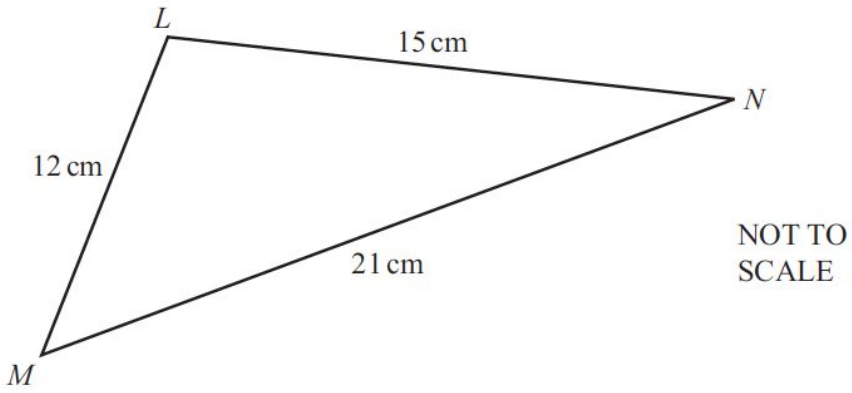
Extended Mathematics
Topic :Trigonometry
Year :May 2013 -May 2023
Paper -4
Questions

Question 1

(a)



The diagram shows triangle LMN with $LM = 12$ cm, $LN = 15$ cm and $MN = 21$ cm.

(i) Calculate angle LMN.
Show that this rounds to 44.4°, correct to 1 decimal place.

Answer(a)(i)

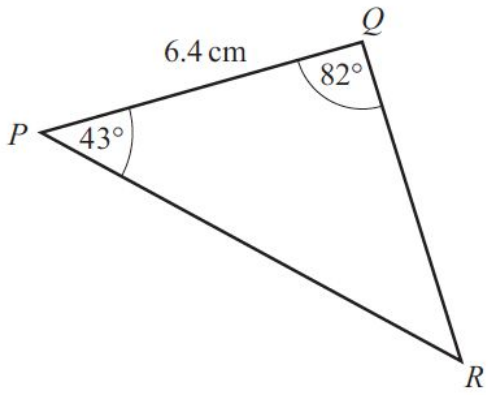
[4]

(ii) Calculate the area of triangle LMN.

Answer(a)(ii) ..... cm^2 [2]

Continue on the next page..

(b)



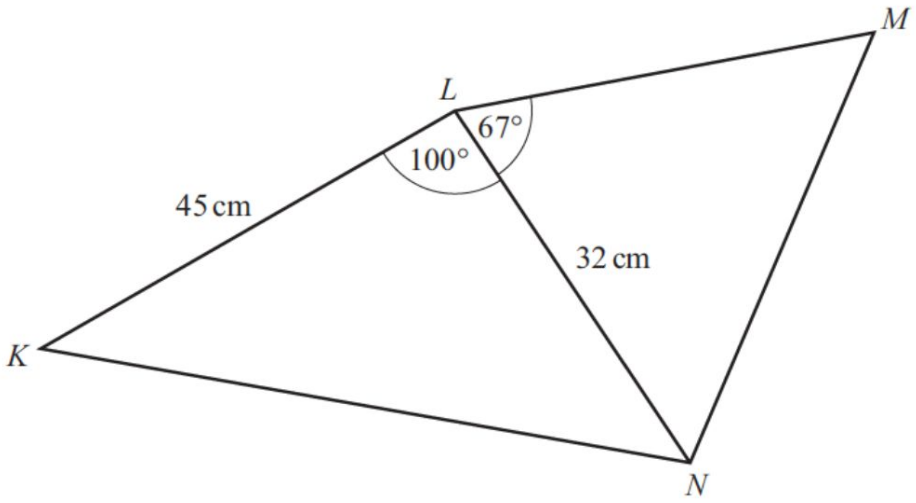
NOT TO SCALE

The diagram shows triangle PQR with $PQ = 6.4$ cm, angle $PQR = 82°$ and angle $QPR = 43°$.

Calculate the length of PR.

Answer(b) $PR =$ ..... cm [4]

Question 2



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

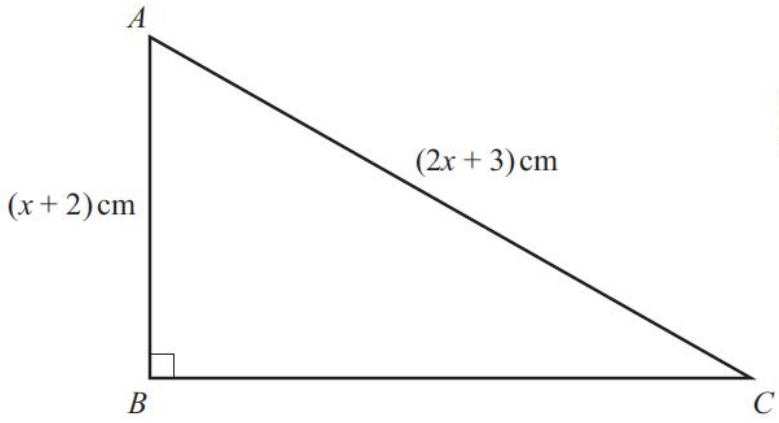
Continue on the next page..

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

Calculate the length LM.

Answer (i) LM = ... cm [3]

Question 3



NOT TO SCALE

In triangle ABC, $AB = (x + 2)\,\text{cm}$ and $AC = (2x + 3)\,\text{cm}$.

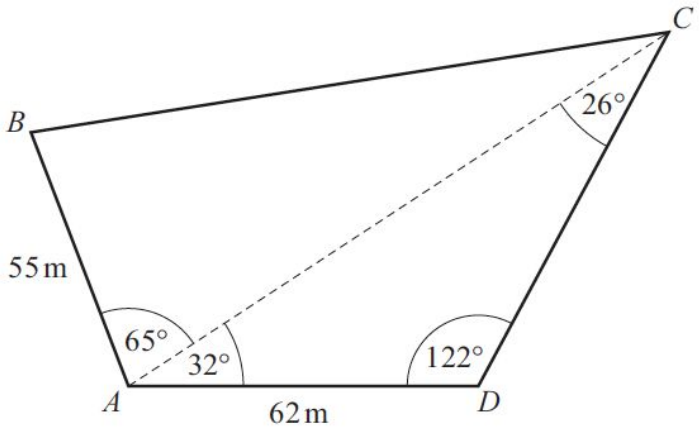
$\sin ACB = \dfrac{9}{16}$

Find the length of BC.

Answer BC = ... cm [6]

Question 4

A field, $ABCD$, is in the shape of a quadrilateral.
A footpath crosses the field from A to C.



NOT TO SCALE

Continue on the next page..

(a) Use the sine rule to calculate the distance AC and show that it rounds to 119.9 m, correct to 1 decimal place.

Answer(a)

[3]

(b) Calculate the length of BC.

Answer(b) BC = ... m [4]

(c) Calculate the area of triangle ACD.

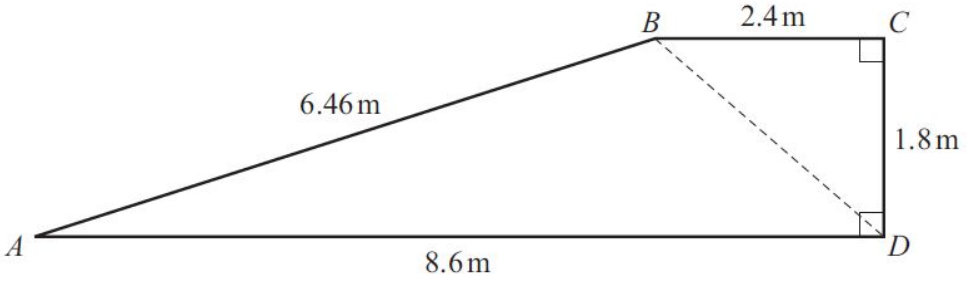
Answer(c) ..... m^2 [2]

(d) The field is for sale at \$4.50 per square metre.

Calculate the cost of the field.

Answer(d) \$ ..... [3]

Question 5



NOT TO SCALE

The diagram shows the cross section, $ABCD$, of a ramp.

(a) Calculate angle DBC.

Answer(a) Angle DBC = ... [2]

(b) **(i)** Show that BD is exactly 3 m.

Answer(b)(i)

[2]

(ii) Use the cosine rule to calculate angle ABD.

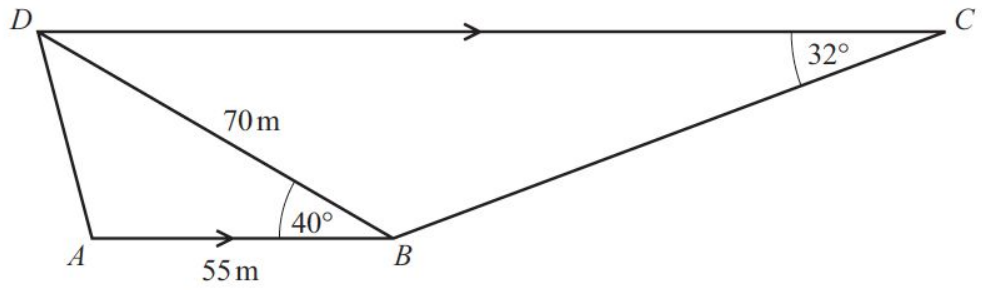
Answer(b)(ii) Angle ABD = ... [4]

(c) The ramp is a prism of width 4 m.

Calculate the volume of this prism.

Answer(c) ..... m^3 [3]

Question 6



NOT TO SCALE

The diagram shows a school playground *ABCD*.
ABCD is a trapezium.
AB = 55 m, *BD* = 70 m, angle *ABD* = 40° and angle *BCD* = 32°.

(a) Calculate *AD*.

Answer(a) AD = ... m [4]

(b) Calculate *BC*.

Answer(b) BC = ... m [4]

(c) **(i)** Calculate the area of the playground *ABCD*.

Answer(c)(i) ..... m^2 [3]

(ii) An accurate plan of the school playground is to be drawn to a scale of 1:200 .

Calculate the area of the school playground on the plan.
Give your answer in cm^2.

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

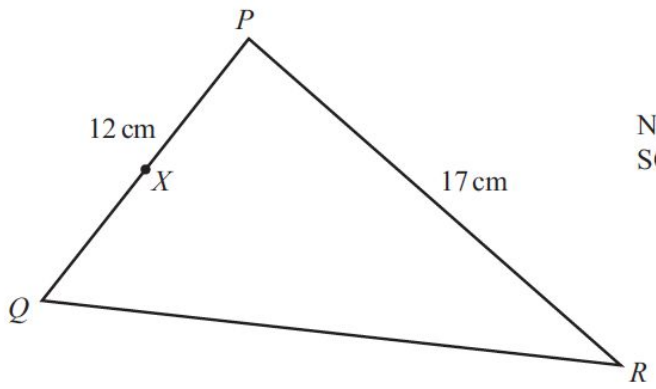
(d) A fence, *BD*, divides the playground into two areas.

Calculate the shortest distance from *A* to *BD*.

Answer(d) ..... m [2]

Question 7

(a)



The diagram shows triangle PQR with $PQ = 12$ cm and $PR = 17$ cm.
The area of triangle PQR is 97 cm^2 and angle QPR is acute.

(i) Calculate angle QPR.

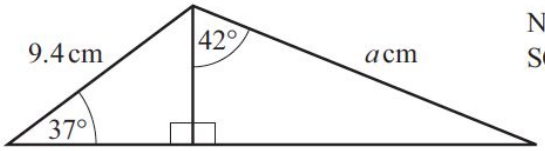
Answer(a)(i) Angle QPR = ... [3]

(ii) The midpoint of PQ is X.

Use the cosine rule to calculate the length of XR.

Answer(a)(ii) XR = ... cm [4]

(b)



Calculate the value of a.

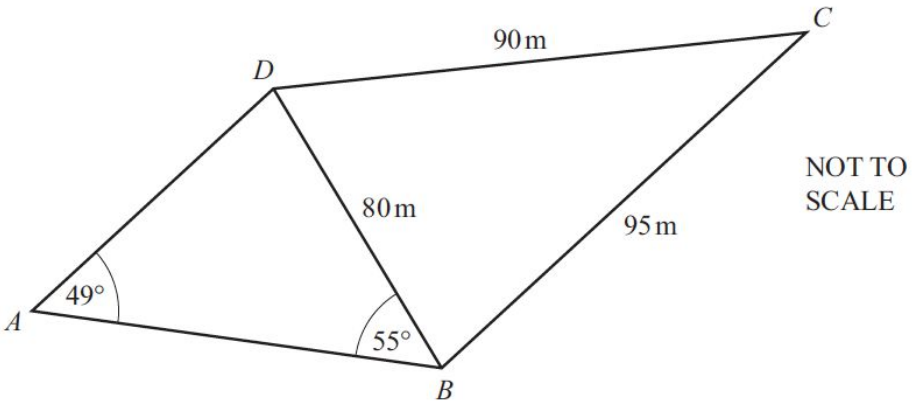
Answer(b) a = ... [4]

(c) $\sin x = \cos 40°, \quad 0° \leqslant x \leqslant 180°$

Find the two values of x.

Answer(c) x = ... or x = ... [2]

Question 8



The diagram shows a quadrilateral $ABCD$.
Angle $BAD = 49°$ and angle $ABD = 55°$.
$BD = 80$ m, $BC = 95$ m and $CD = 90$ m.

(a) Use the sine rule to calculate the length of AD.

Answer(a) $AD =$ ..... m [3]

(b) Use the cosine rule to calculate angle BCD.

Answer(b) Angle $BCD =$ ..... [4]

(c) Calculate the area of the quadrilateral $ABCD$.

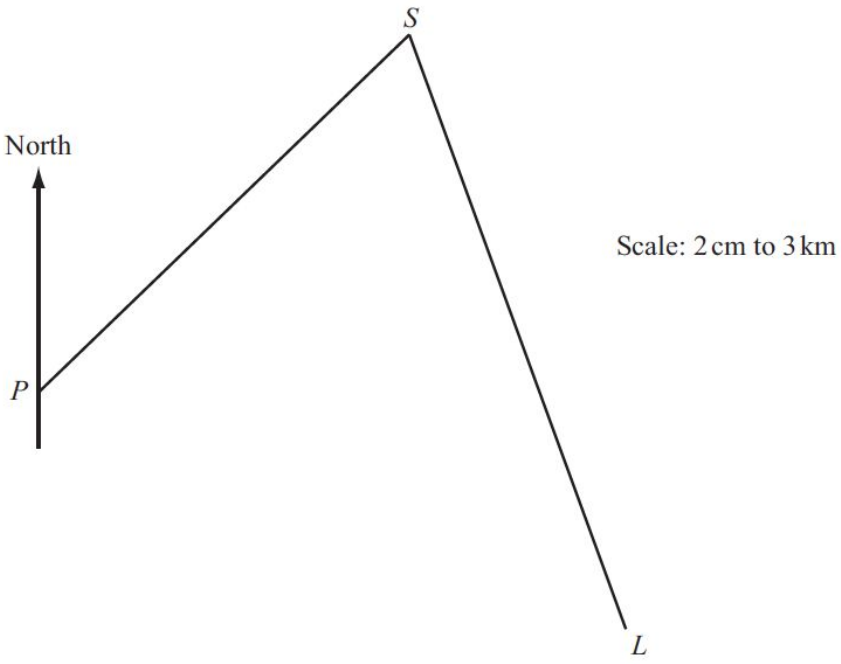
Answer(c) ..... m^2 [3]

(d) The quadrilateral represents a field.
Corn seeds are sown across the whole field at a cost of \$3250 per hectare.

Calculate the cost of the corn seeds used.
1 hectare = 10 000 m^2

Answer(d) \$ ..... [3]

Question 9



In the scale drawing, P is a port, L is a lighthouse and S is a ship.
The scale is 2 centimetres represents 3 kilometres.

(a) Measure the bearing of S from P.

Answer(a) ..... [1]

(b) Find the actual distance of S from L.

Answer(b) ..... km [2]

(c) The bearing of L from S is 160°.

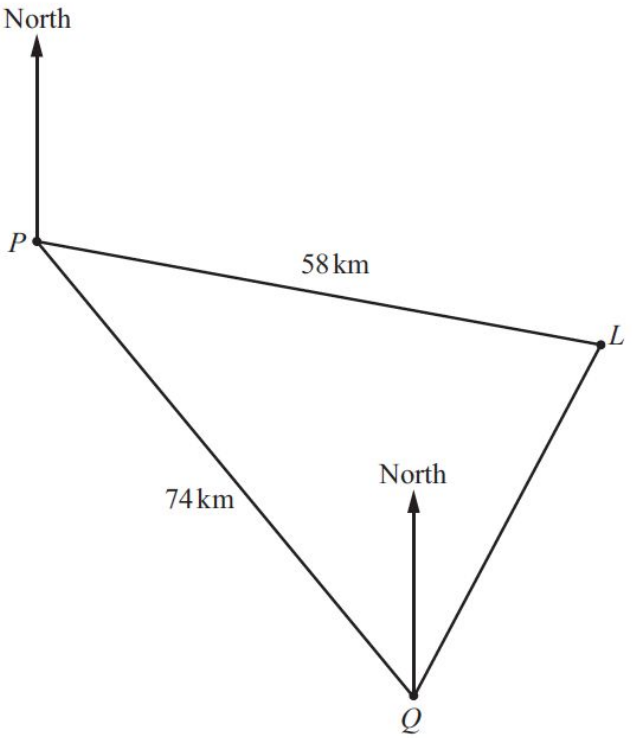
Calculate the bearing of S from L.

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

(d) Work out the scale of the map in the form $1 : n$.

Answer(d) 1 : ..... [2]

Question 10



NOT TO SCALE

A ship sails from port P to port Q.
Q is 74 km from P on a bearing of 142°.
A lighthouse, L, is 58 km from P on a bearing of 110°.

(a) Show that the distance LQ is 39.5 km correct to 1 decimal place.

Answer(a)

[5]

(b) Use the sine rule to calculate angle PQL.

Answer(b) Angle PQL = ... [3]

(c) Find the bearing of

(i) P from Q,

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

(ii) L from Q.

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

Continue on the next page..

(d) The ship takes 2 hours and 15 minutes to sail the 74 km from P to Q.

Calculate the average speed in knots.
[1 knot = 1.85 km/h]

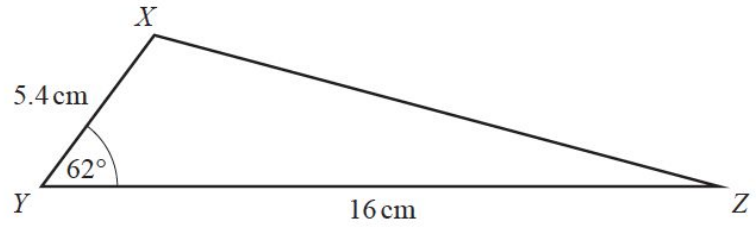
Answer(d) ..... knots [3]

(e) Calculate the shortest distance from the lighthouse to the path of the ship.

Answer(e) ..... km [3]

Question 11

(a)



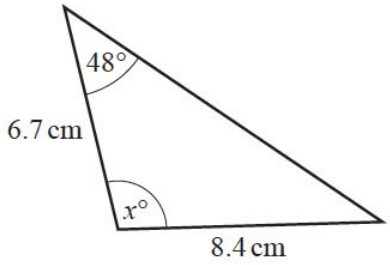
NOT TO SCALE

Show that the area of triangle XYZ is 38.1 cm^2, correct to 1 decimal place.

Answer(a)

[2]

(b)



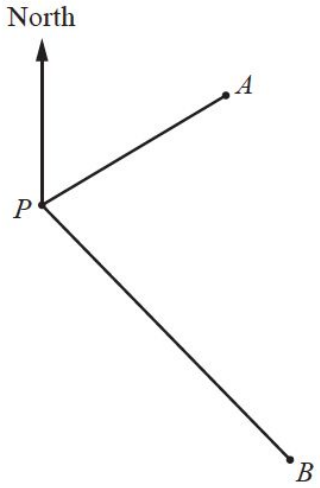
NOT TO SCALE

Calculate the value of x.

Answer(b) x = ... [4]

Continue on the next page..

(c)



NOT TO SCALE

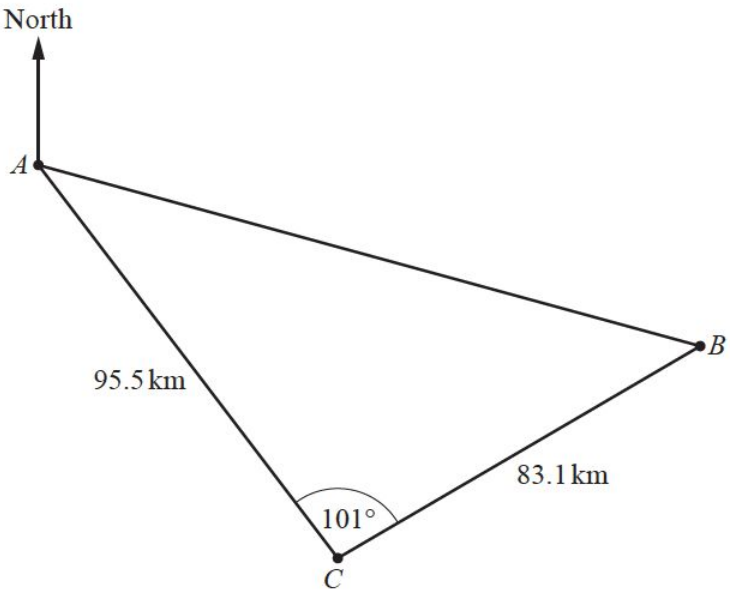
Ship A is 180 kilometres from port P on a bearing of 063°.
Ship B is 245 kilometres from P on a bearing of 146°.

Calculate AB, the distance between the two ships.

Answer(c) ..... km [5]

Question 12

The diagram shows the positions of two ships, A and B, and a coastguard station, C.



NOT TO SCALE

Continue on the next page..

(a) Calculate the distance, AB, between the two ships.
Show that it rounds to 138 km, correct to the nearest kilometre.

Answer(a)

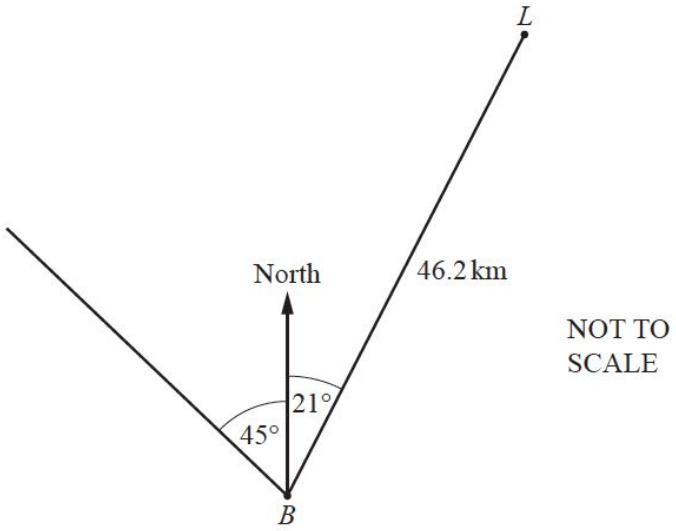
[4]

(b) The bearing of the coastguard station C from ship A is 146°.

Calculate the bearing of ship B from ship A.

Answer(b) ..... [4]

(c)



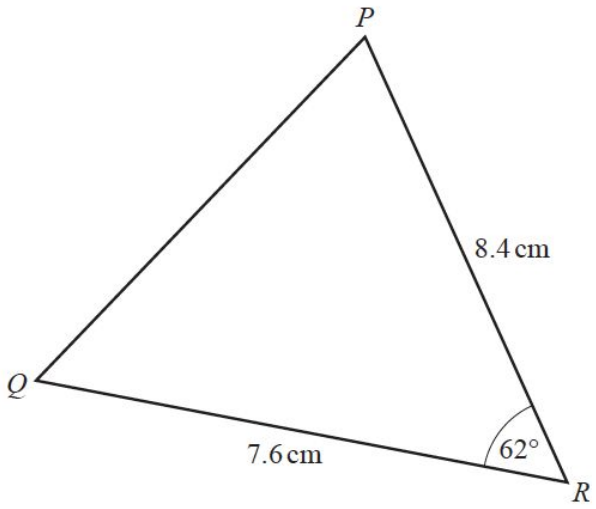
At noon, a lighthouse, L, is 46.2 km from ship B on the bearing 021°.
Ship B sails north west.

Calculate the distance ship B must sail from its position at noon to be at its closest distance to the lighthouse.

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

Question 13

(a)



NOT TO SCALE

In the triangle PQR, $QR = 7.6$ cm and $PR = 8.4$ cm.
Angle $QRP = 62°$.

Calculate

(i) PQ,

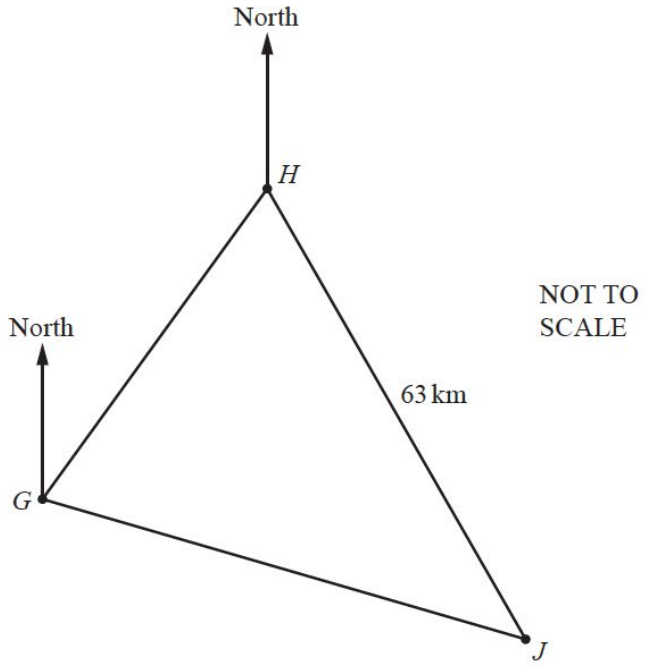
Answer(a)(i) PQ = ... cm [4]

(ii) the area of triangle PQR.

Answer(a)(ii) ..... cm^2 [2]

Continue on the next page..

(b)



NOT TO SCALE

The diagram shows the positions of three small islands G, H and J.
The bearing of H from G is 045°.
The bearing of J from G is 126°.
The bearing of J from H is 164°.
The distance HJ is 63 km.

Calculate the distance GJ.

Answer(b) $GJ =$ ..... km [5]

Question 14

(a) Andrei stands on level horizontal ground, 294 m from the foot of a vertical tower which is 55 m high.

(i) Calculate the angle of elevation of the top of the tower.

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

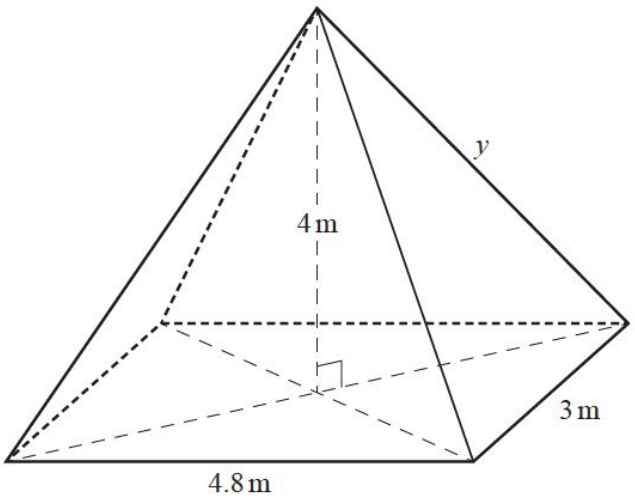
(ii) Andrei walks a distance x metres directly towards the tower.
The angle of elevation of the top of the tower is now 24.8°.

Calculate the value of x.

Answer(a)(ii) $x =$ ..... [4]

Continue on the next page..

(b) The diagram shows a pyramid with a horizontal rectangular base.



NOT TO SCALE

The rectangular base has length 4.8 m and width 3 m and the height of the pyramid is 4 m.

Calculate

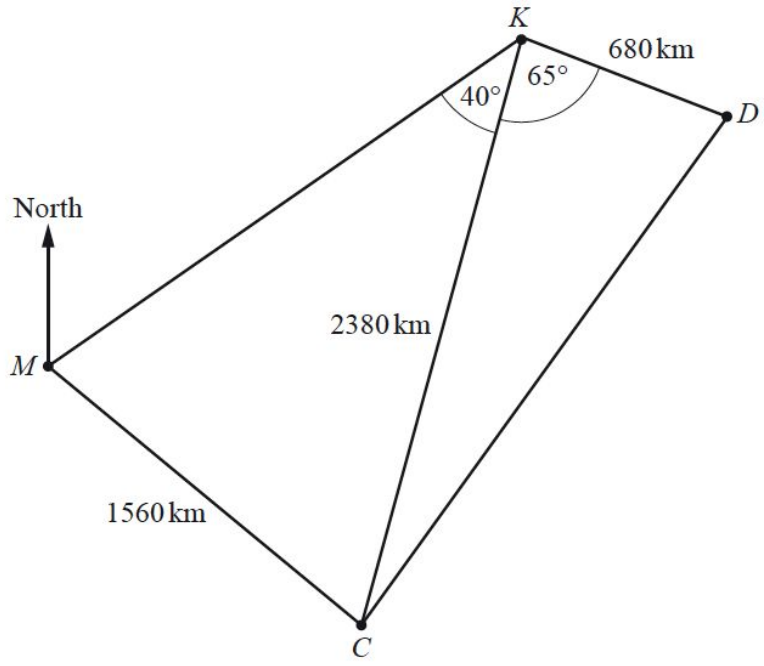
(i) y, the length of a sloping edge of the pyramid,

Answer(b)(i) y = ... m [4]

(ii) the angle between a sloping edge and the rectangular base of the pyramid.

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

Question 15



NOT TO SCALE

The diagram shows some distances between Mumbai (M), Kathmandu (K), Dhaka (D) and Colombo (C).

(a) Angle $CKD = 65°$.

Use the cosine rule to calculate the distance CD.

Answer(a) $CD =$ ..... km [4]

(b) Angle $MKC = 40°$.

Use the sine rule to calculate the acute angle KMC.

Answer(b) Angle $KMC =$ ..... [3]

(c) The bearing of K from M is 050°.

Find the bearing of M from C.

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

Continue on the next page...

(d) A plane from Colombo to Mumbai leaves at 21 15 and the journey takes 2 hours 24 minutes.

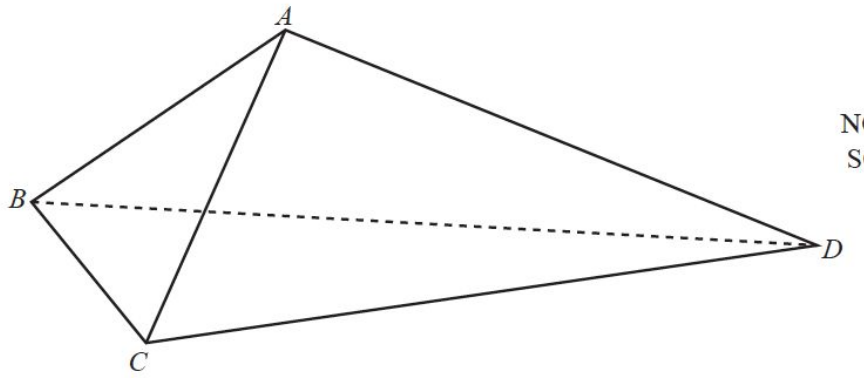
(i) Find the time the plane arrives at Mumbai.

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

(ii) Calculate the average speed of the plane.

Answer(d)(ii) ..... km/h [2]

Question 16



NOT TO SCALE

The diagram shows a tent $ABCD$.
The front of the tent is an isosceles triangle ABC, with $AB = AC$.
The sides of the tent are congruent triangles ABD and ACD.

(a) $BC = 1.2$ m and angle $ABC = 68°$.

Find AC.

Answer(a) AC = ... m [3]

(b) $CD = 2.3$ m and $AD = 1.9$ m.

Find angle ADC.

Answer(b) Angle ADC = ... [4]

(c) The floor of the tent, triangle BCD, is also an isosceles triangle with $BD = CD$.

Calculate the area of the floor of the tent.

Continue on the next page...

Answer(c) .....m^2 [4]

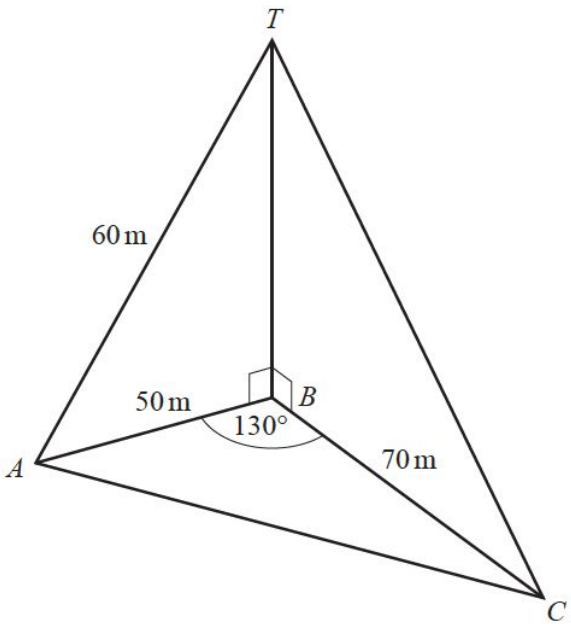
(d) When the tent is on horizontal ground, A is a vertical distance 1.25 m above the ground.

Calculate the angle between AD and the ground.

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

Question 17

(a)



NOT TO SCALE

A, B and C are points on horizontal ground.
BT is a vertical pole.
$AT = 60$ m, $AB = 50$ m, $BC = 70$ m and angle $ABC = 130°$.

(i) Calculate the angle of elevation of T from C.

Answer(a)(i) ..... [5]

(ii) Calculate the length AC.

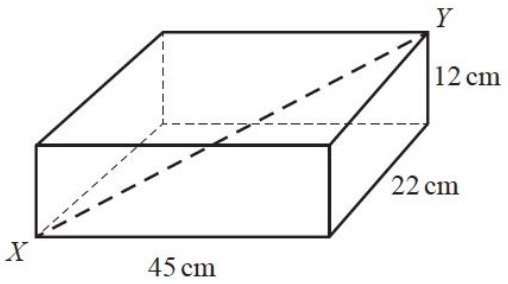
Answer(a)(ii) AC = ... m [4]

(iii) Calculate the area of triangle ABC.

Answer(a)(iii) ..... m^2 [2]

Continue on the next page...

(b)



NOT TO SCALE

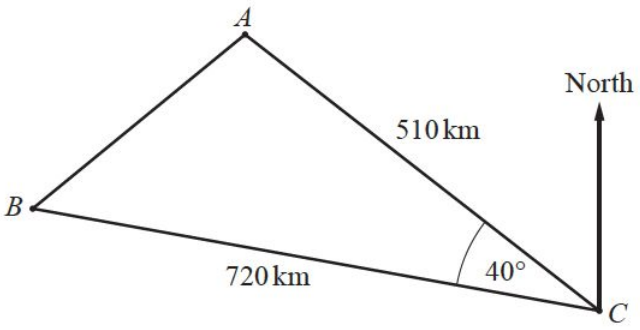
A cuboid has length 45 cm, width 22 cm and height 12 cm.

Calculate the length of the straight line XY.

Answer(b) XY = ... cm [4]

Question 18

NOT TO SCALE



A plane flies from A to C and then from C to B.
AC = 510 km and CB = 720 km.
The bearing of C from A is 135° and angle ACB = 40°.

Continue on the next page...

(a) Find the bearing of

(i) B from C,

..... [2]

(ii) C from B.

..... [2]

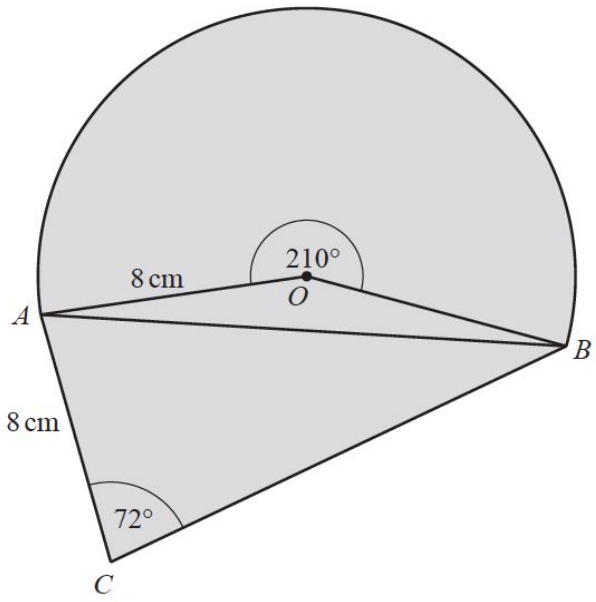
(b) Calculate AB and show that it rounds to 464.7 km, correct to 1 decimal place.

[4]

(c) Calculate angle ABC.

Angle ABC = ... [3]

Question 19



NOT TO SCALE

The diagram shows a design for a logo made from a sector and two triangles.
The sector, centre O, has radius 8 cm and sector angle 210°.
AC = 8 cm and angle ACB = 72°.

(a) Show that angle OAB = 15°.

[2]

Continue on the next page...

(b) Calculate the length of the straight line AB.

$AB =$ ..... cm [4]

(c) Calculate angle ABC.

Angle $ABC =$ ..... [3]

(d) Calculate the total area of the logo design.

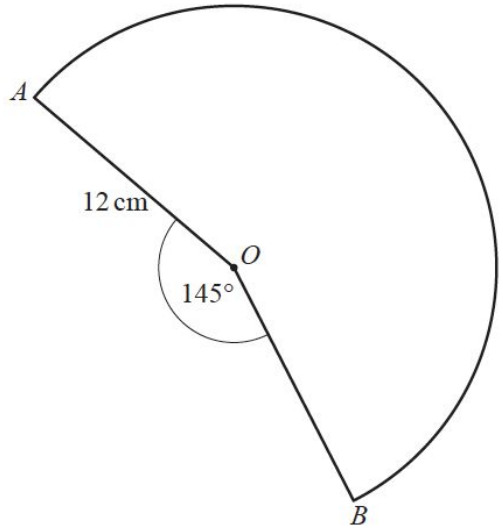
.....cm^2 [6]

(e) The logo design is an enlargement with scale factor 4 of the actual logo.

Calculate the area of the actual logo.

.....cm^2 [2]

Question 20



NOT TO SCALE

The diagram shows a sector, centre O, and radius 12 cm.

(a) Calculate the area of the sector.

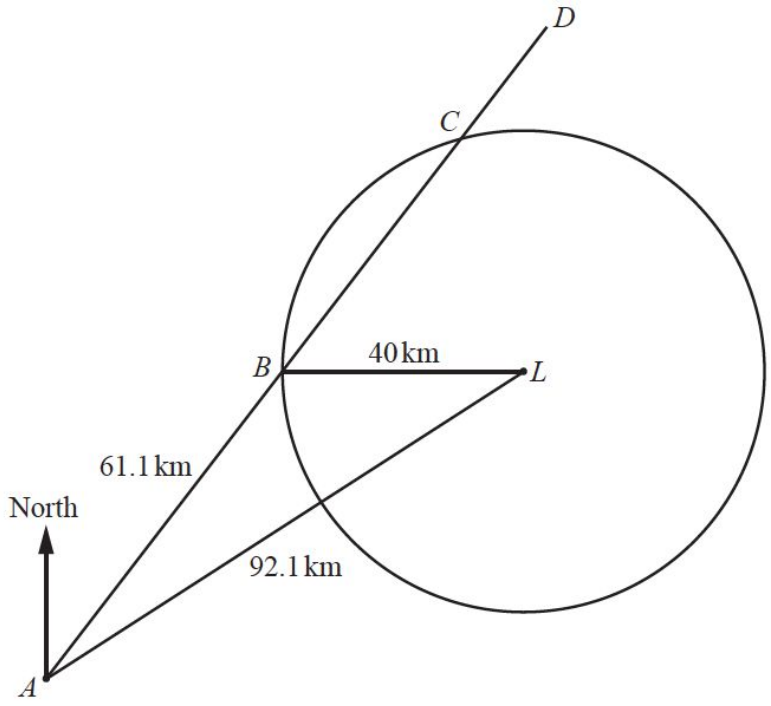
..... cm^2 [3]

(b) The sector is made into a cone by joining OA to OB.

Calculate the volume of the cone.
[The volume, V, of a cone with base radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

..... cm^3 [6]

Question 21



NOT TO SCALE

The diagram shows the position of a port, A, and a lighthouse, L.
The circle, centre L and radius 40 km, shows the region where the light from the lighthouse can be seen.
The straight line, $ABCD$, represents the course taken by a ship after leaving the port.
When the ship reaches position B it is due west of the lighthouse.

$AL = 92.1$ km, $AB = 61.1$ km and $BL = 40$ km.

(a) Use the cosine rule to show that angle $ABL = 130.1°$, correct to 1 decimal place.

[4]

(b) Calculate the bearing of the lighthouse, L, from the port, A.

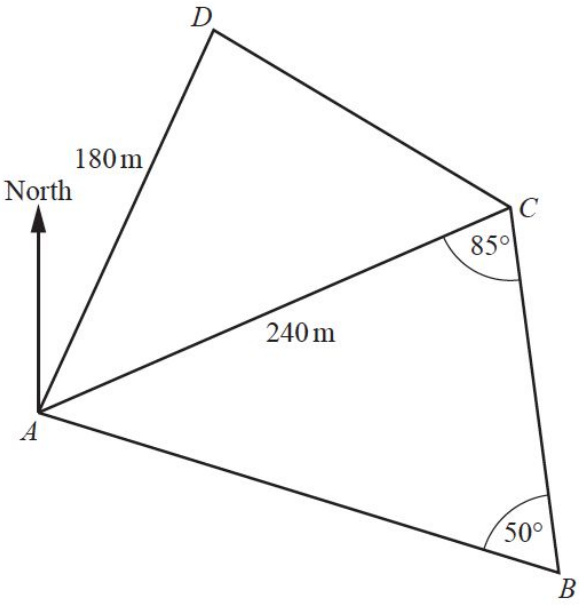
..... [4]

(c) The ship sails at a speed of 28 km/h.

Calculate the length of time for which the light from the lighthouse can be seen from the ship.
Give your answer correct to the nearest minute.

..... h ..... min [5]

Question 22



NOT TO SCALE

The diagram shows a field, $ABCD$.
$AD = 180$ m and $AC = 240$ m.
Angle $ABC = 50°$ and angle $ACB = 85°$.

(a) Use the sine rule to calculate AB.

$AB =$ ..... m [3]

(b) The area of triangle $ACD = 12\,000\,\text{m}^2$.

Show that angle $CAD = 33.75°$, correct to 2 decimal places.

[3]

(c) Calculate BD.

$BD =$ ..... m [5]

(d) The bearing of D from A is 030°.

Find the bearing of

(i) B from A,

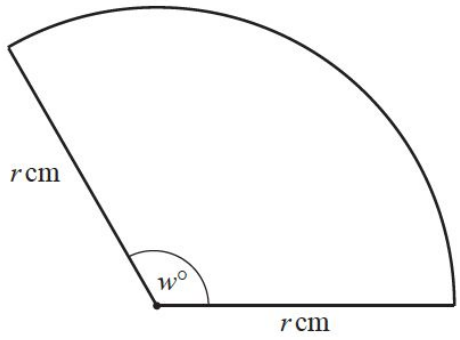
..... [1]

(ii) A from B.

..... [2]

Question 23

(a)



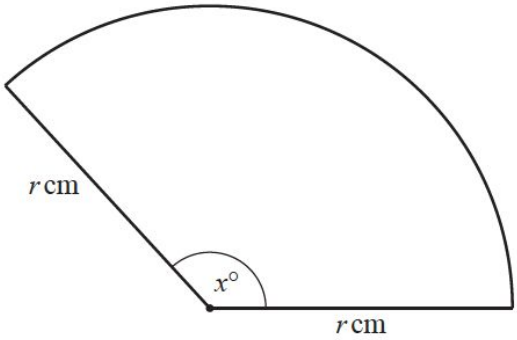
NOT TO SCALE

The area of this sector is r^2 square centimetres.

Find the value of w.

$w =$ ..... [3]

(b)



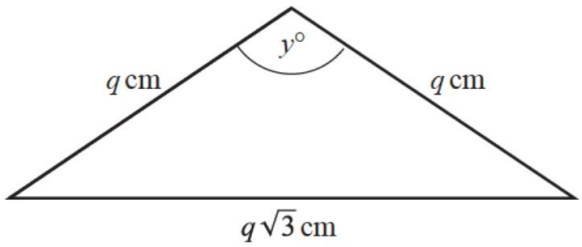
NOT TO SCALE

The perimeter of this sector is $2r + \frac{7\pi r}{10}$ centimetres.

Find the value of x.

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

(c)



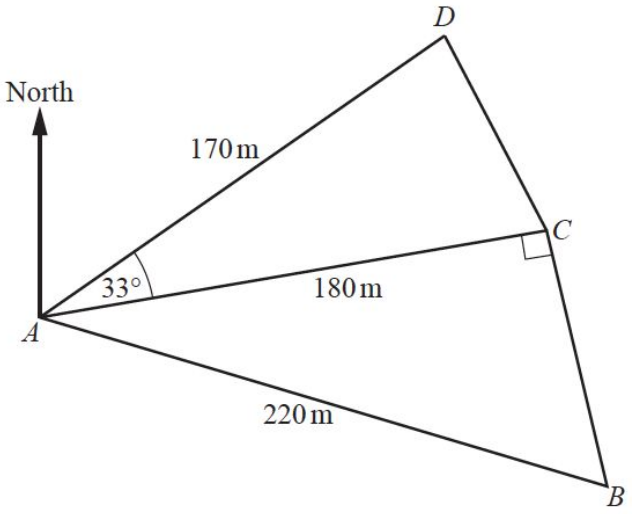
NOT TO SCALE

The perimeter of the isosceles triangle is $2q + q\sqrt{3}$ centimetres.

Find the value of y.

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

Question 24



NOT TO SCALE

The diagram shows five straight footpaths in a park.
$AB = 220$ m, $AC = 180$ m and $AD = 170$ m.
Angle $ACB = 90°$ and angle $DAC = 33°$.

(a) Calculate BC.

$BC =$ ..... m [3]

(b) Calculate CD.

$CD =$ ..... m [4]

(c) Calculate the shortest distance from D to AC.

..... m [2]

(d) The bearing of D from A is 047°.

Calculate the bearing of B from A.

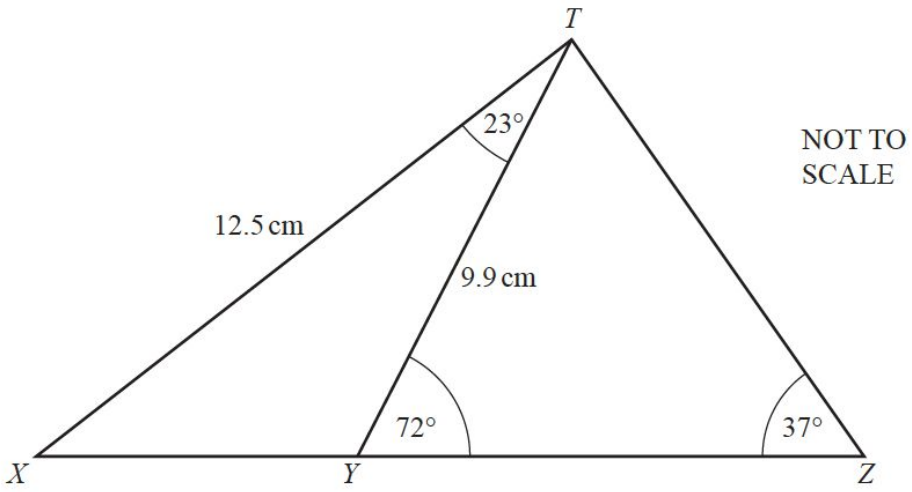
..... [3]

(e) Calculate the area of the quadrilateral $ABCD$.

..... m^2 [3]

Question 25

(a) In triangle TXZ, $TX = 12.5$ cm and angle $TZX = 37°$.
Y is a point on the line XZ such that $TY = 9.9$ cm, angle $XTY = 23°$ and angle $TYZ = 72°$.



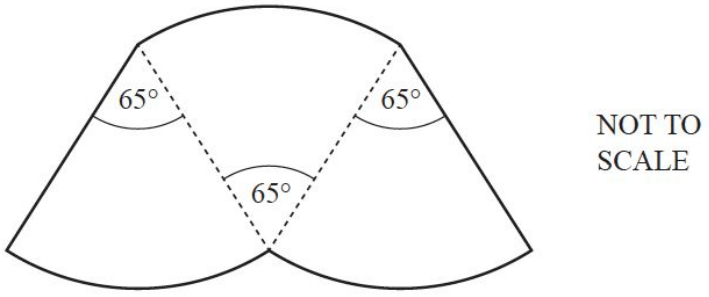
(i) Calculate XY.

$XY =$ ..... cm [4]

(ii) Calculate TZ.

$TZ =$ ..... cm [3]

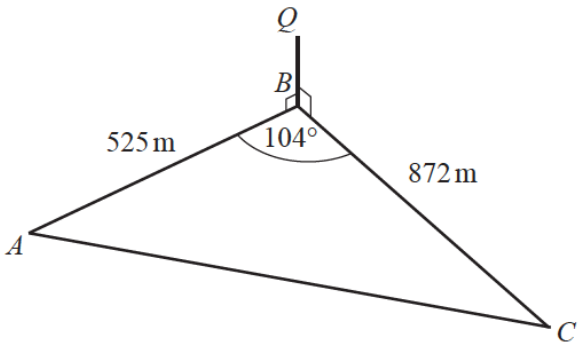
(b) The diagram shows a shape made up of three identical sectors of a circle, each with sector angle 65°.
The perimeter of the shape is 20.5 cm.



Calculate the radius of the circle.

..... cm [4]

Question 26



NOT TO SCALE

ABC is a triangular field on horizontal ground.
There is a vertical pole BQ at B.
$AB = 525$ m, $BC = 872$ m and angle $ABC = 104°$.

(a) Use the cosine rule to calculate the distance AC.

$AC =$ ..... m [4]

(b) The angle of elevation of Q from C is 1.0°.

Showing all your working, calculate the angle of elevation of Q from A.

..... [4]

(c) **(i)** Calculate the area of the field.

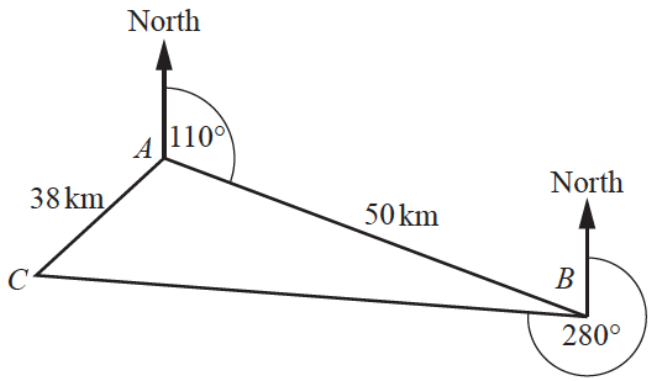
..... m^2 [2]

(ii) The field is drawn on a map with the scale 1 : 20 000.

Calculate the area of the field on the map in cm^2.

..... cm^2 [2]

Question 27



NOT TO SCALE

A, B and C are three towns.
The bearing of B from A is 110°.
The bearing of C from B is 280°.
$AC = 38$ km and $AB = 50$ km.

(i) Find the bearing of A from B.

..... [2]

(ii) Calculate angle BAC.

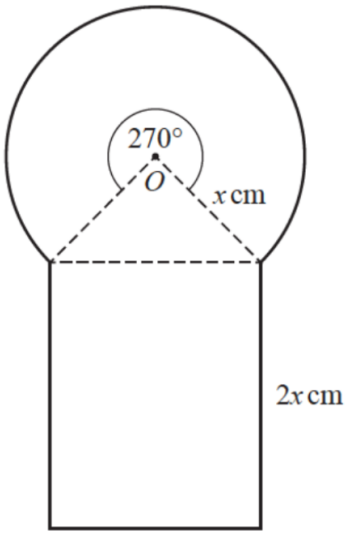
Angle BAC = ... [5]

(iii) A road is built from A to join the straight road BC.

Calculate the shortest possible length of this new road.

..... km [3]

Question 28



NOT TO SCALE

The diagram shows a sector of a circle, a triangle and a rectangle.
The sector has centre O, radius x cm and angle 270°.
The rectangle has length $2x$ cm.

The total area of the shape is kx^2 cm^2.

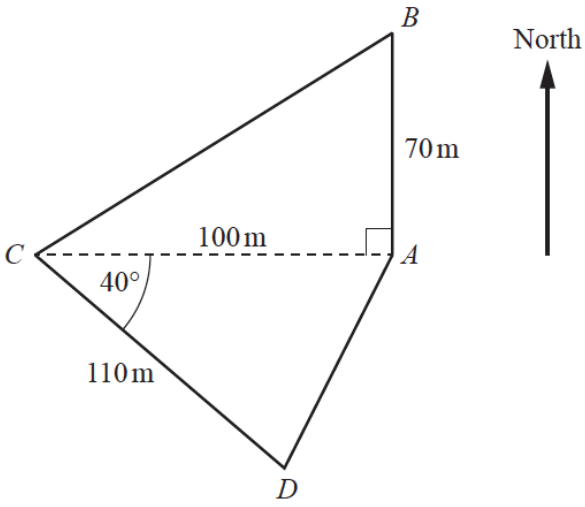
(a) Find the value of k.

$k =$ ..... [5]

(b) Find the value of x when the total area is 110 cm^2.

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

Question 29



The diagram shows a field *ABCD*.

(a) Calculate the area of the field *ABCD*.

.....m^2 [3]

(b) Calculate the perimeter of the field *ABCD*.

..... m [5]

(c) Calculate the shortest distance from *A* to *CD*.

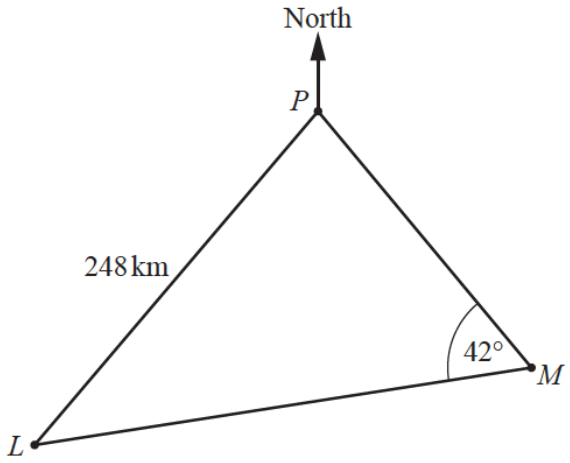
..... m [2]

(d) *B* is due north of *A*.

Find the bearing of *C* from *B*.

..... [3]

Question 30



NOT TO SCALE

The diagram shows two ports, L and P, and a buoy, M.
The bearing of L from P is 201° and $LP = 248$ km.
The bearing of M from P is 127°.
Angle $PML = 42°$.

(a) Use the sine rule to calculate LM.

$LM =$ ..... km [4]

(b) A ship sails directly from L to P.

(i) Calculate the shortest distance from M to LP.

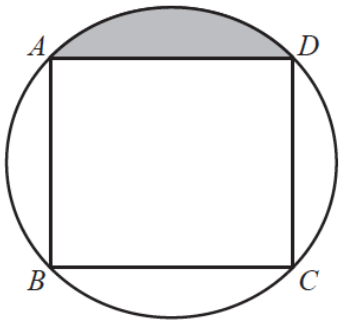
..... km [3]

(ii) The ship leaves L at 2045 and travels at a speed of 40 km/h.

Calculate the time the next day that the ship arrives at P.

..... [3]

Question 31



NOT TO SCALE

The vertices of a square *ABCD* lie on the circumference of a circle, radius 8 cm.

(a) Calculate the area of the square.

..... cm^2 [2]

(b) **(i)** Calculate the area of the shaded segment.

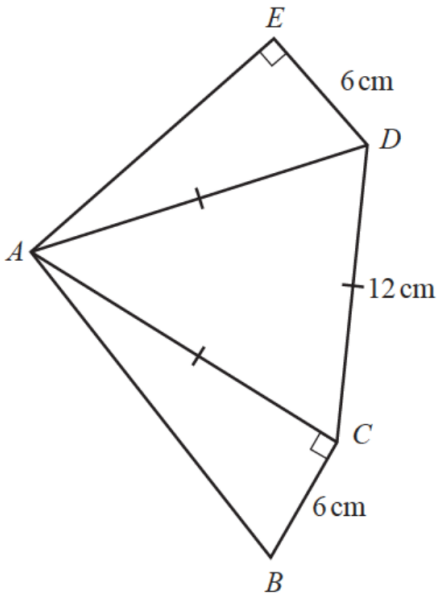
..... cm^2 [3]

(ii) Calculate the perimeter of the shaded segment.

..... cm [4]

Question 32

(a)



NOT TO SCALE

In the pentagon $ABCDE$, angle ACB = angle $AED = 90°$.
Triangle ACD is equilateral with side length 12 cm.
$DE = BC = 6$ cm.

(i) Calculate angle BAE.

Angle BAE = ... [4]

(ii) Calculate AB.

AB = ... cm [2]

(iii) Calculate AE.

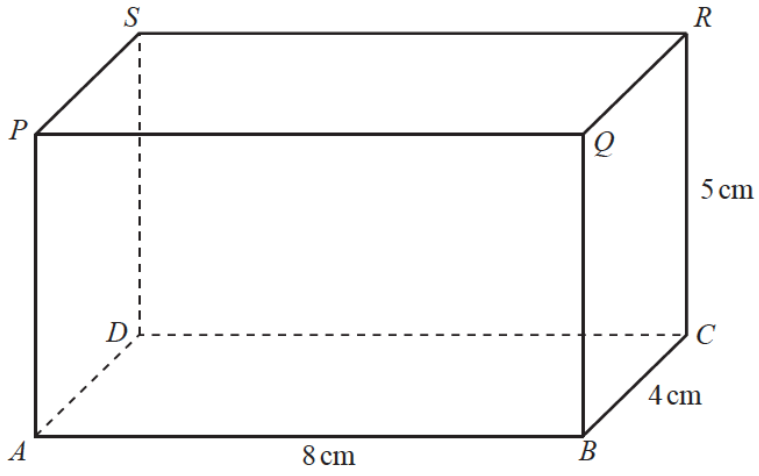
AE = ... cm [3]

(iv) Calculate the area of the pentagon.

..... cm^2 [4]

Continue on the next page…

(b)



NOT TO SCALE

The diagram shows a cuboid.
$AB = 8$ cm, $BC = 4$ cm and $CR = 5$ cm.

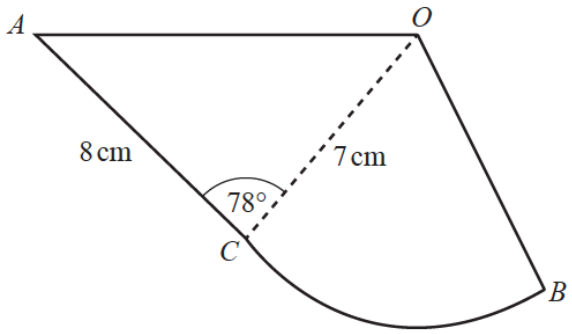
(i) Write down the number of planes of symmetry of this cuboid.

..... [1]

(ii) Calculate the angle between the diagonal AR and the plane $BCRQ$.

..... [4]

Question 33



NOT TO SCALE

The diagram shows a design made from a triangle AOC joined to a sector OCB.
$AC = 8$ cm, $OB = OC = 7$ cm and angle $ACO = 78°$.

(a) Use the cosine rule to show that $OA = 9.47$ cm, correct to 2 decimal places.

[4]

(b) Calculate angle OAC.

Angle $OAC =$ ..... [3]

(c) The perimeter of the design is 29.5 cm.

Show that angle $COB = 41.2°$, correct to 1 decimal place.

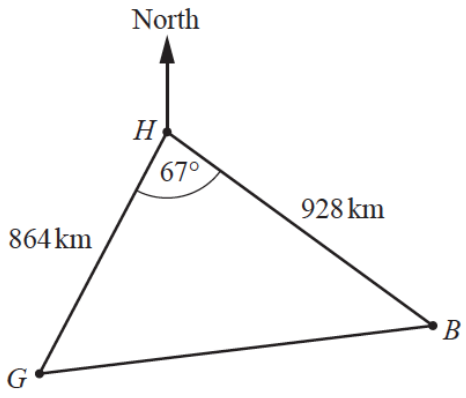
[5]

(d) Calculate the total area of the design.

..... cm^2 [4]

Question 34

The diagram shows the positions of three cities, Geneva (G), Budapest (B) and Hamburg (H).



NOT TO SCALE

(a) A plane flies from Geneva to Hamburg.
The flight takes 2 hours 20 minutes.

Calculate the average speed in kilometres per hour.

..... km/h [2]

(b) Use the cosine rule to calculate the distance from Geneva to Budapest.

..... km [4]

(c) The bearing of Budapest from Hamburg is 133°.

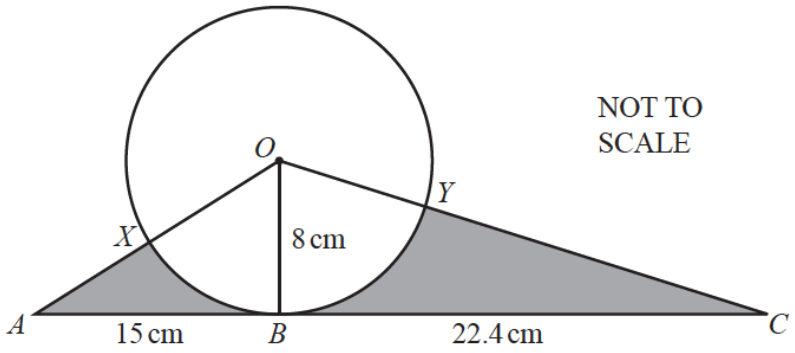
(i) Find the bearing of Hamburg from Budapest.

..... [2]

(ii) Calculate the bearing of Budapest from Geneva.

……...….[4]

Question 35



The diagram shows a circle, centre O.
The straight line ABC is a tangent to the circle at B.
$OB = 8$ cm, $AB = 15$ cm and $BC = 22.4$ cm.
AO crosses the circle at X and OC crosses the circle at Y.

(a) Calculate angle XOY.

Angle XOY = ... [5]

(b) Calculate the length of the arc XBY.

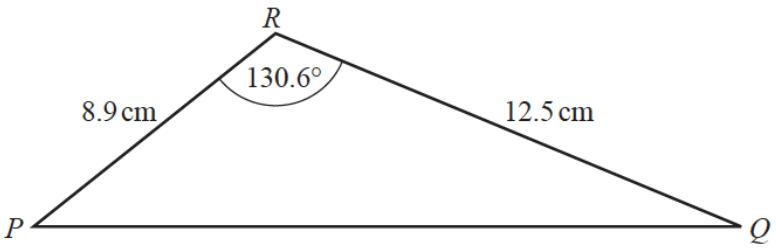
..... cm [2]

(c) Calculate the total area of the two shaded regions.

..... cm^2 [4]

Question 36

(a)

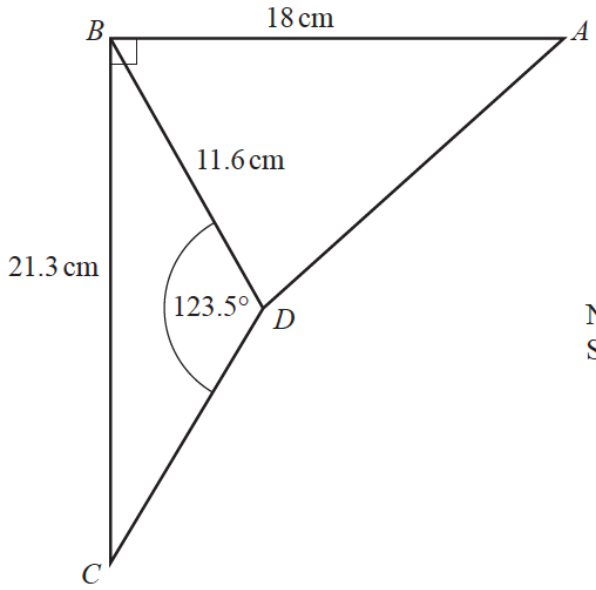


NOT TO SCALE

Calculate the area of triangle PQR.

..... cm^2 [2]

(b)



NOT TO SCALE

In the diagram, $AB = 18$ cm, $BC = 21.3$ cm and $BD = 11.6$ cm.
Angle $BDC = 123.5°$ and angle ABC is a right angle.

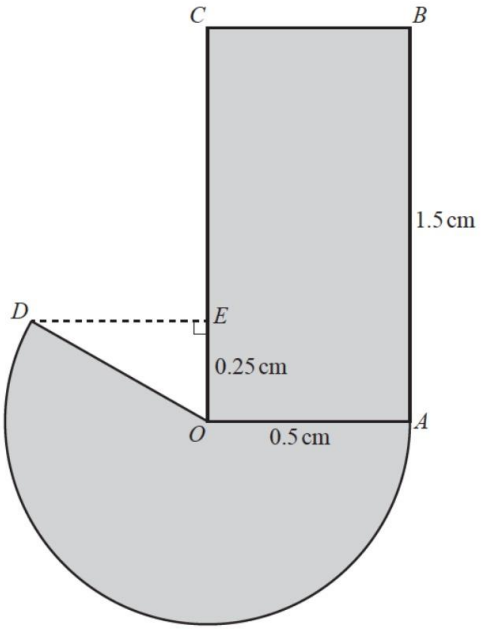
(i) Calculate angle BCD.

Angle BCD = ... [3]

(ii) Calculate AD.

AD = ... cm [5]

Question 37



NOT TO SCALE

The diagram shows a company logo made from a rectangle and a major sector of a circle.
The circle has centre O and radius OA.
$OA = OD = 0.5$ cm and $AB = 1.5$ cm.
E is a point on OC such that $OE = 0.25$ cm and angle $OED = 90°$.

(a) Calculate the perimeter of the logo.

..... cm [5]

(b) Calculate the area of the logo.

..... cm^2 [3]

(c) A mathematically similar logo is drawn.
The area of this logo is 77.44 cm^2.

(i) Calculate the radius of the major sector in this logo.

..... cm [3]

(ii) A gold model is made.
This model is a prism with a cross-section of area 77.44 cm^2.

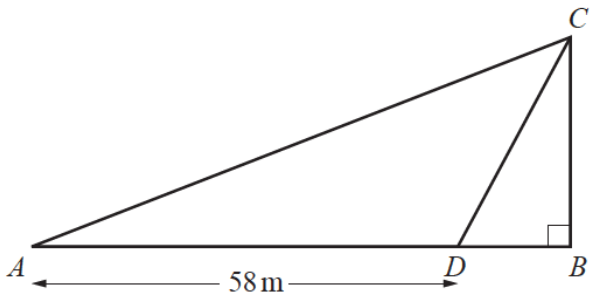
This gold model is 15 mm thick.
One cubic centimetre of gold has a mass of 19 grams.

Calculate the mass of the gold model in kilograms.

..... kg [3]

Question 38

(a)



NOT TO SCALE

In the diagram, BC is a vertical wall standing on horizontal ground AB.
D is the point on AB where $AD = 58$ m.
The angle of elevation of C from A is 26°.
The angle of elevation of C from D is 72°.

(i) Show that $AC = 76.7$ m, correct to 1 decimal place.

[5]

(ii) Calculate BD

$BD =$ …… m [3]

(b) Triangle EFG has an area of 70 m^2.
$EF : FG = 1 : 2$ and angle $EFG = 40°$.

(i) Calculate EF.

$EF =$ …… m [4]

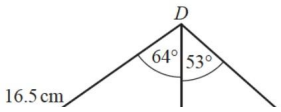
(ii) A **different** triangle PQR also has an area of 70 m^2.
$PQ : QR = 1 : 2$ and $PQ = EF$.

Find angle PQR.

Angle $PQR =$ ..... [1]

Question 39

(a)



NOT TO

(ii) Find BC.

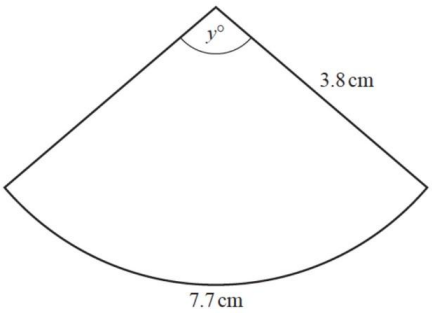
$BC =$ ..... cm [4]

The diagram shows two triangles ABD and BCD.
$AD = 16.5$ cm and $BD = 12.4$ cm.
Angle $ADB = 64°$, angle $BDC = 53°$ and angle $DBC = 95°$.

(i) Find AB.

$AB =$ ..... cm [4]

(b)



NOT TO SCALE

The diagram shows a sector of a circle of radius 3.8 cm.
The arc length is 7.7 cm.

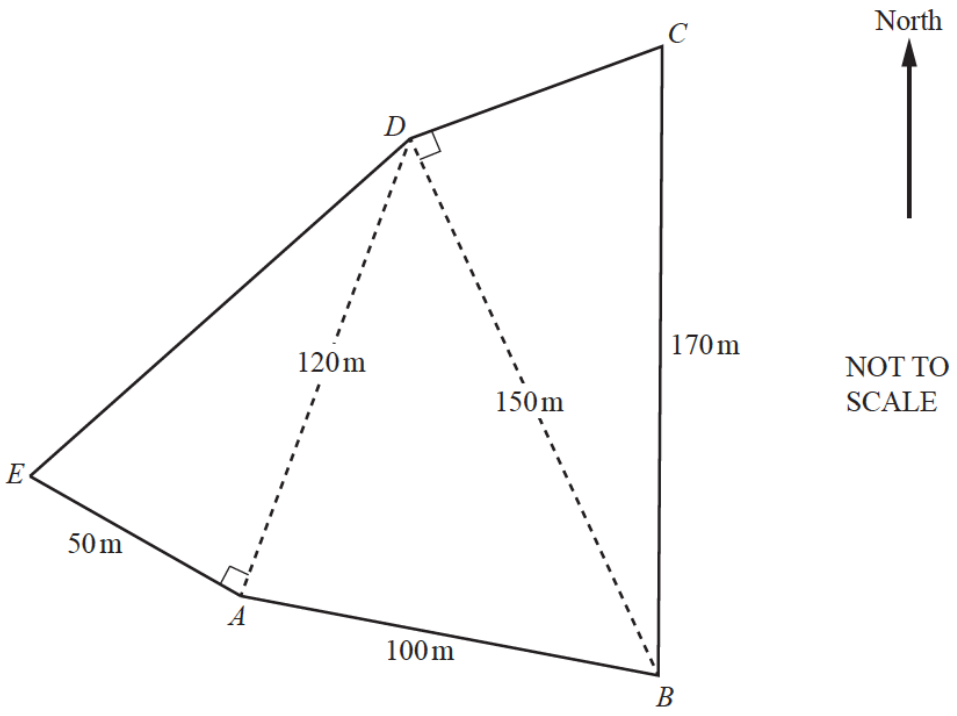
(i) Calculate the value of y.

$y =$ ..... [2]

(ii) Calculate the area of the sector.

..... cm^2 [2]

Question 40



The diagram shows a field *ABCDE*.

(a) Calculate the perimeter of the field *ABCDE*.

..... m [4]

(b) Calculate angle *ABD*.

Angle *ABD* = ... [4]

(c) **(i)** Calculate angle *CBD*.

Angle *CBD* = ... [2]

(ii) The point *C* is due north of the point *B*.

Find the bearing of *D* from *B*.

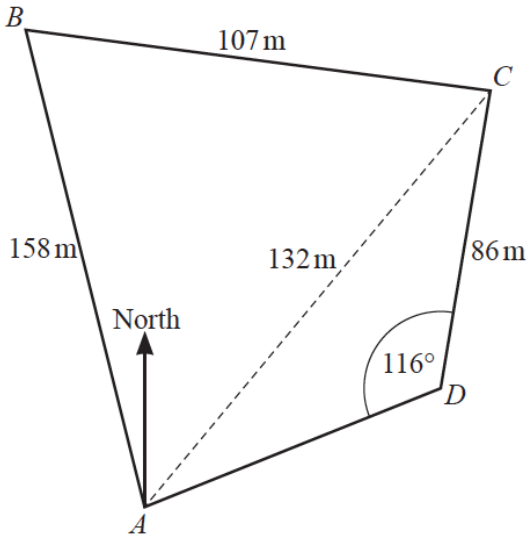
..... [2]

Continue on the next page…

(d) Calculate the area of the field *ABCDE*.
Give your answer in hectares.
[1 hectare = 10000 m^2]

..... hectares [4]

Question 41



NOT TO SCALE

The diagram shows a field, *ABCD*, on horizontal ground.

(a) There is a vertical post at *C*.
From *B*, the angle of elevation of the top of the post is 19°.

Find the height of the post.

..... [2]

(b) Use the cosine rule to find angle *BAC*.

Angle *BAC* = ... [4]

(c) Use the sine rule to find angle *CAD*.

Angle *CAD* = ... [3]

(d) Calculate the area of the field.

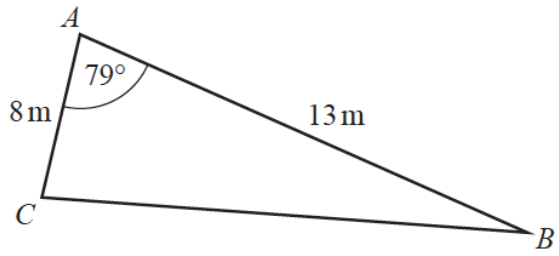
.....m^2 [3]

(e) The bearing of *D* from *A* is 070°.

Find the bearing of *A* from *C*.

..... [2]

Question 42



NOT TO SCALE

The diagram shows triangle ABC.

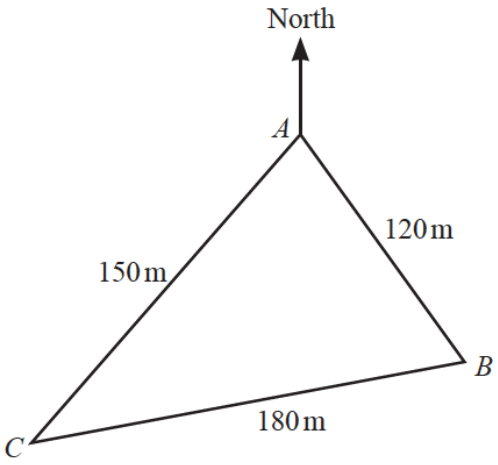
(i) Use the cosine rule to calculate BC.

$BC =$ ..... m [4]

(ii) Use the sine rule to calculate angle ACB.

Angle $ACB =$ ..... [3]

Question 43



NOT TO SCALE

The diagram shows a triangular field, ABC, on horizontal ground.

(a) Olav runs from A to B at a constant speed of 4 m/s and then from B to C at a constant speed of 3 m/s. He then runs at a constant speed from C to A.
His average speed for the whole journey is 3.6 m/s.

Calculate his speed when he runs from C to A.

..... m/s [3]

(b) Use the cosine rule to find angle BAC.

Angle BAC = ... [4]

(c) The bearing of C from A is 210°.

(i) Find the bearing of B from A.

..... [1]

(ii) Find the bearing of A from B.

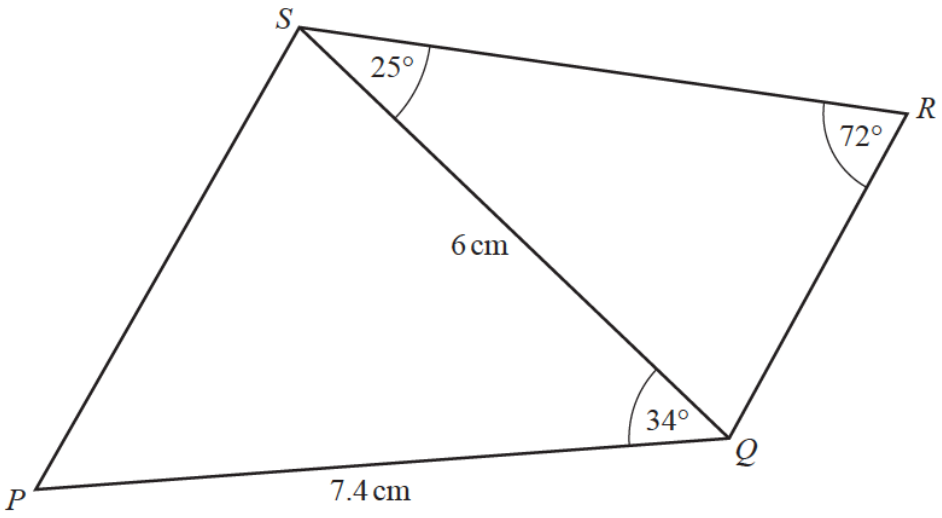
..... [2]

(d) D is the point on AC that is nearest to B.

Calculate the distance from D to A.

.....m [2]

Question 44



NOT TO SCALE

The diagram shows a quadrilateral $PQRS$ formed from two triangles, PQS and QRS.

Calculate

(i) QR,

$QR =$ ..... cm [3]

(ii) PS,

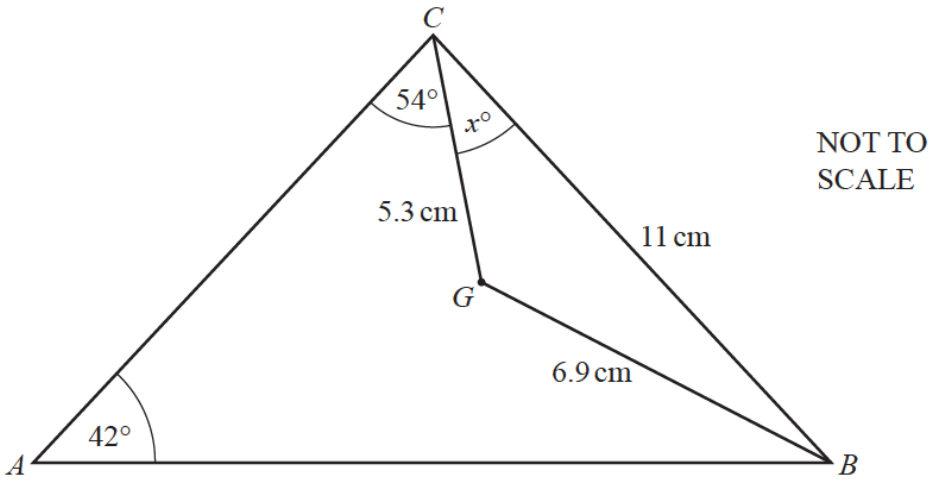
$PS =$ ..... cm [3]

(iii) the area of quadrilateral $PQRS$.

..... cm^2 [4]

Question 45

(a)



The diagram shows triangle ABC with point G inside.
$CB = 11$ cm, $CG = 5.3$ cm and $BG = 6.9$ cm.
Angle $CAB = 42°$ and angle $ACG = 54°$.

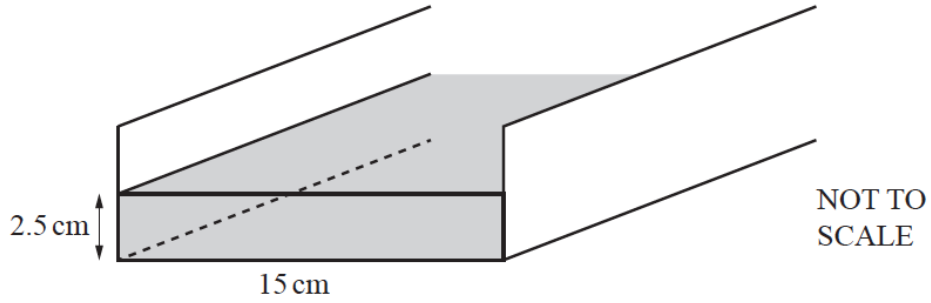
(i) Calculate the value of x.

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

(ii) Calculate AC

$AC =$ .....cm [4]

(b)

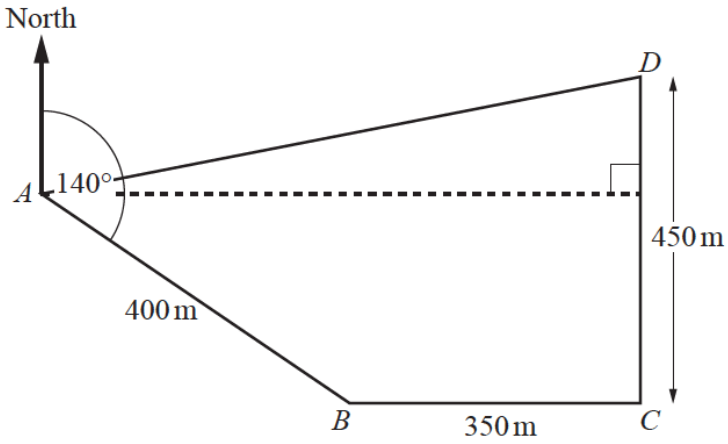


Water flows at a speed of 20 cm/s along a rectangular channel into a lake.
The width of the channel is 15 cm.
The depth of the water is 2.5 cm.

Calculate the amount of water that flows from the channel into the lake in 1 hour.
Give your answer in litres.

..... litres [4]

Question 46



NOT TO SCALE

The diagram shows a field $ABCD$.
The bearing of B from A is 140°.
C is due east of B and D is due north of C.
$AB = 400$ m, $BC = 350$ m and $CD = 450$ m.

(a) Find the bearing of D from B.

..... [2]

(b) Calculate the distance from D to A.

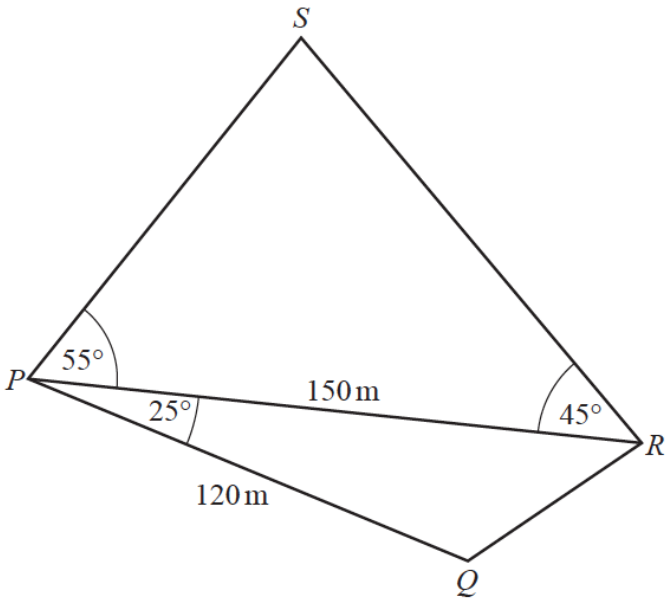
..... m [6]

(c) Jono runs around the field from A to B, B to C, C to D and D to A.
He runs at a speed of 3 m/s.

Calculate the total time Jono takes to run around the field.
Give your answer in minutes and seconds, correct to the nearest second.

..... min ..... s [4]

Question 47



NOT TO SCALE

The diagram shows two triangles.

(a) Calculate QR.

$QR =$ ..... m [3]

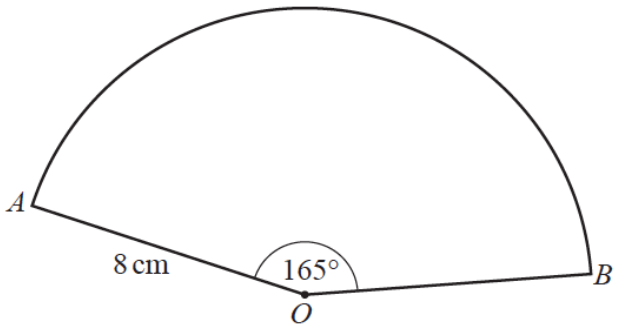
(b) Calculate RS.

$RS =$ ..... m [4]

(c) Calculate the total area of the two triangles.

..... m^2 [3]

Question 48



NOT TO SCALE

The diagram shows a sector of a circle with centre O, radius 8 cm and sector angle 165°.

(a) Calculate the total perimeter of the sector.

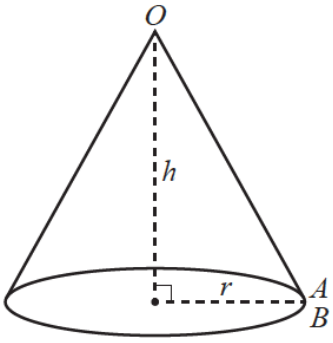
..... cm [3]

(b) The surface area of a sphere is the same as the area of the sector.

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

..... cm [4]

(c)



NOT TO SCALE

A cone is made from the sector by joining OA to OB.

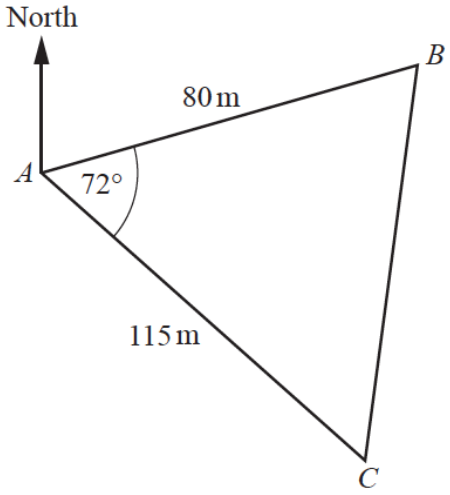
(i) Calculate the radius, r, of the cone.

$r =$ ..... cm [2]

(ii) Calculate the volume of the cone.
[The volume, V, of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

..... cm^3 [4]

Question 49



NOT TO SCALE

The diagram shows the positions of three points A, B and C in a field.

(a) Show that BC is 118.1 m, correct to 1 decimal place.

[3]

(b) Calculate angle ABC.

Angle ABC = ... [3]

(c) The bearing of C from A is 147°.

Find the bearing of

(i) A from B,

..... [3]

(ii) B from C

.....[2]

(d) Mitchell takes 35 seconds to run from A to C.

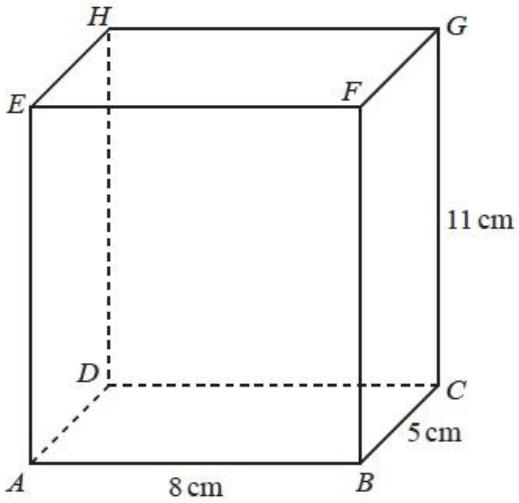
Calculate his average running speed in kilometres per hour.

..... km/h [3]

(e) Calculate the shortest distance from point B to AC.

..... m [3]

Question 50



NOT TO SCALE

ABCDEFGH is a cuboid.
$AB = 8$ cm, $BC = 5$ cm and $CG = 11$ cm.

(a) Work out the volume of the cuboid.

..... cm^3 [2]

(b) Ivana has a pencil of length 13 cm.

Does this pencil fit completely inside the cuboid?
Show how you decide.

[4]

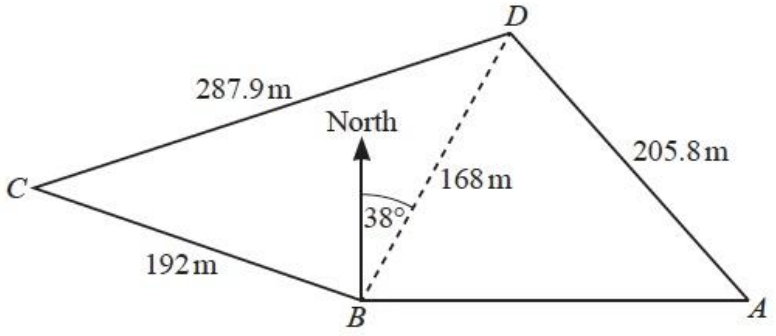
(c) **(i)** Calculate angle *CAB*.

Angle *CAB* = ... [2]

(ii) Calculate angle *GAC*.

Angle *GAC* = ... [2]

Question 51



The diagram shows a field, *ABCD*, on horizontal ground.
$BC = 192$ m, $CD = 287.9$ m, $BD = 168$ m and $AD = 205.8$ m.

(a) (i) Calculate angle *CBD* and show that it rounds to 106.0°, correct to 1 decimal place.

[4]

(ii) The bearing of *D* from *B* is 038°.

Find the bearing of *C* from *B*.

..... [1]

(iii) *A* is **due east** of *B*.

Calculate the bearing of *D* from *A*.

..... [5]

(b) (i) Calculate the area of triangle *BCD*.

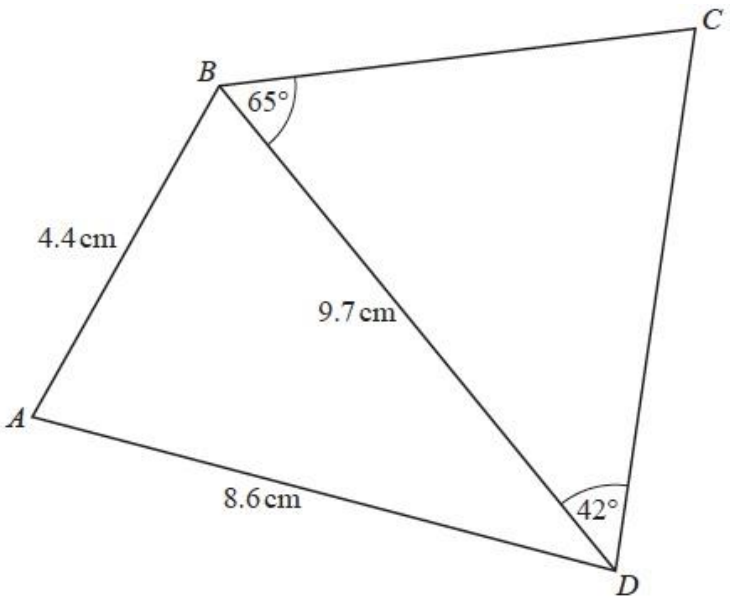
..... m^2 [2]

(ii) Tomas buys the triangular part of the field, *BCD*.
The cost is \$35 750 per hectare.

Calculate the amount he pays.
Give your answer correct to the nearest \$100.
[1 hectare = 10 000 m^2]

\$ ..... [2]

Question 52



NOT TO SCALE

(a) Calculate angle *ADB*.

Angle *ADB* = ... [3]

(b) Calculate *DC*.

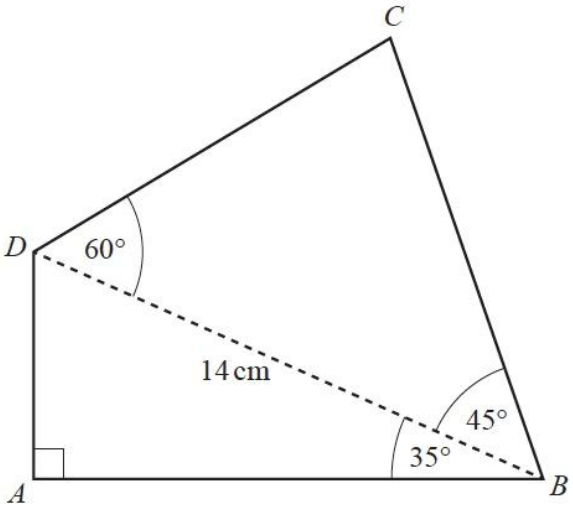
DC = ... cm [4]

(c) Calculate the shortest distance from *C* to *BD*.

..... cm [3]

Question 53

(a)

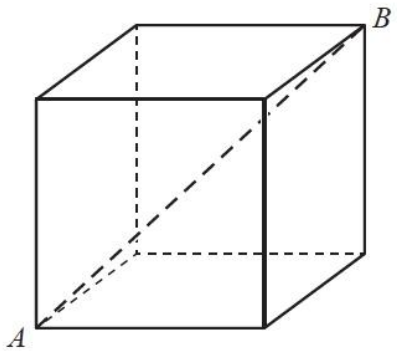


NOT TO SCALE

Calculate the perimeter of the quadrilateral $ABCD$.

..... cm [7]

(b)



NOT TO SCALE

The diagram shows a cube.
The length of the diagonal AB is 8.5 cm.

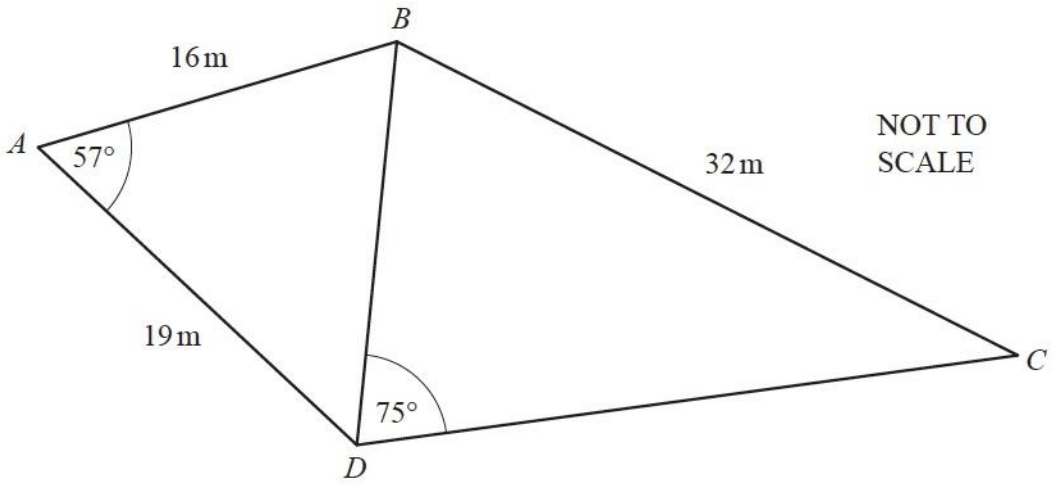
(i) Calculate the length of an edge of the cube.

..... cm [3]

(ii) Calculate the angle between AB and the base of the cube.

..... [3]

Question 54



The diagram shows a quadrilateral $ABCD$ made from two triangles, ABD and BCD.

(a) Show that $BD = 16.9$ m, correct to 1 decimal place.

[3]

(b) Calculate angle CBD.

Angle CBD = ... [4]

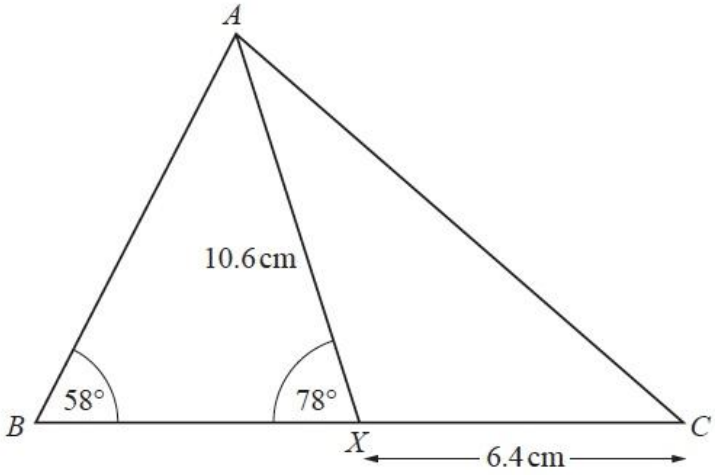
(c) Find the area of the quadrilateral $ABCD$.

..... m^2 [3]

(d) Find the shortest distance from B to AD.

..... m [3]

Question 55



NOT TO SCALE

The diagram shows triangle ABC.
X is a point on BC.
$AX = 10.6$ cm, $XC = 6.4$ cm, angle $ABC = 58°$ and angle $AXB = 78°$.

(a) Calculate AC.

$AC =$ ..... cm [4]

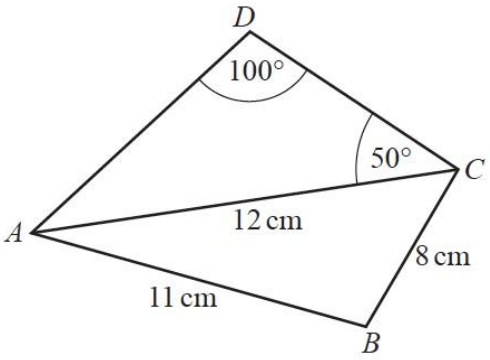
(b) Calculate BX.

$BX =$ ..... cm [4]

(c) Calculate the area of triangle ABC.

..... cm^2 [3]

Question 56



NOT TO SCALE

(a) Calculate AD.

$AD =$ ..... cm [3]

(b) Calculate angle BAC and show that it rounds to 40.42°, correct to 2 decimal places.

[4]

(c) Calculate the area of the quadrilateral $ABCD$.

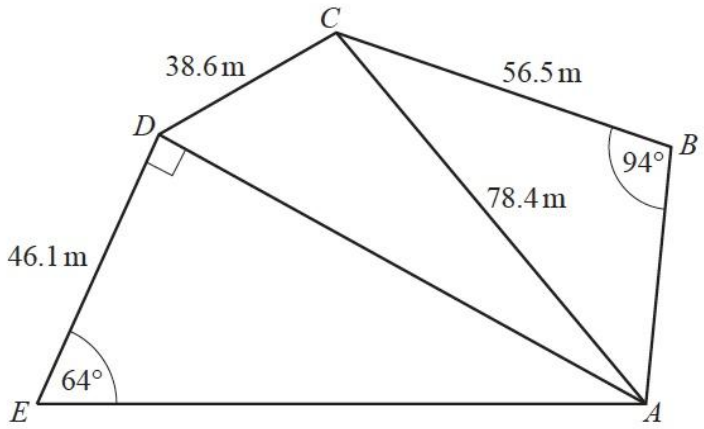
..... cm^2 [3]

(d) Calculate the shortest distance from B to AC.

..... cm [3]

Question 57

(a)



NOT TO SCALE

ABCDE is a pentagon.

(i) Calculate *AD* and show that it rounds to 94.5 m, correct to 1 decimal place.

[2]

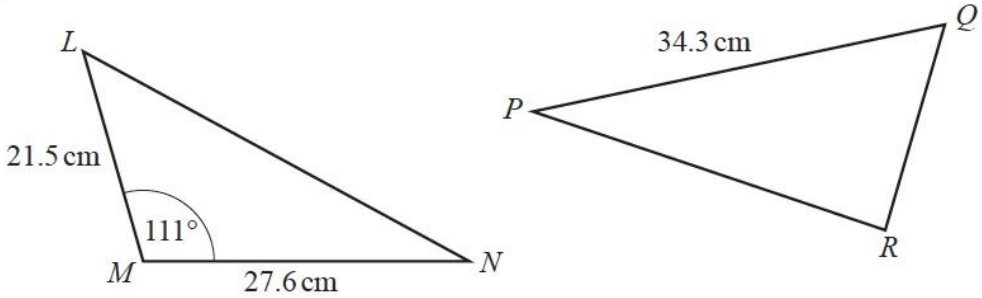
(ii) Calculate angle *BAC*.

Angle *BAC* = ... [3]

(iii) Calculate the largest angle in triangle *CAD*.

..... [4]

(b)



NOT TO SCALE

Triangle *PQR* has the same area as triangle *LMN*.

Calculate the shortest distance from *R* to the line *PQ*.

..... cm [3]

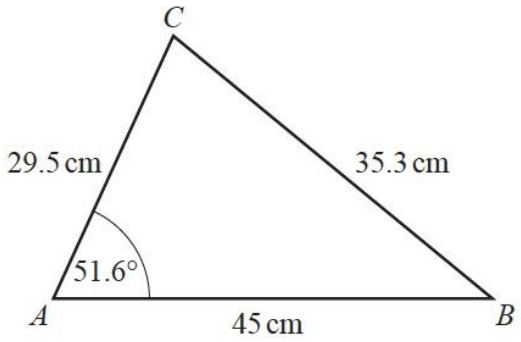
Question 58

Solve the equation $\tan x = 11.43$ for $0° \leqslant x \leqslant 360°$.

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

Question 59

(a)



NOT TO SCALE

In triangle ABC, $AB = 45$ cm, $AC = 29.5$ cm, $BC = 35.3$ cm and angle $CAB = 51.6°$.

(i) Calculate angle ABC.

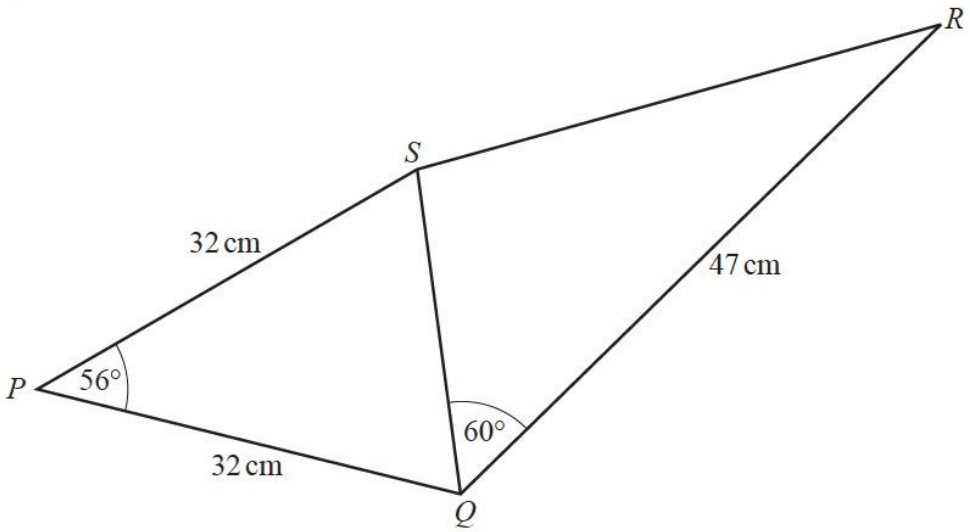
Angle $ABC =$ ..... [3]

(ii) Calculate the area of triangle ABC.

..... cm^2 [2]

Continue on the next page…

(b)



NOT TO SCALE

The diagram shows a quadrilateral $PQRS$ formed from two triangles, PQS and QRS.
Triangle PQS is isosceles, with $PQ = PS = 32$ cm and angle $SPQ = 56°$.
$QR = 47$ cm and angle $SQR = 60°$.

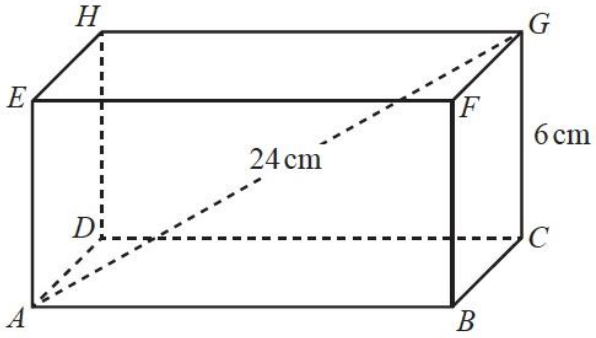
(i) Calculate SR.

$SR =$ ..... cm [4]

(ii) Calculate the shortest distance from P to SQ.

..... cm [3]

Question 60



NOT TO SCALE

The diagram shows a cuboid $ABCDEFGH$.
$CG = 6$ cm, $AG = 24$ cm and $AB = 2BC$.

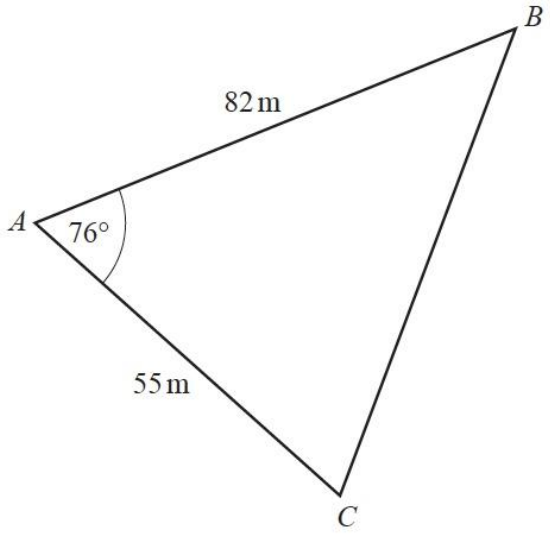
(a) Calculate AB.

$AB =$ ..... cm [4]

(b) Calculate the angle between AG and the base $ABCD$.

..... [3]

Question 61



NOT TO SCALE

The diagram shows a field ABC.

(a) Calculate BC.

$BC =$ ..... m [3]

(b) Calculate angle ACB.

Angle $ACB =$ ..... [3]

(c) A gate, G, lies on AB at the shortest distance from C.

Calculate AG.

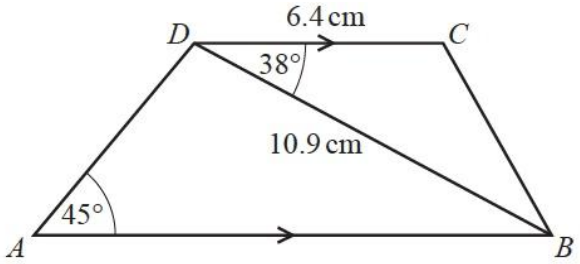
$AG =$ ..... m [3]

(d) A different triangular field PQR has the same area as ABC.
$PQ = 90$ m and $QR = 60$ m.

Work out the two possible values of angle PQR.

Angle $PQR =$ ..... or ..... [5]

Question 62



NOT TO SCALE

$ABCD$ is a trapezium with DC parallel to AB.
$DC = 6.4$ cm, $DB = 10.9$ cm, angle $CDB = 38°$ and angle $DAB = 45°$.

(a) Find CB.

$CB =$ ..... cm [3]

(b) **(i)** Find angle ADB.

Angle $ADB =$ ..... [1]

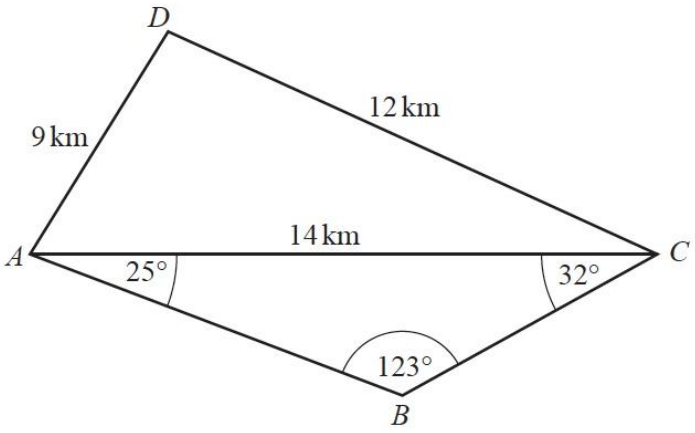
(ii) Find AB.

$AB =$ ..... cm [3]

(c) Calculate the area of the trapezium.

..... cm^2 [3]

Question 63



NOT TO SCALE

(a) Calculate angle ACD.

Angle ACD = ... [4]

(b) Show that $BC = 7.05\,\text{km}$, correct to 2 decimal places.

[3]

(c) Calculate the shortest distance from B to AC.

..... km [3]

(d) Calculate the length of the straight line BD.

BD = ... km [4]

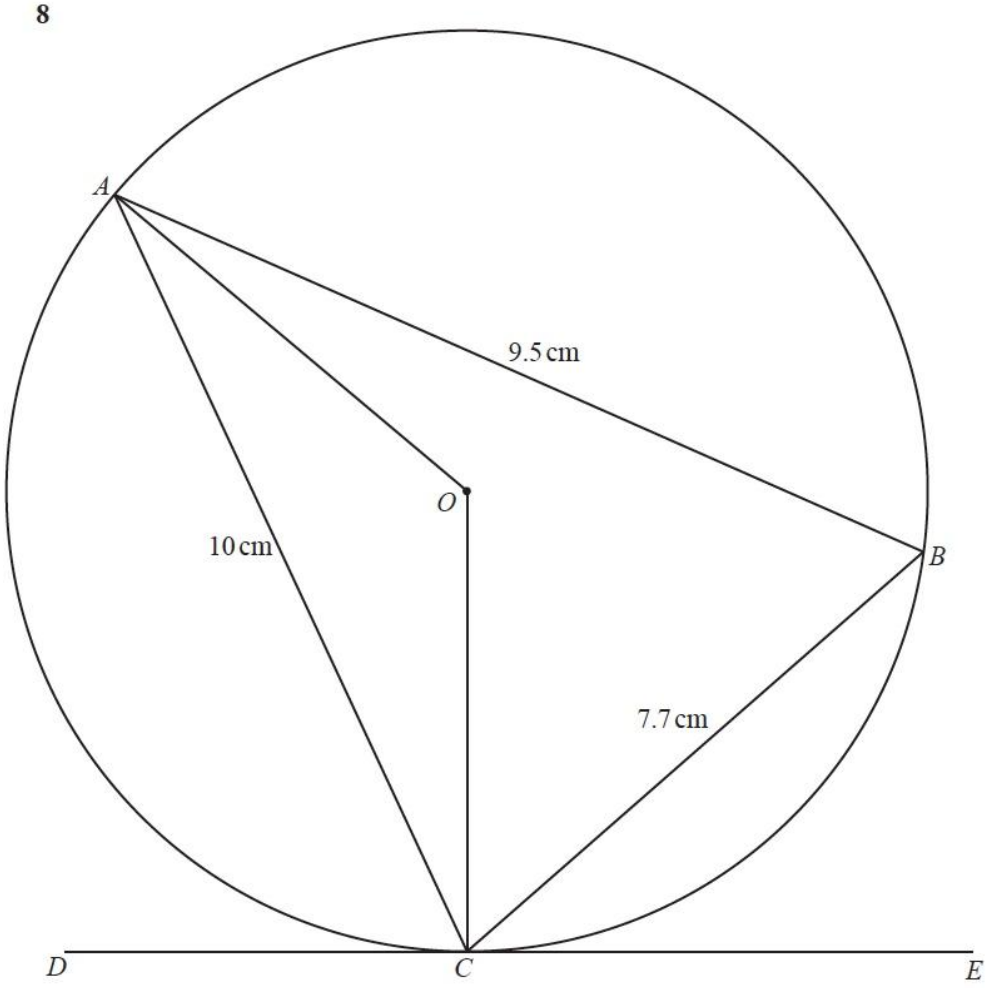
(e) C is due east of A.

Find the bearing of D from C.

..... [2]

Question 64

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]

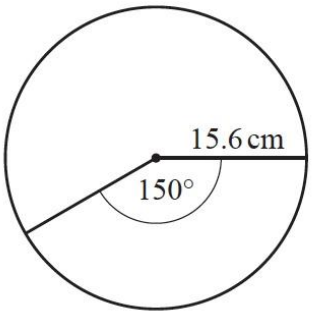
Question 65

(a) The lengths of the sides of a triangle are 11.4 cm, 14.8 cm and 15.7 cm, all correct to 1 decimal place.

Calculate the upper bound of the perimeter of the triangle.

..... cm [2]

(b)



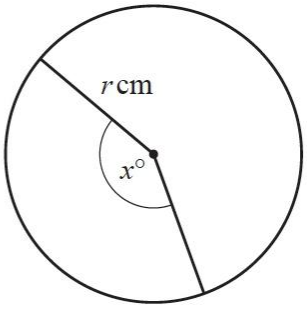
NOT TO SCALE

The diagram shows a circle, radius 15.6 cm.
The angle of the minor sector is 150°.

Calculate the area of the minor sector.

..... cm^2 [2]

(c)



NOT TO SCALE

The diagram shows a circle, radius r cm and minor sector angle $x°$.
The **perimeter** of the major sector is three times the **perimeter** of the minor sector.

Show that $x = \dfrac{90(\pi - 2)}{\pi}$.

[4]

Question 66

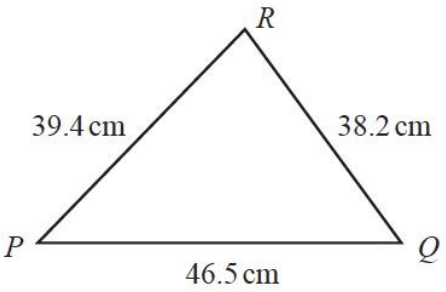
(a) On the diagram, sketch the graph of $y = \sin x$ for $0° \leqslant x \leqslant 360°$. [2]

(b) Solve the equation $5\sin x + 4 = 0$ for $0° \leqslant x \leqslant 360°$.

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

Question 67

(a)



NOT TO SCALE

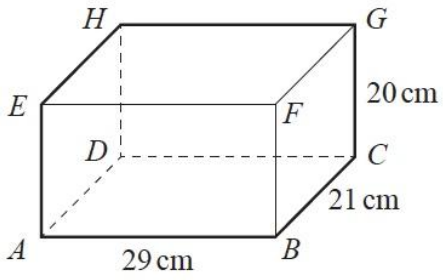
(i) Calculate angle QPR.

Angle QPR = ... [4]

(ii) Find the shortest distance from Q to PR.

..... cm [3]

(b) The diagram shows a cuboid.



NOT TO SCALE

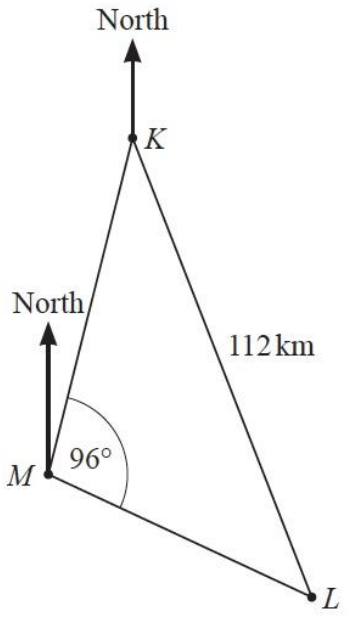
(i) Calculate the length AG.

AG = ... cm [3]

(ii) Calculate the angle between AG and the base $ABCD$.

..... [3]

(c)



NOT TO SCALE

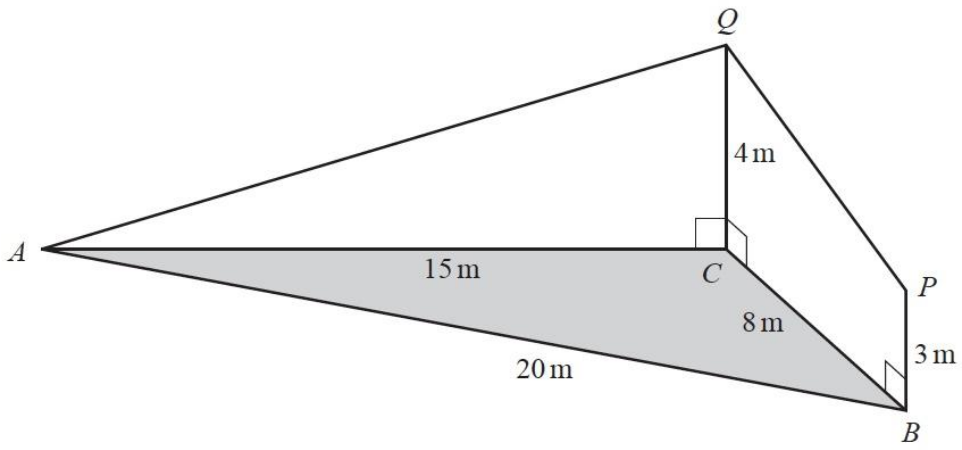
The diagram shows the positions of a lighthouse, L, and two ships, K and M.
The bearing of L from K is 155° and $KL = 112\,\text{km}$.
The bearing of K from M is 010° and angle $KML = 96°$.

Find the bearing and distance of ship M from the lighthouse, L.

Bearing .....

Distance ..... km [5]

Question 68



NOT TO SCALE

The diagram shows triangle ABC on horizontal ground.
$AC = 15\,\text{m}$, $BC = 8\,\text{m}$ and $AB = 20\,\text{m}$.

BP and CQ are vertical poles of different heights.
$BP = 3\,\text{m}$ and $CQ = 4\,\text{m}$.
AQ and PQ are straight wires.

(a) Show that angle $ACB = 117.5°$, correct to 1 decimal place.

[4]

(b) Calculate the area of triangle ABC.

..... m^2 [2]

(c) Calculate the length of AQ.

..... m [2]

(d) Calculate the angle of elevation of Q from P.

..... [3]

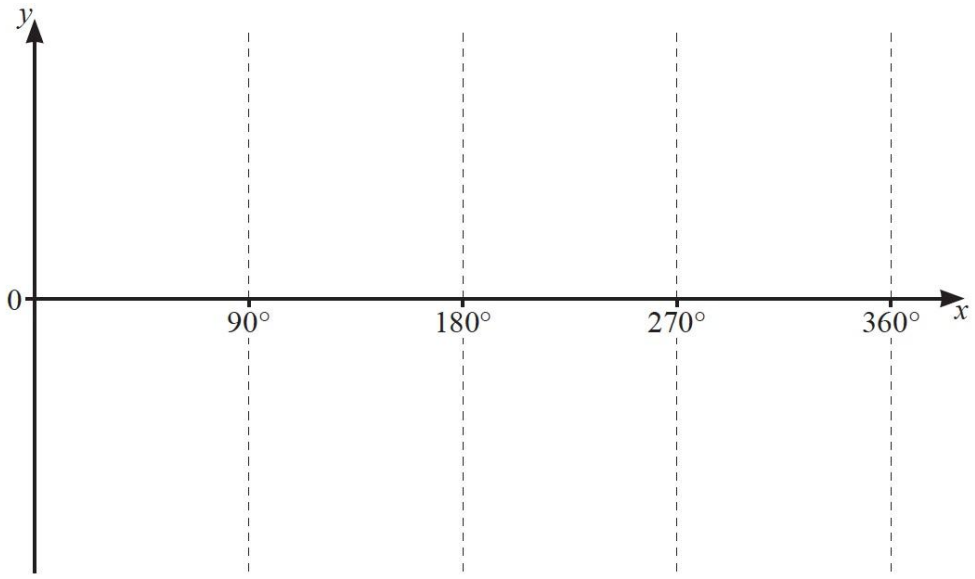
(e) Another straight wire connects A to the midpoint of PQ.

Calculate the angle between this wire and the horizontal ground.

..... [5]

Question 69

(a) Sketch the graph of $y = \tan x$ for $0° \leqslant x \leqslant 360°$.

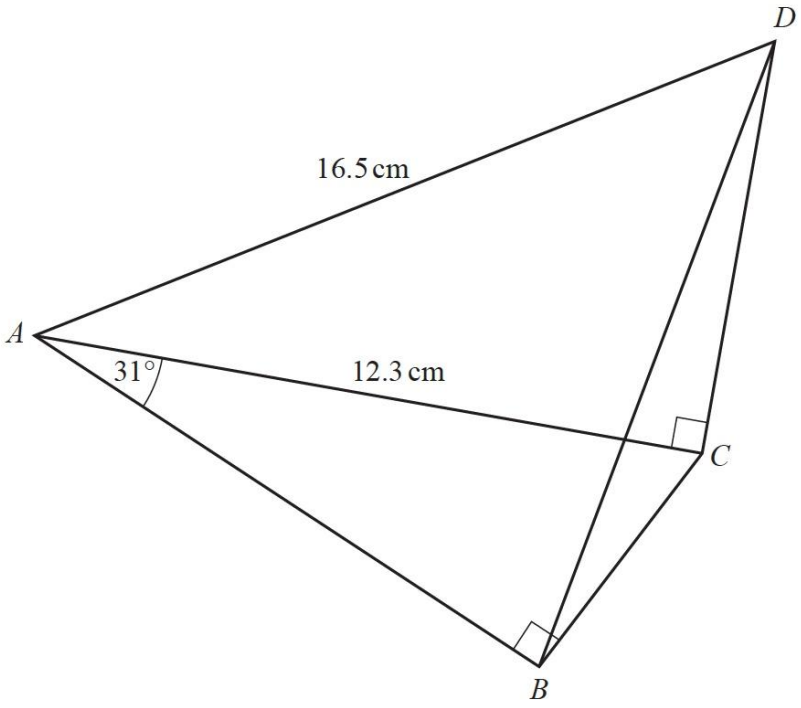


[2]

(b) Find x when $\tan x = \frac{1}{\sqrt{3}}$ and $0° \leqslant x \leqslant 360°$.

..... [2]

Question 70



The diagram shows a quadrilateral $ABCD$.
$AC = 12.3$ cm and $AD = 16.5$ cm.
Angle $BAC = 31°$, angle $ABC = 90°$ and angle $ACD = 90°$.

(a) Show that $AB = 10.54$ cm, correct to 2 decimal places.

[2]

(b) Show that angle $DAC = 41.80°$ correct to 2 decimal places.

[2]

(c) Calculate BD.

BD = ...cm [3]

(d) Calculate angle CBD.

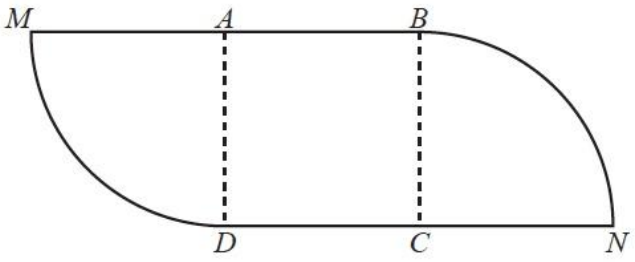
Angle CBD = ... [4]

(e) Calculate the shortest distance from C to BD.

..... cm [4]

Question 71

(a)



NOT TO SCALE

The diagram shows a shape made from a square *ABCD* and two equal sectors of a circle.
The square has side 11 cm.
MAB and *DCN* are straight lines.

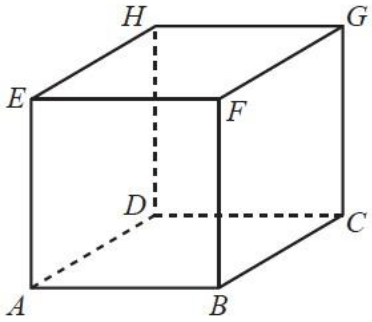
(i) Calculate the area of the shape.

..... cm^2 [3]

(ii) Calculate the perimeter of the shape.

..... cm [3]

(b)



NOT TO SCALE

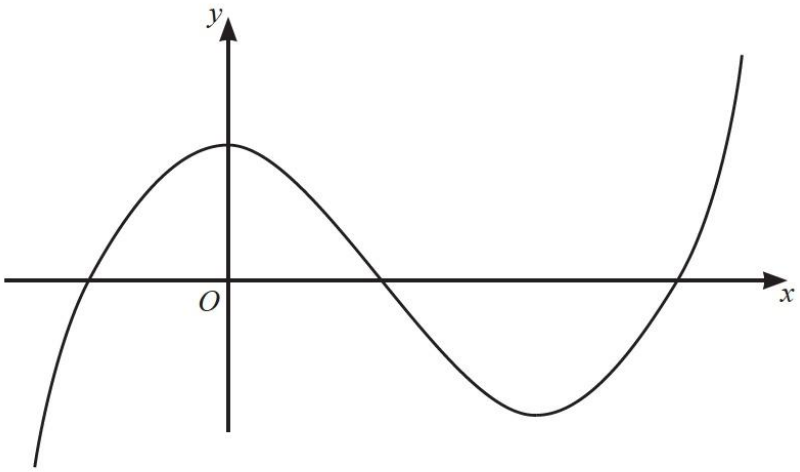
The diagram shows a cube ABCDEFGH of edge 7 cm.

Calculate the angle between AG and the base of the cube.

..... [4]

Question 72

(a) The diagram shows the graph of a function.

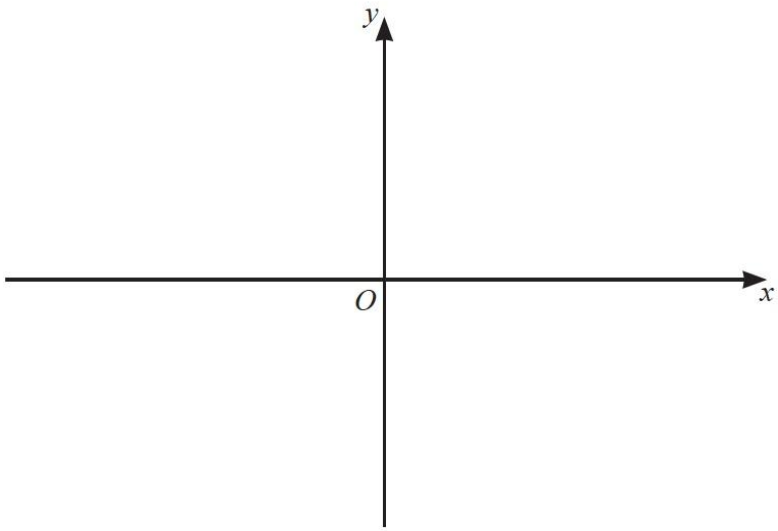


Put a ring around the word which correctly identifies the type of function.

reciprocal quadratic cubic exponential linear

[1]

(b) (i)

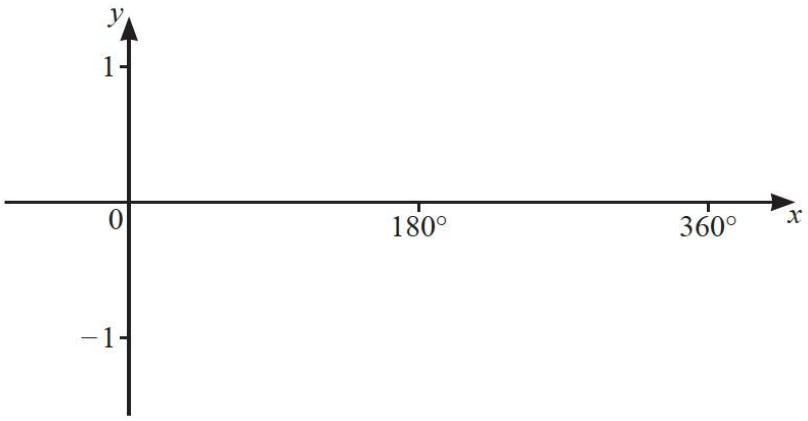


On the diagram, sketch the graph of $y = \frac{1}{2x}, x \neq 0$. [2]

(ii) Solve the equation $\frac{1}{2x} = 2x$.

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

(c) (i)



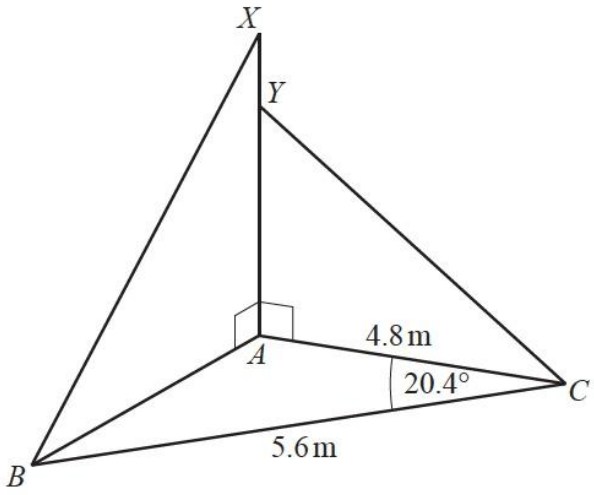
On the diagram, sketch the graph of $y = \sin x$ for $0° \leqslant x \leqslant 360°$. [2]

(ii) Solve the equation $3\sin x + 1 = 0$ for $0° \leqslant x \leqslant 360°$.

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

Question 73

(a)



NOT TO SCALE

ABC is a scalene triangle on horizontal ground.
AYX is a straight vertical post, held in place by two straight wires *XB* and *YC*.
$AC = 4.8$ m, $BC = 5.6$ m and angle $ACB = 20.4°$.

(i) Calculate *AB*.

Continue on the next page…

$AB =$ ..... m [3]

(ii) Angle $XBA = 64°$.

Calculate AX.

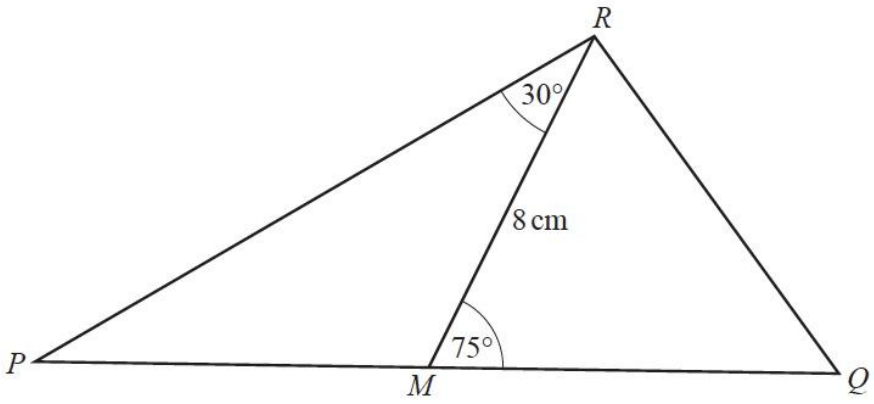
$AX =$ ..... m [2]

(iii) $AY = 2.9$ m.

Calculate the area of triangle YAC.

..... m^2 [2]

(b)



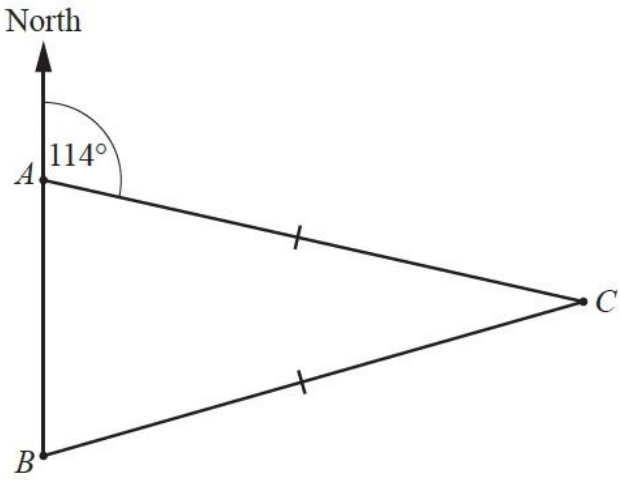
NOT TO SCALE

In triangle PQR, M is the midpoint of PQ.
$RM = 8$ cm, angle $PRM = 30°$ and angle $RMQ = 75°$.

Calculate PQ.

PQ = ... cm [5]

Question 74



NOT TO SCALE

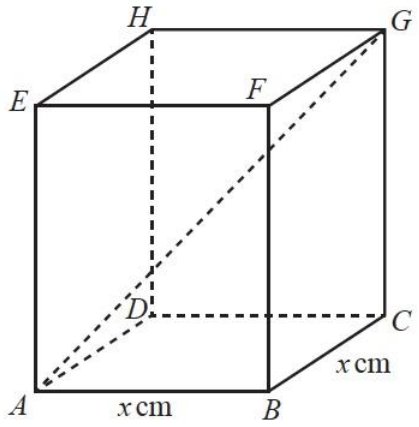
A, B and C are three towns and the bearing of C from A is 114°.
B is due south of A and $AC = BC$.

Calculate the bearing of B from C.

..... [3]

Question 75

(a)



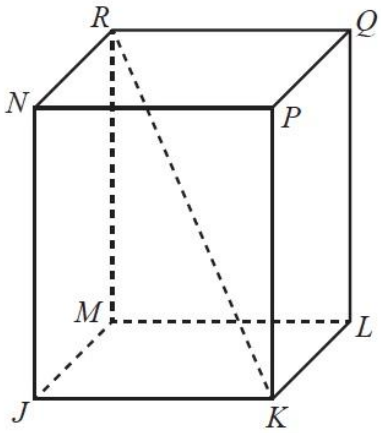
NOT TO SCALE

ABCDEFGH is a cuboid with a square base of side x cm.
$CG = 20$ cm and $AG = 28$ cm.

Calculate the value of x.

x = ... [4]

(b)



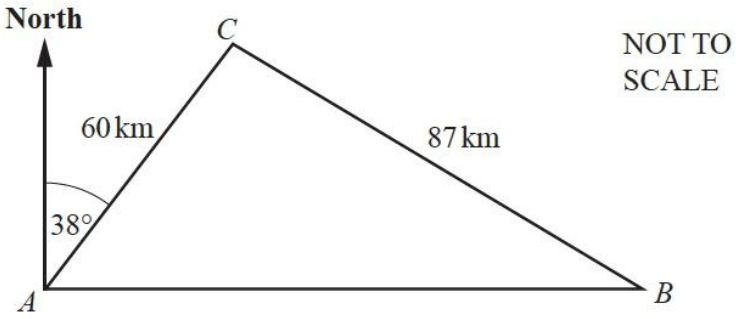
NOT TO SCALE

The diagram shows a different cuboid *JKLMNPQR*.
$MR = 30$ cm correct to the nearest centimetre.
$KR = 37$ cm correct to the nearest centimetre.

Calculate the lower bound of the angle between *KR* and the base *JKLM* of the cuboid.

..... [4]

Question 76



The diagram shows the straight roads between town A, town B and town C.
$AC = 60$ km, $CB = 87$ km and B is due east of A.
The bearing of C from A is 038°.

(a) Show that angle $ACB = 95.1°$, correct to 1 decimal place.

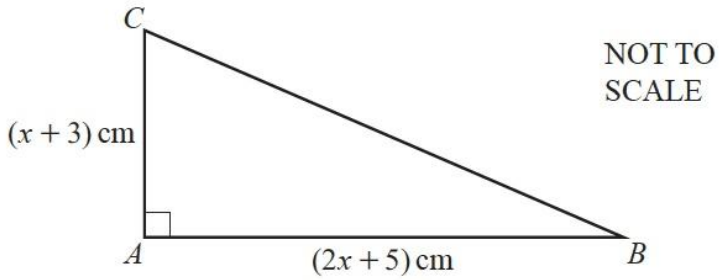
[5]

(b) Without stopping, a car travels from town A to town C then to town B, before returning directly to town A.
The total time taken for the journey is 3 hours 20 minutes.

Calculate the average speed of the car for this journey.
Give your answer in kilometres per hour.

..... km/h [6]

Question 77



The diagram shows a right-angled triangle ABC.

(a) (i) The area of the triangle is $60\,\text{cm}^2$.

Show that $2x^2 + 11x - 105 = 0$.

[3]

(ii) Solve by factorisation.

$$2x^2 + 11x - 105 = 0$$

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

(iii) Calculate angle ACB.

..... [3]

(b) Triangle ABC is similar to triangle DEF.
Triangle DEF has an area of $93.75\ \text{cm}^2$.

(i) Find the size of the smallest angle of triangle DEF.

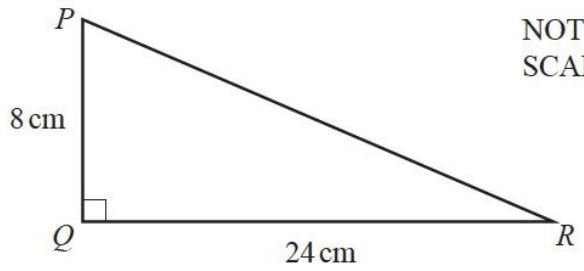
..... [1]

(ii) Find the length of the shortest side of triangle DEF.

..... cm [3]

Question 78

(a)



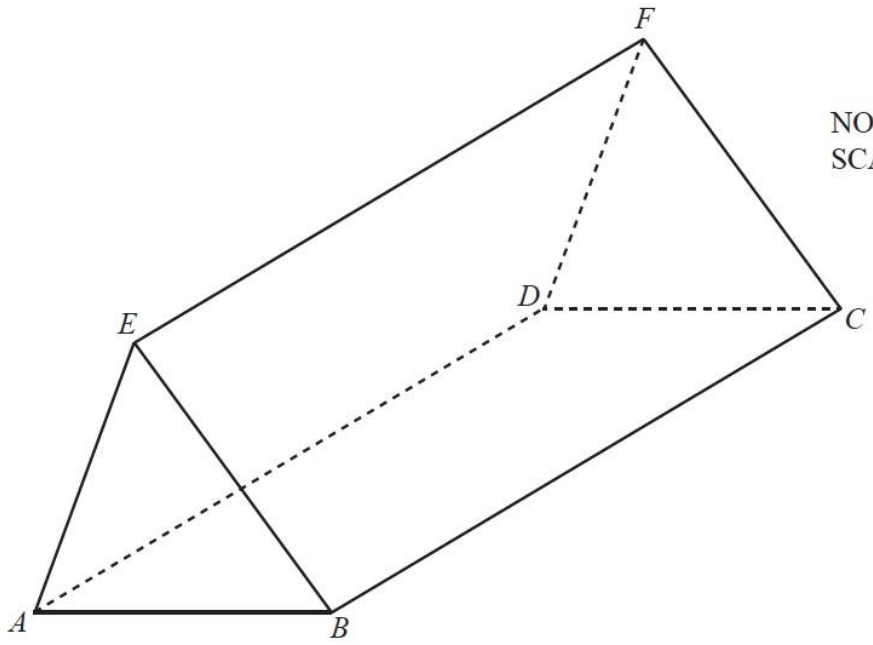
(i) Calculate the area of triangle PQR.

..... cm^2 [2]

(ii) Calculate angle PRQ.

Angle PRQ = ... [2]

Question 79



The diagram shows a solid triangular prism $ABCDEF$ of length 15 cm.
$AB = 6.4$ cm, $EB = 5.7$ cm and the volume of the prism is 145 cm^3.

(a) Show that angle $EBA = 32°$, correct to the nearest degree.

[3]

(b) Find the length of EA.

..... cm [3]

(c) Calculate the shortest distance from E to AB.

..... cm [3]

(d) Calculate the angle BF makes with the base, ABCD, of the prism.

..... [4]

(e) The prism is made of plastic with density 938 kg/m^3.

Calculate the mass of the prism in **grams**.
[Density = mass ÷ volume]

..... g [3]