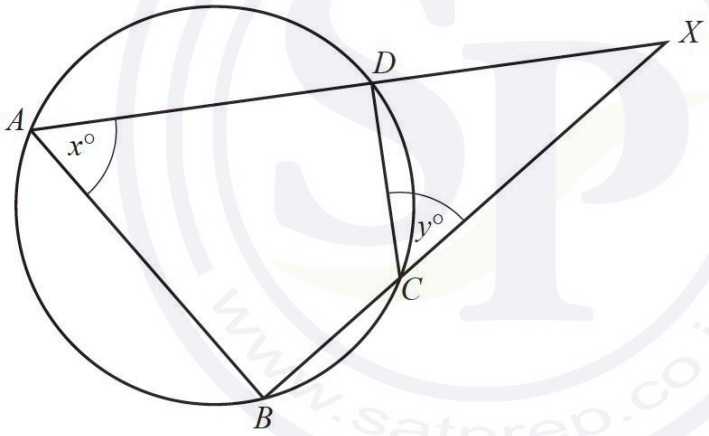
Angle OPT = angle ..... = 90° because .....

Triangles OPT and OQT are congruent using the criterion .....

This proves that the tangents TP and TQ are .....

[5]

Question 51



NOT TO SCALE

A, B, C and D are points on a circle.
ADX and BCX are straight lines.
Angle $BAD = x°$ and angle $DCX = y°$.

(a) Explain why $x = y$.
Give a geometrical reason for each statement you make.

[2]

(b) Show that triangle ABX is similar to triangle CDX.

[2]

Continue on the next page…

(c) $AD = 15\,\text{cm}$, $DX = 9\,\text{cm}$ and $CX = 12\,\text{cm}$.

(i) Find BC.

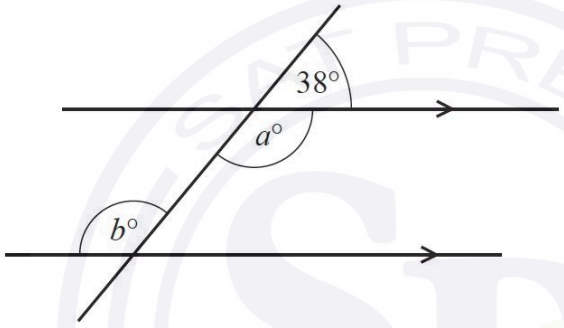
$BC =$ ..... cm [3]

(ii) Complete the statement.

The ratio area of triangle ABX : area of triangle CDX = ... : 1. [1]

Question 52

(a)



NOT TO SCALE

The diagram shows a straight line intersecting two parallel lines.

Find the value of a and the value of b.

$a =$ .....

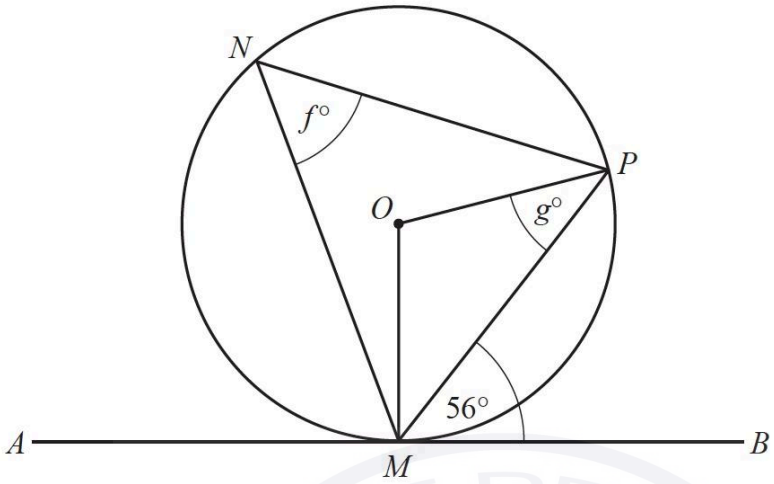
$b =$ ..... [2]

(b) Calculate the interior angle of a regular 12-sided polygon.

..... [2]

Continue on the next page…

(c)



NOT TO SCALE

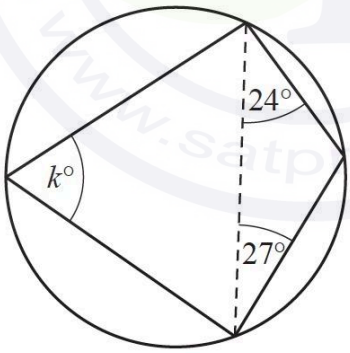
The diagram shows a circle, centre O.
The points M, N and P lie on the circumference of the circle.
AMB is a tangent to the circle at M.

Find the value of f and the value of g.

$f =$ .....

$g =$ ..... [3]

(d)



NOT TO SCALE

The diagram shows a cyclic quadrilateral.

Find the value of k.

$k =$ ..... [2]