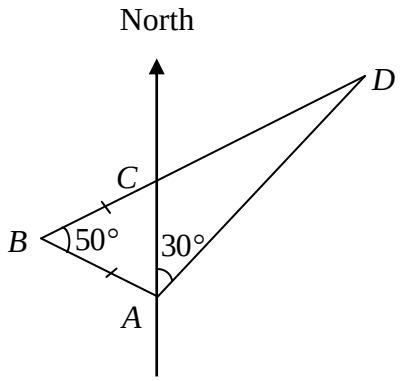
Name: _____ ( ) Date: _____

Class: _____

Applications of Trigonometry

Question 1

The bearing of D from A is $030°$, $\angle ABC = 50°$ and $AB = BC$.



Find

(a) the bearing of A from D.

(b) the bearing of C from B.

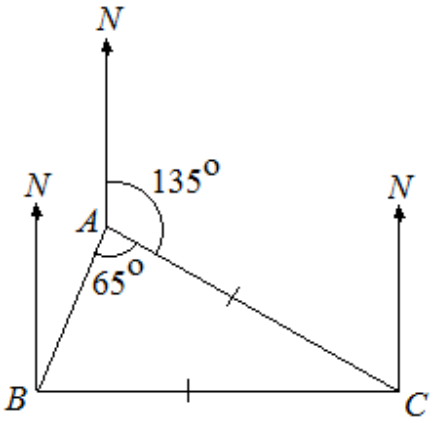
Question 2

The diagram shows three towns, A, B and C. C is equidistant from A and B. The bearing of C from A is $135°$ and $\angle BAC = 65°$. Calculate the

(a) reflex $\angle ACB$,

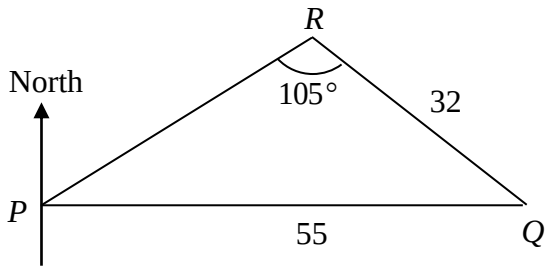
(b) bearing of A from C,

(c) bearing of A from B.



Question 3

In the diagram, Q is due east of P. Given that PQ = 55 m, RQ = 32 m and $\angle PRQ = 105°$.



Find

(a) the bearing of R from P.

(b) the area of ΔPRQ .

Question 4

The diagram shows the positions of points A, B and C. The bearing of B from A is $130°$.

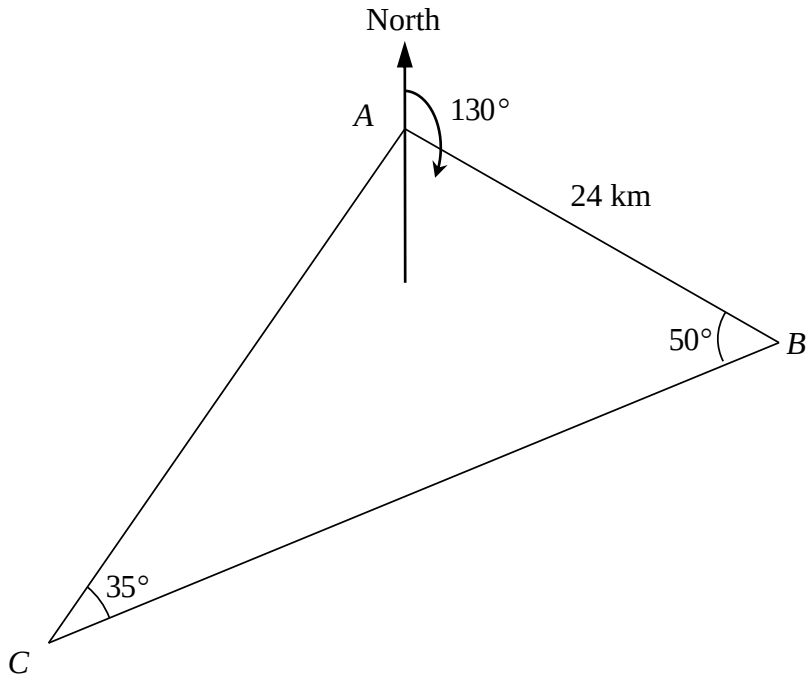
AB = 24 km.

(a) Calculate the bearing of

(i) C from A.

(ii) A from B.

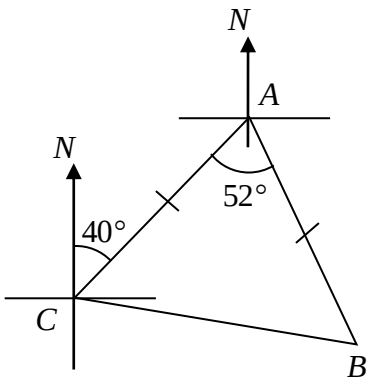
(b) Calculate BC.



Question 5

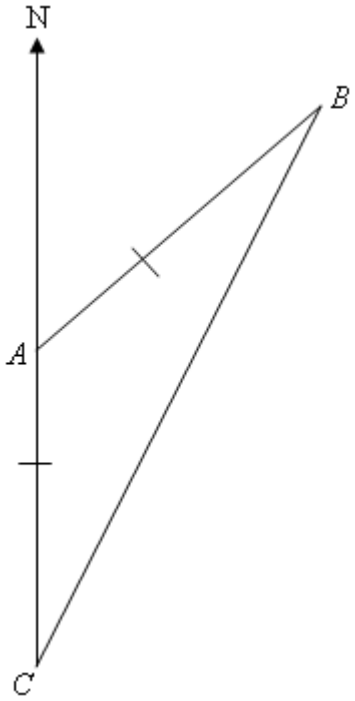
In the diagram, the points A, B and C form an isosceles triangle, $\angle BAC = 52°$ and the bearing of A from C is $040°$.

(a) Find the bearing of *B* from *C*.
(b) Find the bearing of *B* from *A*.



Question 6

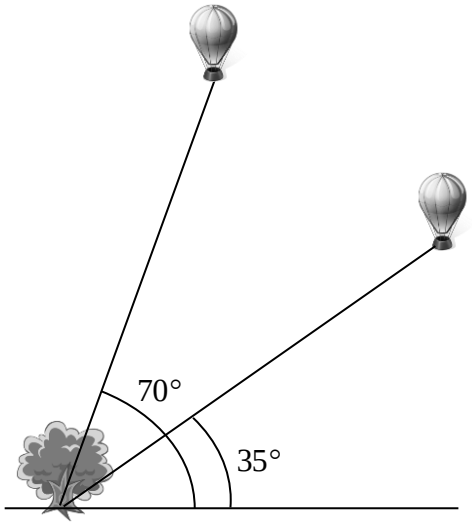
The diagram below shows the positions of 3 ships, *A*, *B* and *C*. *C* is due south of *A* and *B*
and *C* are equidistant from *A*. The bearing of *B* from *A* is 040°.



Find the bearing of
(a) *B* from *C*,
(b) *C* from *B*.

Question 7

A hot air balloon was tied with a 300 m rope to the bottom of a tree. At first, the angle between the rope and ground was $70°$ and finally decreased to $35°$. Find the vertical distance that the hot air balloon descended.



Question 8

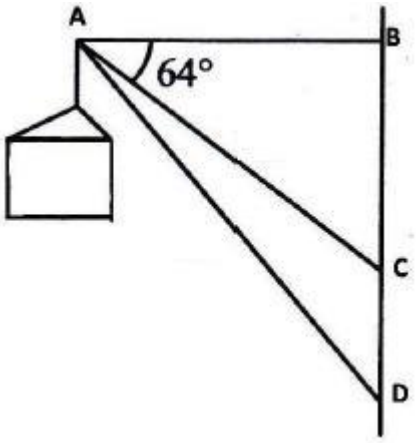
From the top of a lighthouse of 52 m high, the angles of depression of ship *A* and ship *B* are $45°$ and $38°$ respectively.

(a) State which ship is nearer to the lighthouse.

(b) Find the distance between the two ships.

Question 9

The diagram below shows a signboard suspended by three metal poles *AB*, *AC* and *AD*. *AC* = 2.5 m and *AD* = 3.5 m. Pole *AC* makes an angle of $64°$ with the horizontal pole *AB*.

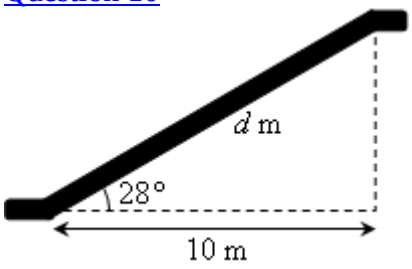


Calculate

(a) the angle of depression of *D* from *A*,

(b) $\cos \angle ACD$.

Question 10



The diagram shows an escalator at an angle of inclination of $28°$ and a horizontal travel distance of 10 m.

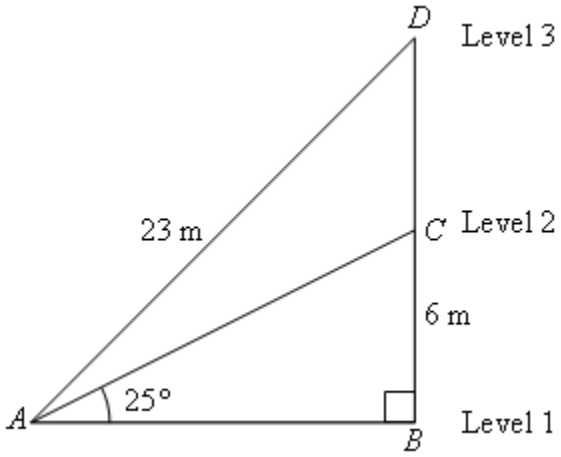
(a) Find the value of d.

(b) Using this value of d, find the time taken, to the nearest second, to travel on the escalator given that the speed is 0.65 m/s.

Question 11

The diagram shows two escalators AC and AD leading to level 2 and level 3 respectively.

The vertical height of the escalator to level 2 is 6 m and the escalator to level 3 is 23 m long.



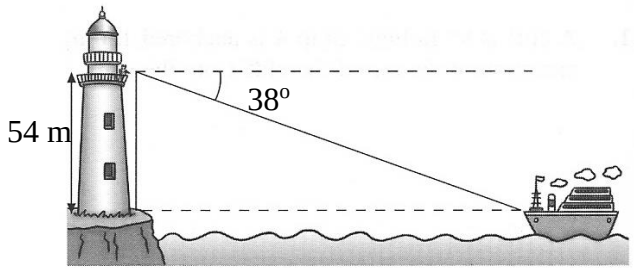
Given the angle of elevation of C from A is $25°$, find

(a) AB,

(b) $\angle CAD$.

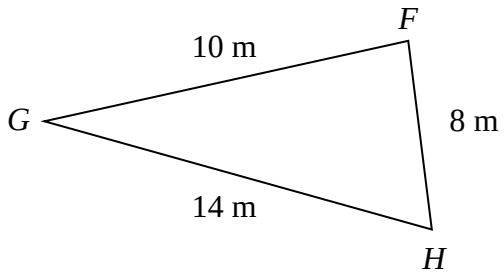
Question 12

A man stands in a lighthouse tower, 54 metres above the ground. He spots a ship some distance away. The angle of depression of the ship from the lighthouse tower is 38^{o}. Calculate how far away the ship is from the lighthouse.



Question 13

In the diagram, FG = 10 m, GH = 14 m, FH = 8 m.



Calculate,

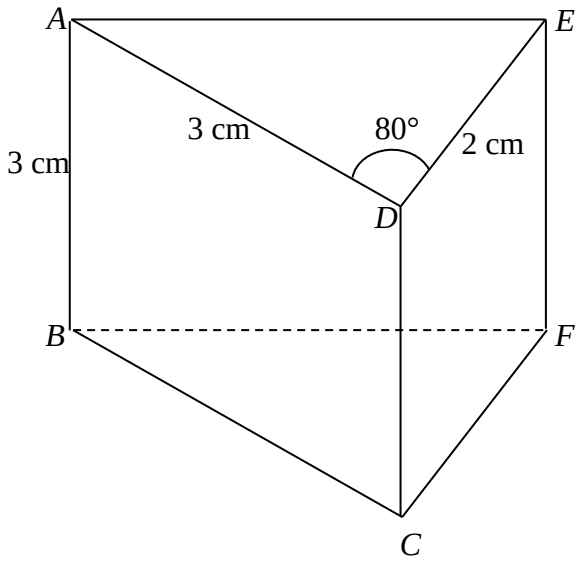
(a) FGH,

(b) the shortest distance from F to GH,

(c) the greatest angle of depression from the top of a block, which is 58 m high, at F to a stationary car along GH.

Question 14

The figure shows a triangular prism in which $AD = AB$ = 3 cm, DE = 2 cm and $\angle ADE = 80°$.



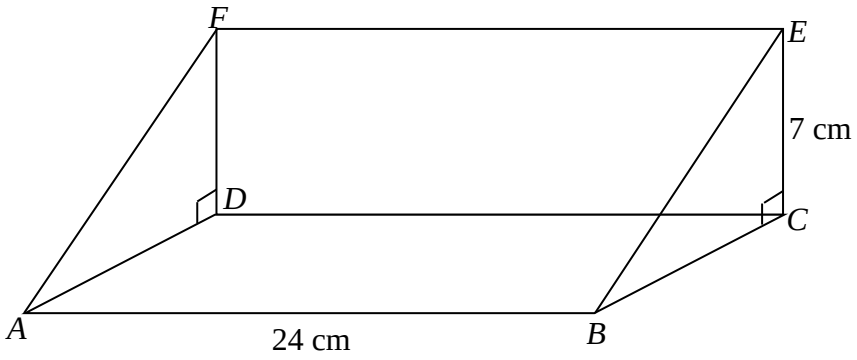
Find

(a) the length of AE,

(b) $\angle DAE$,
(c) the volume of the prism,
(d) the perpendicular distance of D to AE.

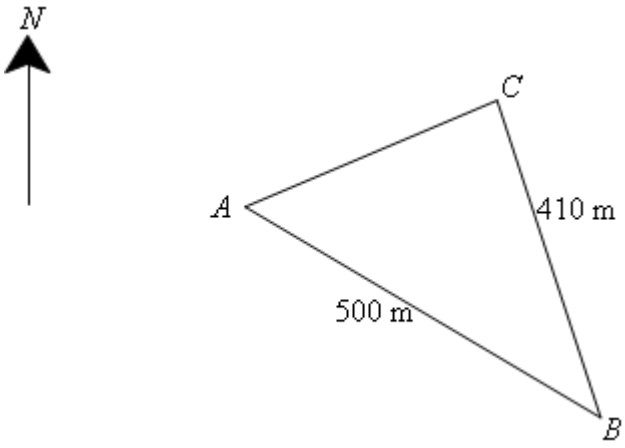
Question 15

The diagram shows a right-angled triangular prism. AB = 24 cm, BC = 10 cm and CE = 7 cm. Find
(a) AE.
(b) angle DAF.
(c) angle CAE.



Question 16

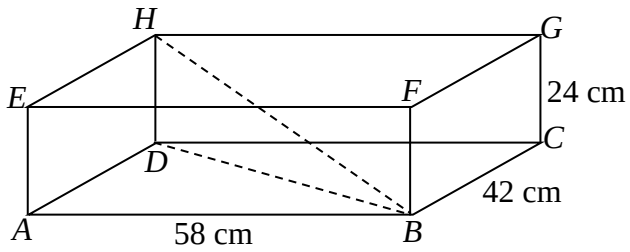
Henna walked from her house at point A to a hawker centre to a hawker centre at point B,
which is 500 m away on a bearing of 121°. After buying some food, she walked to school at point C, on a bearing 342°, which is 410 m from B.



(a) Show that $\angle ABC$ is 41°.
(b) Find the distance AC.
(c) Calculate the bearing of A from C.
(d) Find the shortest distance from A to BC.

Question 17

The diagram below shows a cuboid of dimensions 58 cm by 42 cm by 24 cm.

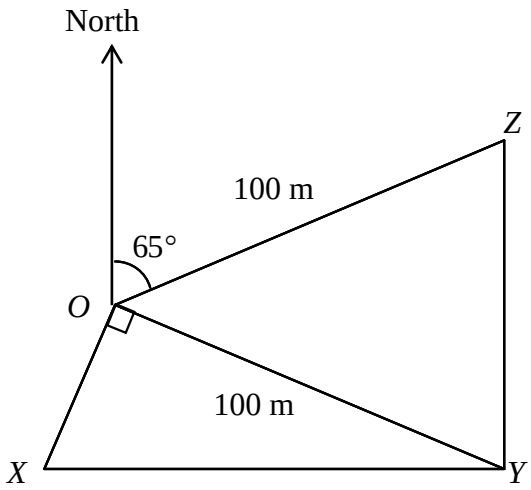


Calculate

(a) BH,
(b) $\angle BHF$.

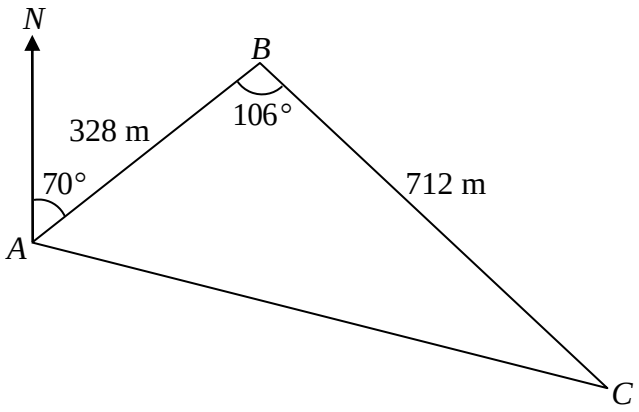
Question 18

O, X, Y and Z are four points on level ground. Z is on a bearing of $065°$ from O. Y is due
east of X and due south of Z. $OY = OZ = 100$ m and $\angle XOY = 90°$.
Calculate
(a) the bearing of X from O,
(b) the distance YZ,
(c) the area of ΔOYZ .



Question 19

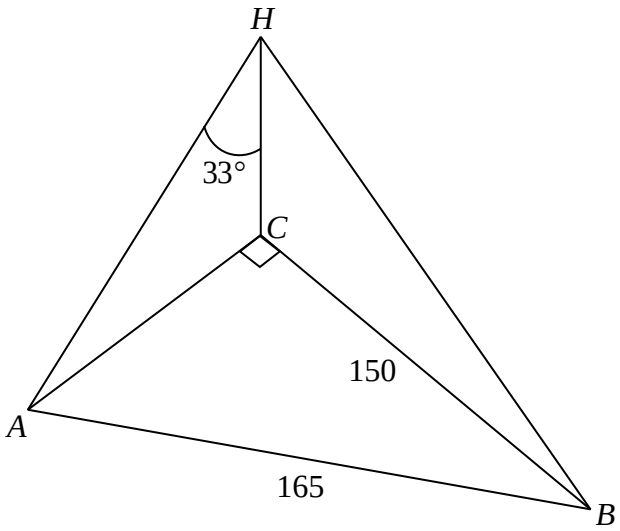
A, B and C are three points on a field. $AB = 328$ m, $BC = 712$ m, $\angle ABC = 106°$ and the bearing of B from A is $70°$.



Calculate
(a) the bearing of C from B,
(b) the length of AC,
(c) $\angle ACB$,
(d) the area of ΔABC .

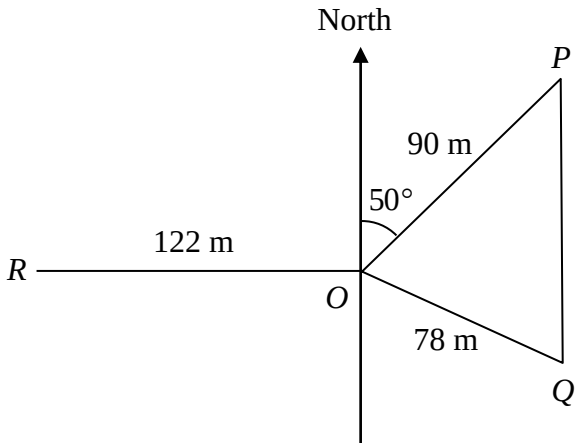
Question 20

The diagram shows a horizontal field ABC. H is a hot-air balloon hovering directly above C. $AB = 165$ m and $BC = 150$ m. $\angle ACH = \angle BCH = \angle BCA = 90°$ and $\angle AHC = 33°$.



Find
(a) the angle of elevation of H from A.
(b) the length of AC.
(c) CH, the height of the hot-air balloon above the ground.
(d) the angle of depression of B from H.

Question 21



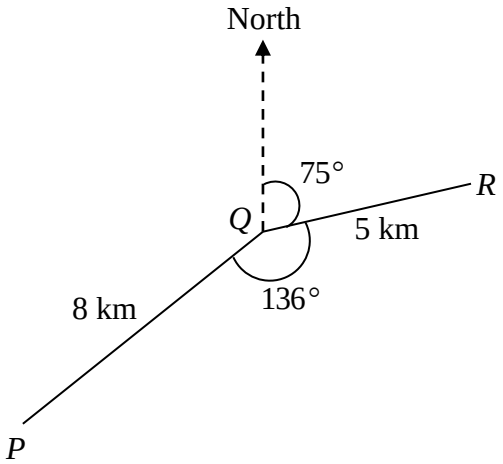
(a) A surveyor is carrying out a survey on horizontal ground. From a point O, she observes a point P which is 90 m from O on a bearing of $050°$ and a point Q which is 78 m from O and due south of the point P. Calculate the
(i) bearing of O from P.
(ii) angle OQP.

(b) The point R is 122 m due west of O. The surveyor walks directly from R to P. Calculate the distance she walked.

(c) The surveyor then walks from P towards Q until she reaches a point T, where RT is a
minimum. Calculate RT.

Question 22

A ship sails 8 km from P to Q. It then sails 5 km from Q to R on a bearing of $075°$.

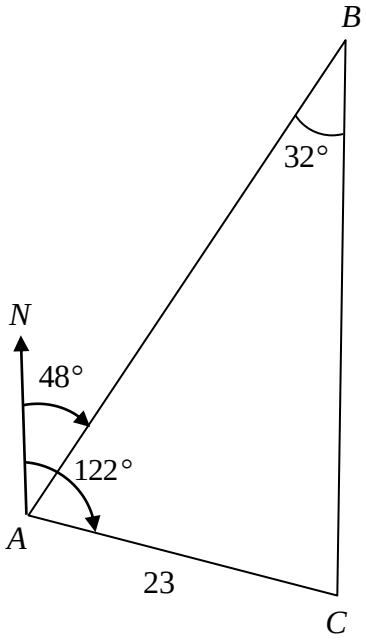


(a) Given that $\angle PQR = 136°$, calculate the
(i) bearing of Q from P.
(ii) distance PR.

(b) The ship finally sails from R to a position T, which is due North of Q. Given that $\angle QTR = 40°$, calculate the
(i) distance RT.

(ii) shortest distance between the point Q and the ship as it sails from R to T.

Question 23

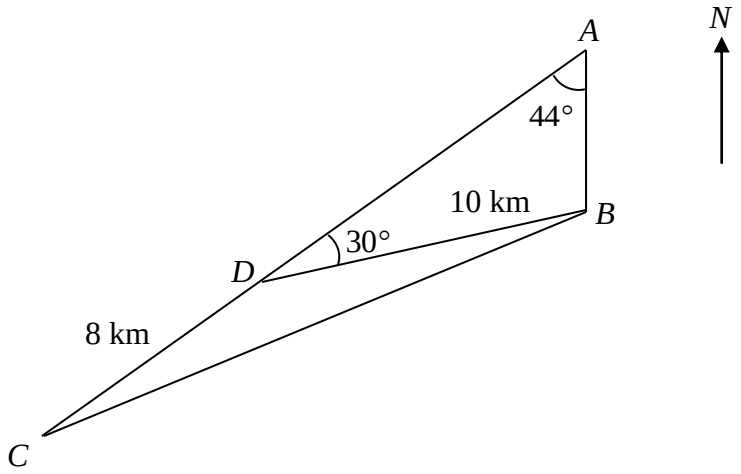


The points A, B and C lie on level ground. B is on a bearing of $048°$ from A and C is on a bearing of $122°$ from A. Given that $\angle ABC = 32°$ and C is 23 m from A, find, giving your answer correct to one decimal place,

(a) the distance BC.
(b) the area of triangle ABC.
(c) the bearing of A from B.
(d) the bearing of B from C.
(e) the shortest distance from A to BC.

Question 24

A, B, C and D represent four islands in the open sea with A due north of B. A, D and C are on a straight line. $\angle BAD = 44°$, $\angle ADB = 30°$, BD = 10 km and CD = 8 km.

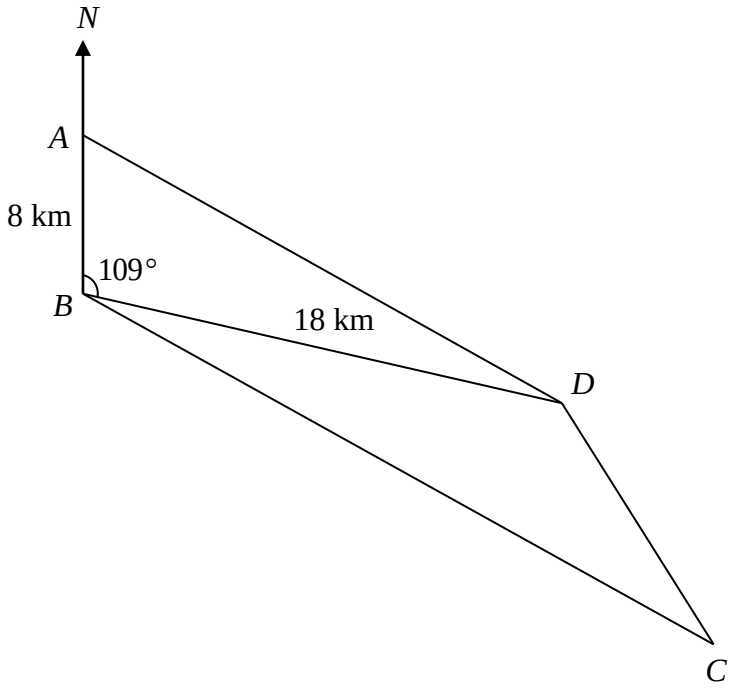


Calculate

(a) the length of BC.
(b) the length of AB.
(c) the bearing of B from C.
(d) the area of triangle BCD.
(e) A ship travels from C to B along the line CB. Find the shortest distance from the ship to Island D.

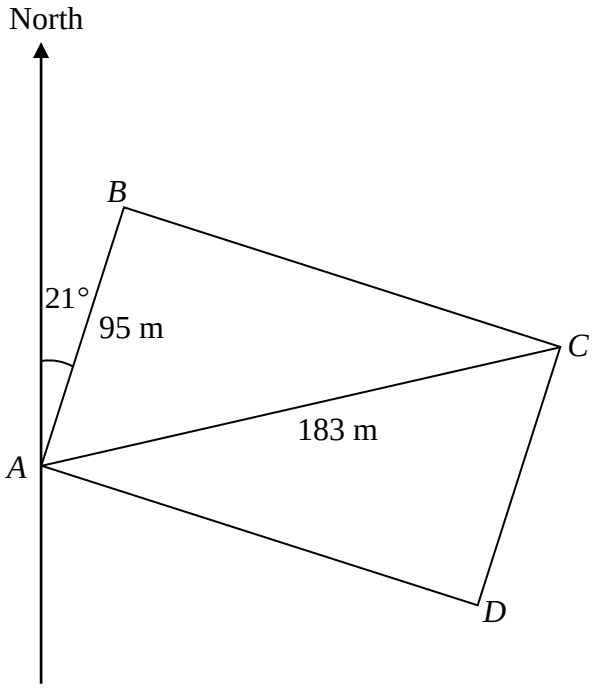
Question 25

A, B, C and D are four points on level ground. The bearing of D from B is $109°$ and the bearing of C from B is $124°$. The bearing of C from D is $160°$. Given that $AB = 8$ km and $BD = 18$ km, calculate
(a) the length of AD,
(b) the bearing of D from C,
(c) the length of BC,
(d) the shortest distance from D to BC,
(e) area of ΔBCD,
(f) the length of DX, if X is a point due west of D.



Question 26

The diagram below shows a flat rectangular field $ABCD$. $AB = 95$ m, $AC = 183$ m and the bearing of B from A is $021°$.

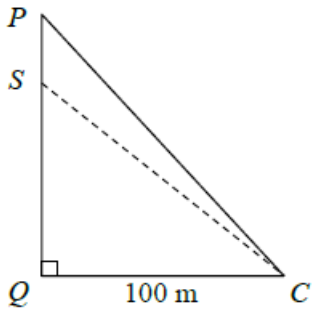


(a) Calculate
(i) the bearing of C from B,
(ii) $\angle BAC$,
(iii) the bearing of A from C.

(b) A hot air balloon was hovering above point C. The angle of elevation of the balloon from D was $38°$. Calculate the
(i) height of the balloon above C.
(ii) angle of elevation of the balloon from B.

Question 27

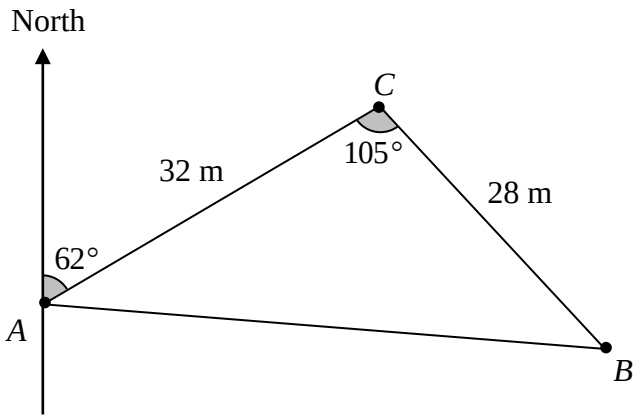
At the National Day Parade, a parachutist descended from a helicopter (not shown in the diagram). When he was at point P, he began to descend vertically at a constant speed of 7 m/s towards point Q on the parade ground. To record the descent, an automated motorized video camera was placed at point C on the parade ground, 100 m away from point Q. The angle of depression of C from P was $60°$.



(a) Calculate the time taken for the parachutist to reach the parade ground.
(b) Given that in the descent, it took 10 s for the parachutist to reach point S, calculate the angle of elevation of S from C.

Question 28

Points A, B and C are on level ground. The bearing of C from A is $062°$ and $\angle ACB = 105°$. AC = 32 m and BC = 28 m.

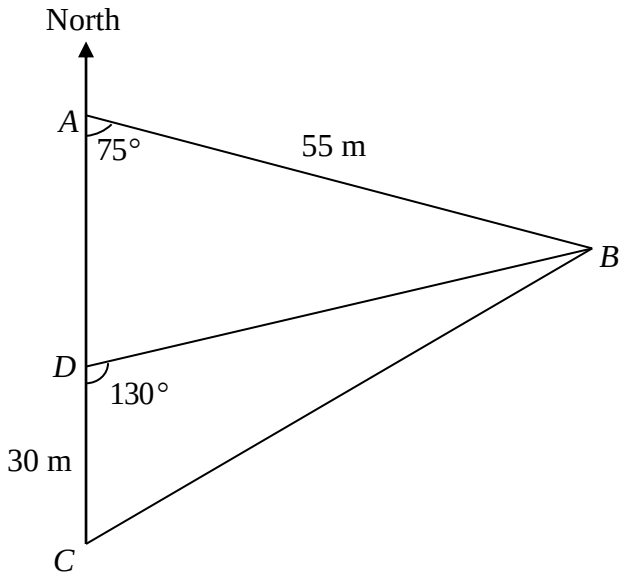


(a) Calculate
(i) the length of AB.
(ii) the area of triangle ABC.
(iii) the shortest distance from C to AB.
(iv) the bearing of C from B.

(b) A bird is vertically on top of point C. The angle of elevation of the bird from A is $20°$. Calculate the distance of the bird from A.

Question 29

A, B, C and D are points on level ground with A due north of C and D. $\angle BAD = 75°$, $\angle BDC = 130°$, AB = 55 m and CD = 30 m.



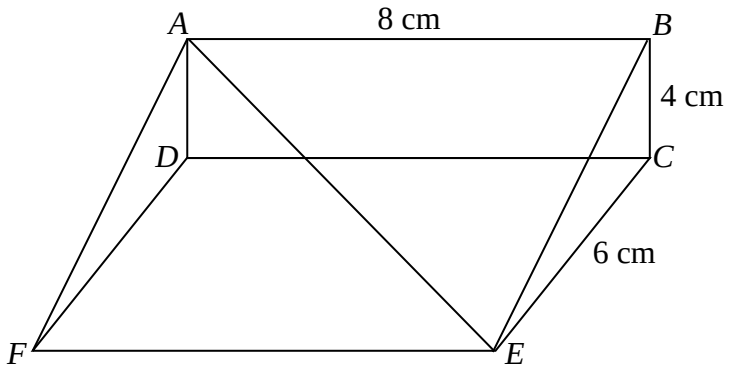
(a) Calculate
(i) the bearing of D from B.
(ii) the length of BD.

(iii) the length of CB.
(iv) the area of triangle ABC.

(b) A watch tower is erected at the point B. Given that the largest angle of elevation from AC to the top of the tower is $43.3°$, calculate the height of the tower.

Question 30

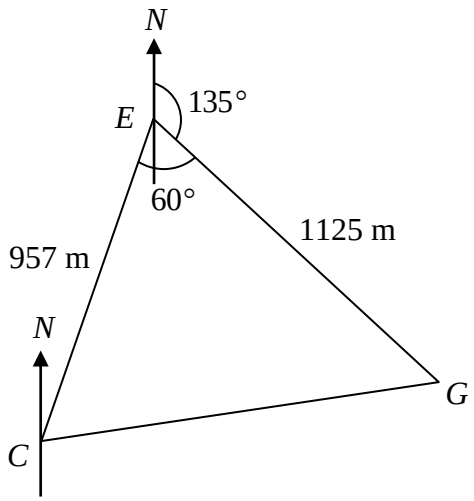
The diagram shows two rectangular boards being supported by straight wires AF, BE and
AE, such that $ABCD$ and $DCEF$ are perpendicular to each other. It is given that $AB = 8$ cm, $BC = 4$ cm and $CE = 6$ cm.



(a) Calculate the length of DE.
(b) An ant crawls in a straight line from E to A. Calculate the distance travelled by the ant.
(c) Standing at point A, the ant looks down towards EF. Find the greatest angle of depression from A to EF.

Question 31

Three points, E, C and G lie on a horizontal field. $EC = 957$ m, $EG = 1125$ m, $\angle CEG = 60°$ and the bearing of G from E is $135°$.



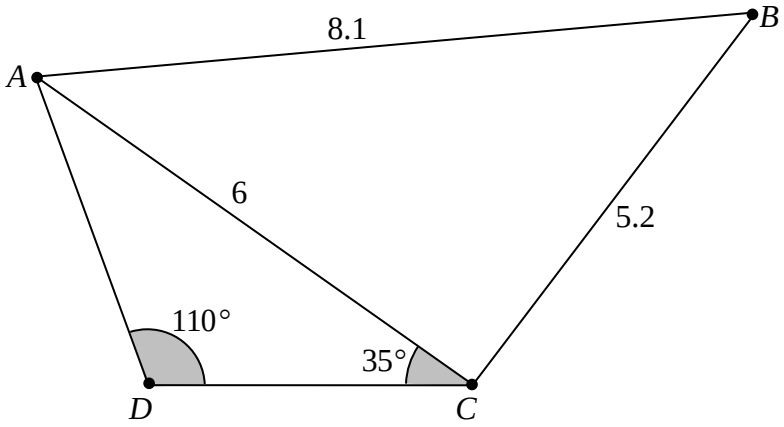
(a) Show that $CG = 1051.1$ m, correct to 1 decimal place.

(b) Find

(i) $\angle ECG$,
(ii) the bearing of E from C,
(iii) the bearing of C from G,
(iv) the shortest distance from C to EG.

(c) A building of height 60 m is erected at C. Calculate the angle of elevation of the top
of the building when viewed from E.

Question 32



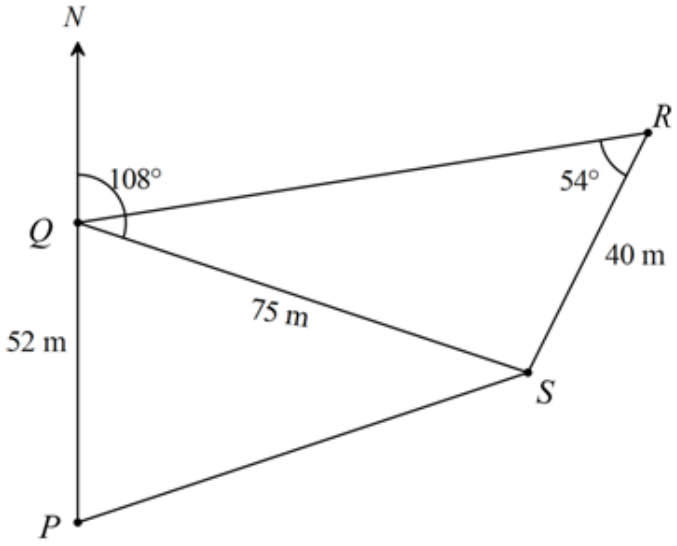
In the diagram, A, B, C and D are on level ground and D is due west of C. AC = 6 m, AB = 8.1 m, BC = 5.2 m, $\angle ADC = 110°$ and $\angle ACD = 35°$.

(a) Find
(i) the distance AD,
(ii) $\angle ABC$,
(iii) area of ABC.

(b) There is a vertical pole, with a height of 10 m at A.
Calculate
(i) the shortest distance from the pole to BC,
(ii) the largest angle of depression from the top of the pole.

Question 33

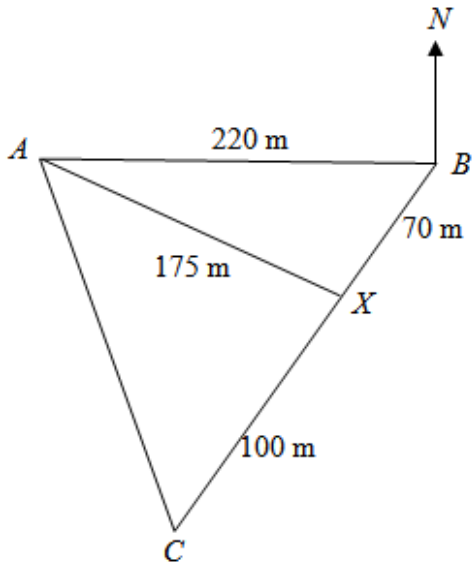
P, Q, R and S are four corners of a plot of land gazetted for development into a neighbourhood park. PQ = 52 m, QS = 75 m, RS = 40 m and $\angle QRS = 54°$. P is due south of Q and the bearing of S from Q is $108°$.



(a) Find the distance *PS*.
(b) Find the bearing of *Q* from *R*.
(c) Calculate the area of *PQRS*.
(d) A flag pole is erected at *Q* and the angle of elevation of the top of this flag pole from
P is 13° . Calculate the height of the flag pole.

Question 34

A, *B* and *C* are three points in a horizontal field. *A* is 220 m due west of *B*. *X* is a point on *BC* such that *BX* = 70 m, *CX* = 100 m and *AX* = 175 m.



(a) Calculate
(i) the size of angle *ABX*,
(ii) the bearing of *C* from *B*,
(iii) the area of triangle *ABX*, giving your answer, correct to 3 significant figures.

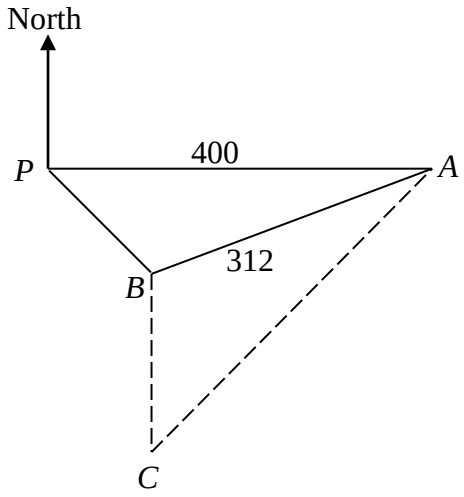
A vertical mast of 10 m stands at point X.

(b) Calculate

(i) the shortest distance from X to AB,
(ii) the greatest angle of elevation of the top of the mast, T, as seen from the path AB.

Question 35

In the diagram, P is the point at sea level at the foot of a lighthouse. Two yachts, A and B, are on the surface of the sea. $AP = 400$ m and $AB = 312$ m. A is dues east of P and the bearing of B from P is $135°$.



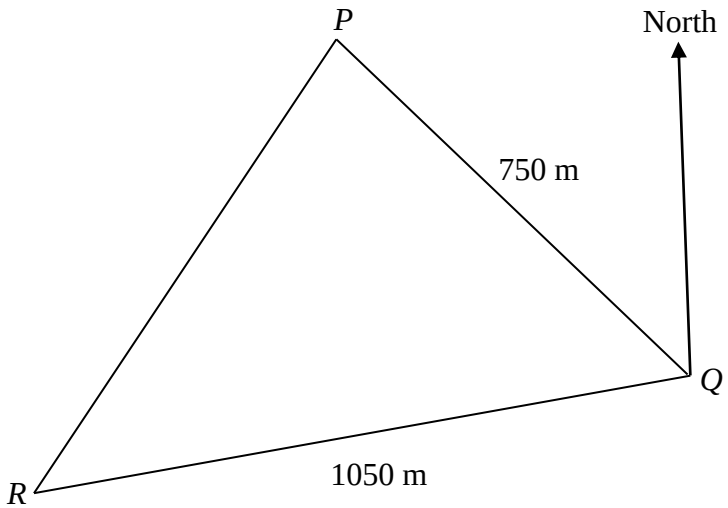
(a) Calculate
(i) obtuse $\angle PBA$,
(ii) area of ΔABP.

(b) Yacht B sails 200 m due south to point C. Calculate AC.

(c) The angle of depression of point C from the top of the lighthouse is $30°$. $PC = 325$ m. Find the height of the lighthouse.

Question 36

In the diagram, Q is the foot of a light tower. Ships P and R are anchored as shown below. Bearings of P and R from Q are $316°$ and $260°$ respectively.

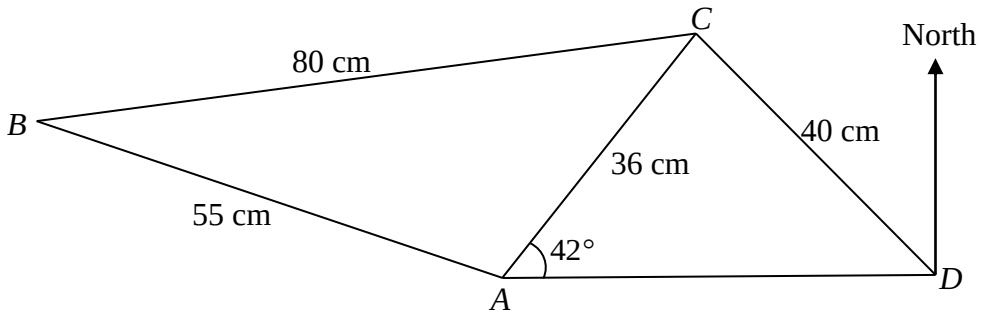


(a) Calculate
(i) PR,
(ii) angle QRP,
(iii) the bearing of R from P.

(b) S is a top end of a long flag pole mounted on the light tower at Q. QS is 250 m. Calculate
(i) angle of depression of R from S.
(ii) the greatest possible angle of elevation of S from a point on RP.

Question 37

In the diagram, A, B, C and D represent four points on a piece of horizontal land. D is due East of A. $AB = 55$ m, $AC = 36$ m, $BC = 80$ m, $CD = 40$ m and $\angle CAD = 42°$.

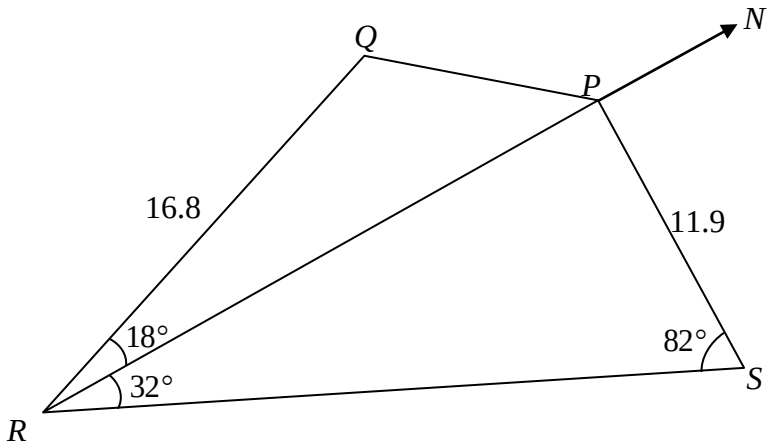


(a) Calculate
(i) $\angle BAC$.
(ii) $\angle ADC$.

(b) Find the bearing of A from C.

(c) A vertical pole AT of height 7 m is positioned at A.
(i) Calculate the shortest distance from A to BC.
(ii) Calculate the greatest angle of elevation of T from the point on BC that is closest
to A.

Question 38



The diagram shows a piece of land $PQRS$ where R is due south of P.
$QR = 16.8$ cm, $PS = 11.9$ m, $\angle PRS = 32°$, $\angle PSR = 82°$ and $\angle PRQ = 18°$.

(a) Show that PR is approximately 22.24 m.

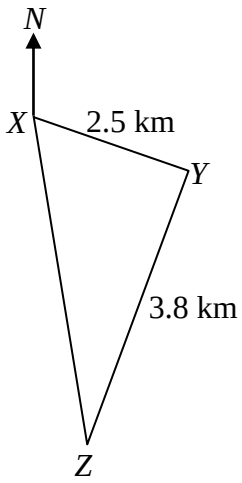
(b) Calculate
(i) the bearing of R from S,
(ii) the length of PQ,
(iii) the shortest distance from Q to PR.

(c) Find the area of the triangular land PQR.

(d) A vertical mast of height 8 m is erected at Q. Find the greatest angle of elevation of the top of the mast if you are walking along a straight path from P to R.

Question 39

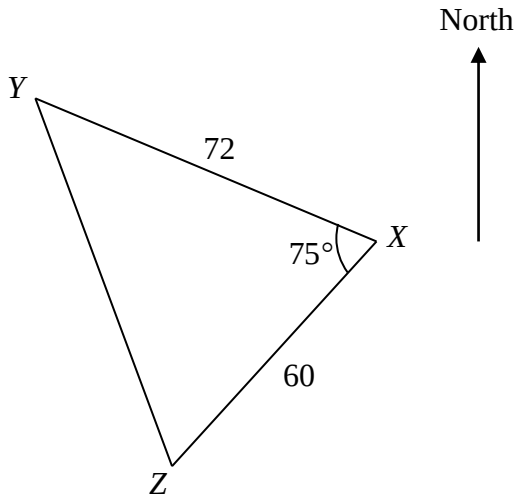
The points X, Y and Z, in the same horizontal plane, are at the base of three buildings AX, BY and CZ. The bearings of Z and X from Y are $200°$ and $290°$ respectively.



(a) Given that XY = 2.5 km and YZ = 3.8 km, calculate
(i) the length of XZ in km,
(ii) the bearing of Z from X,
(iii) the area of ΔXYZ.

(b) The heights of buildings XA and YB are 178 m and 110 m respectively. Calculate the
angle of elevation of a man at B looking up to the top of the building A.

Question 40



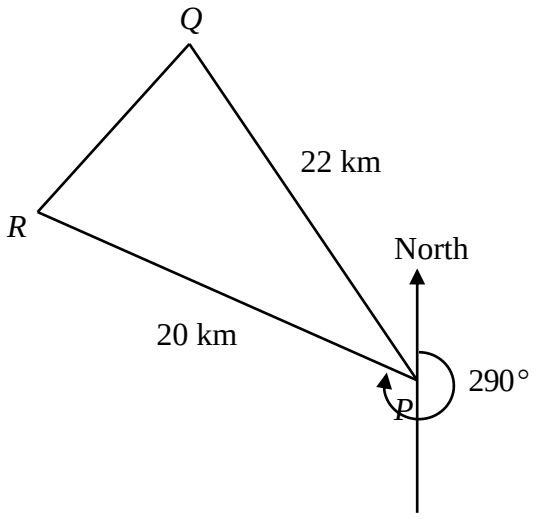
Three points, X, Y and Z, lie on a horizontal field. $\angle YXZ = 75°$ and the bearing of Z from X is $217°$. $XY = 72$ m and $XZ = 60$ m.

(a) Calculate
(i) the bearing of Y from X,
(ii) YZ,
(iii) $\angle XYZ$,
(iv) the bearing of Z from Y.

(b) A boy standing at X is flying a kite. The kite, K, is directly above Y. The string, XK, attached to the kite is at $24°$ to the horizontal. Calculate the angle of elevation of the kite when viewed from Z.

Question 41

In the diagram, P, Q and R represent three reservoirs, P is 22 km from Q on a bearing of $140°$ and R is 20 km from P on a bearing of $290°$.



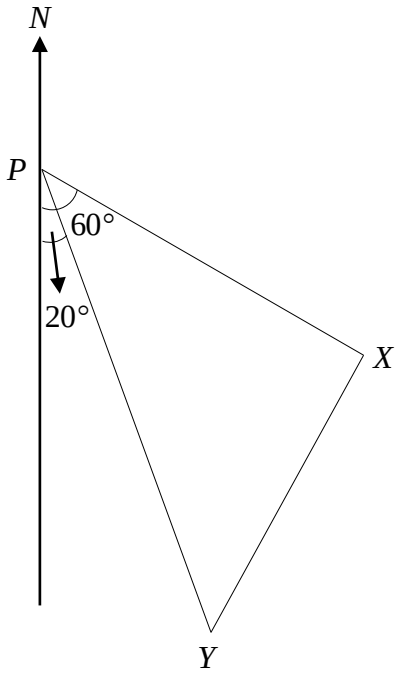
(a) Calculate the bearing of Q from P.

(b) A cyclist leaves P and cycled along PQ towards Q at a steady speed of 10 km/h. He stops at a point S which is due east of R.
(i) Mark the point S on the diagram.
(ii) Calculate the distance PS.
(iii) Calculate the time taken to reach S from P, giving your answer in minutes.

(c) A tower of height 800 m is located at P. What is the angle of elevation of the top of the tower from the cyclist at point S.

Question 42

Two ships A and B leave a port P at 0915 hour. Ship A sails on a bearing of $120°$ at 25 km/h for an hour and stops at X. Ship B sails on a bearing of $160°$ at 40 km/h for an hour and stops at Y.



(a) After an hour, find the
(i) distance between ships A and B.
(ii) bearing of ship A from ship B.

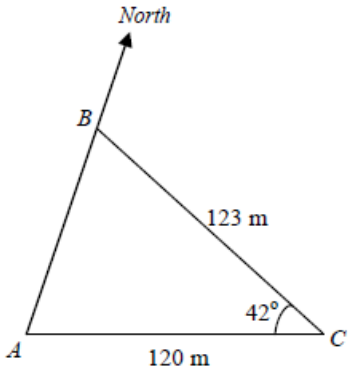
(b) Find how far is ship B due east of port P.

(c) If ship B anchored at point Y after an hour whereas ship A continues its sail, find the shortest distance between ship A and ship B.

(d) If ships A and B, after an hour, then travel towards each other with their speeds unchanged, when will they meet?

Question 43

Three markers, A, B and C, are placed on a horizontal field, where B is due north of A. $AC = 120$ m, $BC = 123$ m and $\angle ACB = 42°$.



(a) Calculate
(i) *AB*,
(ii) the bearing of *C* from *A*.

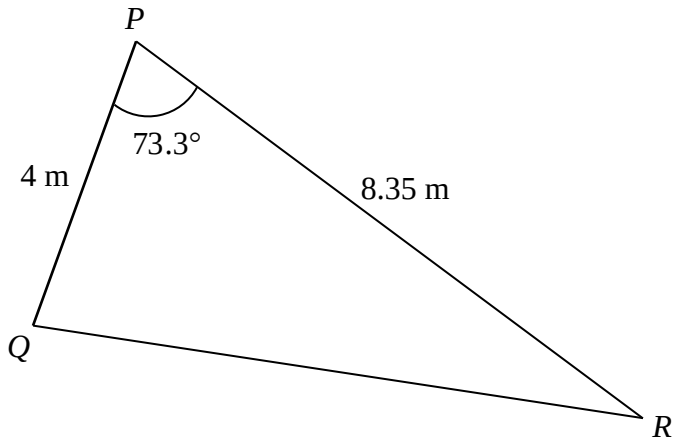
(b) A man standing at *A* is flying a drone. The drone, *D*, is 65 m vertically above *B*. Calculate the angle of depression of an object at *C* from the drone.

(c) The man starts to walk from *A* to *C*. Calculate his distance from *B* when his angle of
elevation of *D* is the greatest.

(d) The marker at *B* is relocated along the path *BC* to a point *E* such that *AE* = *AB*. Calculate the area of ΔAEC , giving your answer to 3 significant figures.

Question 44

The diagram shows a horizontal field with three points marked on it, *P*, *Q* and *R*.
A rope is used to join the three points to form a triangle *PQR*.



(a) Calculate
(i) the area of triangle *PQR*,
(ii) the total length of rope used to form triangle *PQR*.

(b) (i) A marking, *M* is made along *PQ* such that *RM* is the shortest distance from *R* to
PQ. Find the length of *RM*. Jensen, standing at *R*, is flying a kite.
(ii) The kite, *G* is vertically above *M* and *GM* = 6.8 m. Find the angle of elevation of *G* when viewed from *P*.

(iii) Jensen's mother would like to watch Jensen fly the kite. She wants to stand at a
point whereby she would take the least effort to view the kite. Suggest one point, either P or Q, that she should stand at. Justify your answer with reason(s).

Question 45

A simplified diagram of a building is shown below. It is 20 m tall. $ABCD$ represents the
rectangular floor of the building. E, F, G and H are vertically above A, B, C and D respectively. V represents the vertex of the roof in the shape of a pyramid. M is the midpoint of EG. It is given that $AB = 10$ m, $BC = 8$ m and $CG = 12$ m.

Calculate

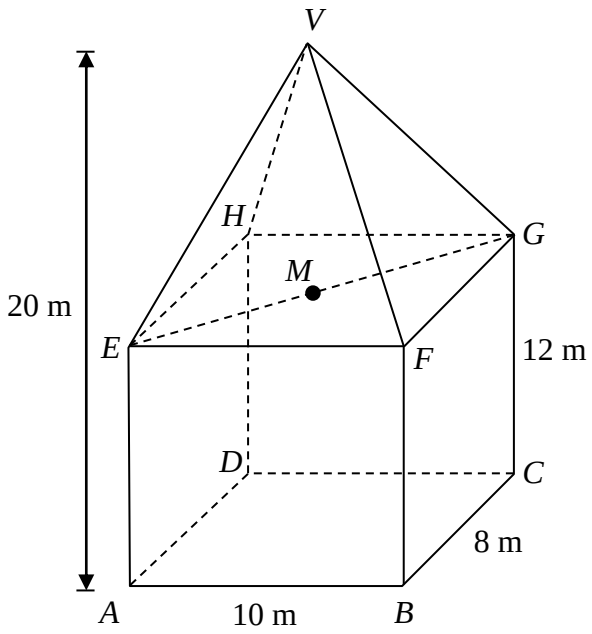
(a) AC.

(b) $\angle VEM$.

(c) AG.

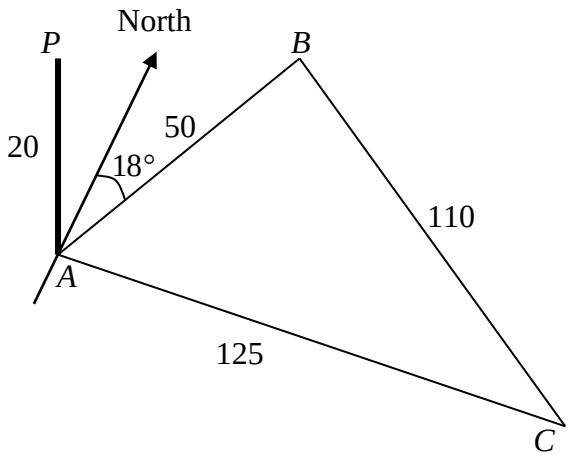
(d) $\angle AGD$.

(e) the angle of depression of B from V.



Question 46

In the diagram, ABC represents a horizontal triangular field and AP represents a vertical flagpole. B is 50 m from A on a bearing $018°$ and C is 125 m from A. The length of BC
is 110 m and the height of the flagpole is 20 m.



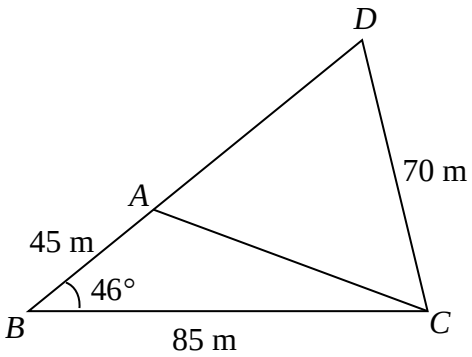
(a) Calculate
  (i) the bearing of A from B.
  (ii) $\angle ABC$.

(b) If the land costs \$48 per m^2, find the cost of the triangular field ABC.

(c) Kristofer walks along BC.
  (i) Calculate the shortest distance Kristofer is from A as he walks along BC produced.
  (ii) Calculate the greatest angle of elevation of the top of the flagpole when viewed by Kristofer as he travels along BC produced.

Question 47

The diagram shows the positions of four signal beacons A, B, C and D. Beacons D, A and
B lie in a straight line.

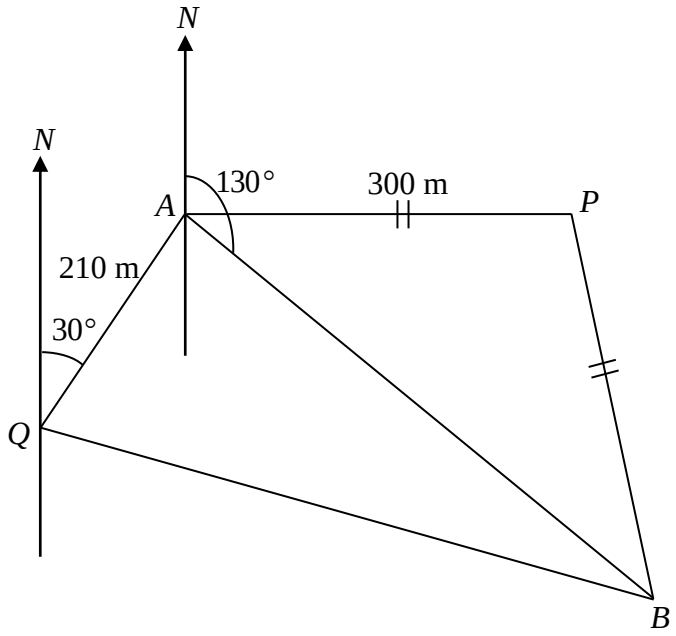


(a) Given also $AB = 45$ m, $BC = 85$ m, $CD = 70$ m and $\angle ABC = 46°$, calculate
  (i) the distance AC,
  (ii) the size of acute angle $\angle ADC$,
  (iii) the area of triangle CBD.

(b) A guard G walks from B to D in a straight line.
  (i) Find the distance of the guard G from B when he is closest to C.

(ii) A drone hovering 2.6 m directly above A, spies on the guard G through a camera. What is the angle of depression of the guard from the drone, when the guard is closest to C?

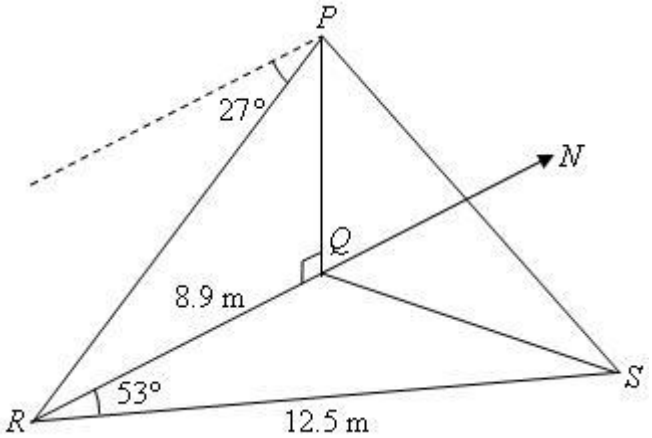
Question 48



In the diagram, not drawn to scale, P and Q represent the sites of two light-houses. A sailing boat with a mast 28 m high travels from A to B. Given that the bearing of B from A is $130°$, the bearing of A from Q is $030°$, $AP = PB = 300$ m and $AQ = 210$ m. Calculate

(a) the bearing of A from B,
(b) the bearing of B from P, given that P is due east of A,
(c) the shortest distance between the boat and P during the journey,
(d) the greatest angle of elevation of the mast from P,
(e) the distance of AB,
(f) the area of triangle QAB.

Question 49



In the diagram above, Q, R and S are three points on horizontal ground. $RQ = 8.9$ m and

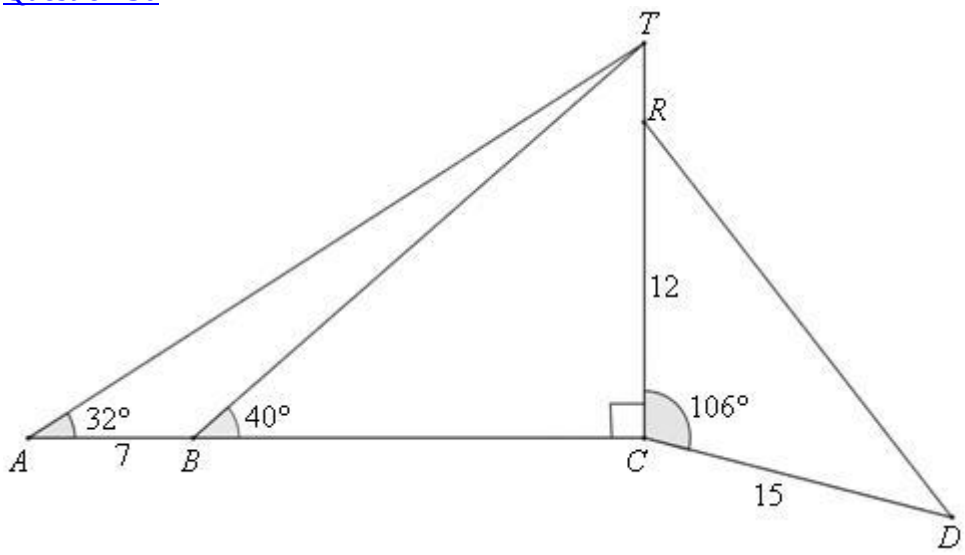
SR = 12.5 m. A vertical flag pole PQ stands at Q and the angle of depression of R from P is $27°$. Given that R is due south of Q and the bearing of S from R is $053°$, find

(a) the length of QS,
(b) the angle QSR,
(c) the bearing of S from Q,
(d) the height of flag pole PQ,
(e) angle of elevation of P from S.

A man walks from R to S.

(f) Find his distance from R at which the angle of elevation of P from the man is the largest.

Question 50



A, B and C lie in a straight line on level ground. T is the top of a vertical flagpole TC.

(a) June wants to find the height of the flagpole. She measures the angle of elevation of the flagpole from A and finds that it is $32°$. She then walks 7 m to B and finds that the angle of elevation is now $40°$. Calculate
  (i) $\angle ATB$.
  (ii) the length of TB.
  (iii) the height, TC, of the flagpole.

(b) On the opposite side of the flagpole from A and B, the ground slopes down to D such that $\angle TCD = 106°$. A rope is stretched from D, which is 15 m from C, to the point R, where CR = 12 m. Calculate the length of the rope DR.

(c) A second vertical flagpole DE is to be erected at D. Given that RE is horizontal, calculate the length DE.

[Answer Key]

Question 1
(a) 210° (b) 065°

Question 2
(a) 310° (b) 315° (c) 20°

Question 3
(a) 055.8° (b) 575 m^2

Question 4
(a) (i) 225° (ii) 310° (b) 41.7 km

Question 5
(a) 104° (b) 168°

Question 6
(a) 020° (b) 200°

Question 7
110 m

Question 8
(a) Ship *A* is nearer to the lighthouse. (Due to greater angle of elevation)
(b) 14.6 m

Question 9
(a) 71.8° (b) – 0.899

Question 10
(a) 11.3 m (b) 17 s

Question 11
(a) 12.9 m (b) 31°

Question 12
69.1 m

Question 13
(a) $\angle FGH \approx 34.04773237$ ° (b) 58.60 m (c) 84.5°

Question 14
(a) 3.30 cm (b) 36.6° (c) 8.86 cm (d) 1.79 cm

Question 15
(a) 26.9 cm (b) 35.0° (c) 15.1°

Question 16
(b) 330 m (c) 246.4° (d) 328 m

Question 17
(a) 75.5 cm (b) 18.5^{o}

Question 18
(a) 205° (b) 84.5 m (c) 3830 m^2

Question 19

Question 20
(a) 57° (b) 68.7 m (c) 106 m (d) 35.2°

Question 21
(a) (i) 230° (ii) 62.1° (b) 200 m (c) 191 m

Question 22
(a) (i) 031° (ii) 12.1 km (b) (i) 7.51 km (ii) 4.53 km

Question 23
(a) 41.7 m (b) 461.2 m^2 (c) 228° (d) 016° (e) 22.1 m

Question 24
(a) 17.4 km (b) 7.2 km (c) 060.7° (d) 20 km^2 (e) 2.3 km

Question 25
(a) 21.95 cm (b) 340° (c) 23.8 cm (d) 4.66 cm (e) 55.4 cm^2
(f) 8.33 cm

Question 26
(a) (i) 111° (ii) 58.7° (iii) 259.7° (b) (i) 74.2 m (ii) 25.4°

Question 27
(a) 24.7 s (b) 45.9°

Question 28
(a) (i) 47.7 m (ii) 433 m^2 (iii) 18.2 m (iv) 317° (b) 34.1 m

Question 29
(a) (i) 230° (ii) 69.4 m (iii) 91.6 m (iv) 2360 m^2 or 2359 m^2
(b) 50.1 m

Question 30
(a) 10 cm (b) 10.8 cm (c) 33.7°

Question 31
(b) (i) 68.0° (ii) 015° (iii) 263.0° (iv) 829 m (c) 3.6°

Question 32

Question 33
(a) 76.9 m (b) 262.4° (c) 3330 m^2 (d) 12.0 m

Question 34
(a) (i) 42.6° (ii) 227° (iii) 5210 m^2 (b) (i) 47.4 m (ii) 11.9°

Question 35
(a) (i) 115.0° (ii) 21400 m^2 (b) 424 m (c) 188 m

Question 36
(a) (i) 886 m (ii) 44.6° (iii) 215.4°
(b) (i) 13.4° (ii) 18.7°

Question 37

Question 38
(b) (i) 212° (ii) 8.13 m (iii) 5.19 m (c) 57.7 m^2 (d) 57.0°

Question 39
(a) (i) 4.55 km (ii) 166.7° (iii) 4.75 km^2 (b) 1.6°

Question 40
(a) (i) 292° (ii) 80.9 m (iii) 45.7° (iv) 157.7° (b) 21.6°

Question 41
(a) 320° (b) (ii) 8.93 km (iii) 53.6 min (c) 5.1°

Question 42
(a) (i) 26.3 km (ii) 017.7° (b) 13.68 km or 13.7 (c) 25.7 km
(d) 1039

Question 43
(a) (i) 87.1 m (ii) 070.8° (b) 27.9° (c) 82.3 m (d) 2220 m^2

Question 44
(a) (i) 16 cm^2 (ii) 20.5 m
(b) (i) 8 m (ii) 70.6°
(iii) Point *P*. Distance of *PM* is longer as compared to *MQ*, hence angle of elevation
is smaller. This mean lesser effort to view the kite.

Question 45
(a) 12.8 m (b) 51.3° (c) 17.5 m or 17.6 m (d) 27.1° (e) 72.2°

Question 46
(a) (i) 198° (ii) 95.3° (b) $131000 (c) (i) 49.8 cm (ii) 21.9°

Question 47
(a) (i) 62.7 m (ii) 60.9° (iii) 2850 m^2

(b) (i) 59.0 m (ii) 10.5°

Question 48

(a) 310° (b) 170° (c) 193 m (d) 8.3° (e) 460 m
(f) 47500 m^2

Question 49

(a) 10.1 m (b) 44.9° (c) 097.9° (d) 4.53 m (e) 24.2°
(f) 5.36 m

Question 50

(a) (i) 8° (ii) 26.7 m (iii) 17.1 m (b) 21.6 m (c) 16.1 m

[Solution]

Question 2

(c) $180° - (360° - 135° - 65°) = 20°$

$\therefore \text{Bearing} = 020°$

Question 6

(a) Bearing of B from C

$= \frac{40}{2}$

$= 020°$

(b) Bearing of C from B

$= 360 - 20 - (180 - 40)$

$= 200°$

Question 8

(b) Let the distance of A and B from the lighthouse be x and y m respectively.

$$\tan 45° = \frac{52}{x}$$

$$x = \frac{52}{\tan 45°}$$

$$= 52 \text{ m}$$

$$\tan 38° = \frac{52}{y}$$

$$y = \frac{52}{\tan 38°}$$

$$= 66.5569\ldots \text{ m}$$

$$= 66.6 \text{ m} \quad (3 \text{ Sig. fig.})$$

$$\text{Distance between } A \text{ and } B = 66.5569 - 52$$

$$= 14.5569$$

$$= 14.6 \text{ m} \quad (3 \text{ Sig. fig.})$$

Question 9

(a)

$$\cos 64° = \frac{AB}{2.5}$$

$$AB = 1.095928 \text{ m}$$

Let angle of depression be y.

$$\cos y = \frac{1.095928}{3.5}$$
$$= 2.246985$$

(b)

$$BC = \sqrt{2.5^2 - 1.095928^2}$$
$$= 2.246985$$

$$\cos\angle ACD = -\cos ACB$$
$$= \frac{BC}{AC}$$
$$= -0.89879$$
$$= -0.899 \text{ (3sf)}$$

Question 10

(a)

$$\cos 28° = \frac{10}{d}$$
$$d = 11.3 \text{ m}$$

(b) $\frac{11.3}{0.65} = 17 \text{ s}$

Question 11

(a)

$$\tan 25° = \frac{6}{AB}$$
$$AB = \frac{6}{\tan 25°}$$
$$AB = 12.86$$
$$\approx 12.9 \text{ m}$$

(b)

$$\cos\angle BAD = \frac{12.86}{23}$$
$$\angle BAD = 56.0°$$

$$\angle CAD = 56.0° - 25°$$
$$= 31°$$

Question 12

Let x be the distance of the ship from the lighthouse.

$$\tan 38° = \frac{54}{x}$$
$$x = 69.1\,\text{m}$$

Alternative Solution

$$\tan 52° = \frac{x}{54}$$
$$x = 69.1\,\text{m}$$

Question 13

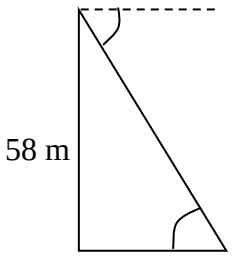
(a)

$$\cos \angle FGH = \frac{14^2 + 10^2 - 8^2}{2(14)(10)}$$
$$= \frac{232}{280}$$
$$\angle FGH \approx 34.04773237°$$

(b)

$$\sin 34.04773237° = \frac{\text{shortest dist}}{10}$$
$$\text{Shortest distance} \approx 5.60\,\text{m}$$

(c)



5.59883 m

$$\tan \vartheta = \frac{58}{5.59883}$$

Greatest angle of depression is 84.5^o

Question 14

(a)

$$AE^2 = 3^2 + 2^2 - 2(3)(2)\cos 80°$$
$$= 10.916$$
$$AE = 3.30397...$$
$$= 3.30\,\text{cm} \quad (3\,\text{sig. fig.})$$

(b)

$$\frac{\sin \angle DAE}{2} = \frac{\sin 80°}{3.303...}$$
$$\sin \angle DAE = 0.5961...$$
$$\angle DAE = 36.593...$$
$$= 36.6°$$

(c)

$$\text{area of } \Delta ADE = \frac{1}{2}(3)(2)\sin 80°$$
$$= 2.95442...$$

$$\text{volume of prism} = 3 \times 2.95442...$$
$$= 8.86 \text{ cm} \quad (3 \text{ sig. fig.})$$

(d)

$$\text{area of } \Delta ADE = \frac{1}{2}(AE)(d)$$
$$2.95442 = \frac{1}{2}(3.30397...)(d)$$
$$d = \frac{2.95442... \times 2}{3.30397...}$$
$$= 1.78840...$$
$$= 1.79 \text{ cm}$$

Question 15

(a) By Pythagoras theorem,

$$BE = \sqrt{10^2 + 7^2}$$
$$= \sqrt{149}$$

$$AE = \sqrt{149 + 24^2}$$
$$= 26.9 \text{ cm}$$

(b)

$$\tan \angle DAF = \frac{7}{10}$$
$$\angle DAF = 35.0°$$

(c)

$$\sin \angle CAE = \frac{7}{\sqrt{725}}$$
$$\angle CAE = 15.1°$$

Question 16

(a)

$\angle ABD = \angle EAB$ (alt $\angle$s)

$= 121 - 90$

$= 31°$

$\angle ABC = 342 - 270 - 31$

$= 41°$

(b)

$AC^2 = 500^2 + 410^2 - 2(500)(410)\cos 41^0$

$AC^2 = 108669$

$AC = 330\,\text{m}$

(c)

$$\frac{329.65}{\sin 41°} = \frac{410}{\sin \angle CAB}$$

$\angle CAB = 54.6°$

$\angle NAC = 121 - 54.6$

$= 66.4°$

Bearings $= 360 - (180 - 66.4)$

$= 246.4°$

Or

$$\frac{\sin 41°}{329.65} = \frac{\sin \angle ACB}{500}$$

$\angle NBC = 360° - 342°$

$= 18°$ ($\angle$s at a pt)

$\angle NCB = 180° - 18°$

$= 162°$ (int $\angle$)

Bearing $= 84.317° + 162°$

$= 246.3°$

(d)

$$\text{Area of Triangle } ABC = \frac{1}{2} \times 500 \times 410 \times \sin 41$$

$$= 67246.05$$

$$\frac{1}{2} \times 410 \times h = 67246.05$$

$h = 328\,\text{m}$

Or

$$\sin 41 = \frac{x}{500}$$
$$x = 500 \sin 41$$
$$x = 328 \text{ m}$$

Question 17

(a)

$$BD^2 = 42^2 + 58^2$$
$$= 5128$$
$$BD = \sqrt{5128}$$

$$BH^2 = BD^2 + HD^2$$
$$= 5128 + 24^2$$
$$= 5704$$
$$BH = 75.5 \text{ cm}$$

(b)

$$\tan \angle BHF = \frac{24}{\sqrt{5128}}$$
$$\angle BHF = 18.5°$$

Or

$$\sin \angle BHF = \frac{24}{\sqrt{5704}}$$

Or

$$\cos \angle BHF = \frac{\sqrt{5128}}{\sqrt{5704}}$$

Question 18

(a) $\angle OZY = 65°$ (alt. $\angle$s)

$$\angle ZOY = 180° - 65° - 65°$$
$$= 50°$$

$$\text{Bearing of } X \text{ from } O = 065° + 050° + 090°$$
$$= 205°$$

(b)

$$YZ^2 = 100^2 + 100^2 - 2(100)(100)\cos 50°$$
$$YZ = 84.5237 \text{ m}$$
$$\approx 84.5 \text{ m}$$

(c)

$$\text{Area of } \Delta OYZ = \frac{1}{2}(100)(100)\sin 50°$$
$$= 3830 \text{ m}^2$$

Question 20

(a)

$$\angle \text{ of elevation of } H \text{ from } A = 90° - 33°$$
$$= 57°$$

(b) By Pythagoras' theorem,

$$AC^2 + 150^2 = 165^2$$
$$AC = \sqrt{165^2 - 150^2}$$
$$= \sqrt{4725}$$
$$= 68.73$$
$$= 68.7 \text{ m} \quad (3 \text{ sig. fig.})$$

(c)

$$\tan 33° = \frac{68.73}{HC}$$
$$HC = \frac{68.73}{\tan 33°}$$
$$= 105.83 \text{ m}$$
$$= 106 \text{ m} \quad (3 \text{ sig. fig.})$$

(d)

$$\angle HBC = \tan^{-1}\frac{105.83}{150}$$
$$= 35.2°$$
$$= \text{angle of depression of } B \text{ from } H \quad (\text{alt.} \angle \text{s})$$

Question 21

(a) (ii)

$$\sin \angle OQP = \frac{\sin 50°}{78} \times 90$$
$$\angle OQP = 62.116°$$
$$= 62.1° \quad (\text{to 1 decimal place})$$

(b)

$$RP^2 = 90^2 + 122^2 - 2(90)(122)\cos 140°$$
$$RP = \sqrt{39806.33597}$$
$$= 199.52$$
$$\approx 200\,\text{m}$$

(c)
$$OT = 90\sin 50°$$
$$= 68.944\,\text{m}$$

$$RT = 122 + 68.944$$
$$= 190.944$$
$$\approx 191\,\text{m}$$

Question 22

(a) (ii)
$$PR = \sqrt{8^2 + 5^2 - 2(8)(5)\cos 136°}$$
$$= 12.106$$
$$= 12.1\,\text{km}$$

(b) (i) Using sine rule,
$$\frac{5}{\sin 40°} = \frac{RT}{\sin 75°}$$
$$RT = \frac{5\sin 75}{\sin 40}$$
$$= 7.5136$$
$$= 7.51\,\text{km}$$

(ii) Let QS be the shortest distance.

$$\angle QRT = 180 - 40 - 75$$
$$= 65$$

$$\sin 65 = \frac{QS}{5}$$
$$QS = 5\sin 65$$
$$= 4.5315$$
$$= 4.53\,\text{km}$$

Question 23

(a)
$$\angle BAC = 122° - 48°$$
$$= 74°$$

Using sine rule,

$$\frac{BC}{\sin 74°} = \frac{23}{\sin 32°}$$

$$BC = \frac{23\sin 74°}{\sin 32°}$$

$$= 41.72$$

$$\approx 41.7 \text{ m}$$

(b)

$$\angle BCA = 180° - 74° - 32°$$

$$= 74°$$

$$\text{Area of } \Delta ABC = \frac{1}{2}(23)(41.72)\sin 74°$$

$$= 461.2 \text{ m}^2$$

(c) The bearing of A from B

$$= 180° + 48°$$

$$= 228°$$

(d) The bearing B from C

$$= 48° - 32°$$

$$= 016°$$

(e)

$$x = 23\sin 74°$$

$$= 22.1 \text{ m}$$

Question 24

(a)

$$\angle CDB = 180° - 30°$$

$$= 150°$$

$$BC^2 = 8^2 + 10^2 - 2(8)(10)\cos 150°$$

$$BC = 17.39 \text{ km}$$

$$\approx 17.4 \text{ km}$$

(b)

$$\frac{10}{\sin 44°} = \frac{AB}{\sin 30°}$$

$$AB = \frac{10\sin 30°}{\sin 44°}$$

$$= 7.19778$$

$$\approx 7.2 \text{ km}$$

(c) Bearing of A from C

$= \angle CAB$

$= 44°$

$$\frac{10}{\sin \angle DCB} = \frac{17.39}{\sin 150°}$$

$$\angle DCB = 16.7°$$

Bearing of B from C
$= 44 + 16.7$

$= 60.7°$

$\approx 060.7°$

(d)

$$\text{Area of } \Delta BCD = \frac{1}{2} \times 10 \times 8 \sin 150°$$

$$= 20 \text{ km}^2$$

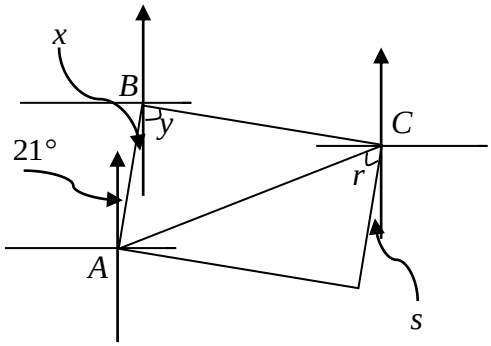
(e)

$$\frac{1}{2} \times 17.394 \times h = 20$$

$$h = 2.3 \text{ km}$$

Question 26

(a) (i)



$\angle x = 21°$ (alt. $\angle$s)

$\angle y = 90° - 21°$

$= 69°$

Bearing of C from B
$= 180° - 69°$

$= 111°$

(ii)

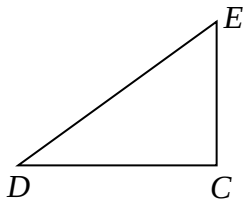
$$\angle BAC = \cos^{-1}\frac{95}{183}$$
$$= 58.7263777\,°$$
$$= 58.7° \quad (1\,\text{decimal place})$$

(iii) $\angle s = 21°$

$$\angle r = \angle BAC$$
$$= 58.7263777°$$

Bearing of A from C
$$= 180° + 21° + 58.7263777°$$
$$= 259.7° \quad (1\,\text{decimal place})$$

(b) (i)

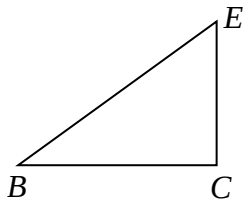


Let position of balloon be E.

$$EC = CD\tan 38°$$
$$= 95\tan 38°$$
$$= 74.222213452$$

Require height = 74.2 m

(ii)



$$BC = \sqrt{183^2 - 95^2}$$
$$= 156.4097184\,\text{m}$$

$$\angle EBC = \tan^{-1}\frac{EC}{BC}$$
$$= \tan^{-1}\frac{74.222213452}{156.4097184}$$
$$= 25.38605067°$$

Required $\angle = 25.4°$ (1 decimal place)

Question 27

(a)

$$\frac{QP}{100} = \tan 60°$$
$$QP = 173.21$$

$$\text{time taken} = \frac{173.21}{7}$$
$$\approx 24.7 \text{ s}$$

(b)

$$QS = 173.21 - 10(7)$$
$$= 103.21$$

Angle of Elevation of S from C

$$= \tan^{-1} \frac{103.21}{100}$$
$$\approx 45.9°$$

Question 28

(a) (i)

$$AB^2 = 32^2 + 28^2 - 2(32)(28)\cos 105°$$
$$AB = 47.66$$
$$\approx 47.7 \text{ m}$$

(ii)

$$\frac{1}{2}(32)(28)\sin 105° = 432.7$$
$$\approx 433 \text{ m}^2$$

(iii)

$$\frac{1}{2} \times 47.66 \times h = 432.7$$
$$h = 18.16$$
$$\approx 18.2 \text{ m}$$

(iv) $105° - 62° = 43°$

$360° - 43° = 317°$

(b)

$$\cos 20° = \frac{32}{d}$$
$$d = 34.1\,\text{m}$$

Question 29

(a) (i) The bearing of D from B
$= 360° - 130°$
$= 230°$

Or

The bearing of D from B
$= 180° + 50°$
$= 230°$

(ii)
$$\frac{BD}{\sin 75°} = \frac{55}{\sin 50°}$$
$$BD = \frac{55}{\sin 50} \times \sin 75°$$
$$= 69.3509$$
$$= 69.4\,\text{m}$$

(iii)
$$CB^2 = 30^2 + (69.3509)^2 - 2(30)(69.359)\cos 130°$$
$$= 3884.232595$$
$$CB = 91.5654$$
$$= 91.6\,\text{m}$$

(iv)
$$\text{Area} = \frac{1}{2}(55)(BD)\sin 55° + \frac{1}{2}(30)(BD)\sin 130°$$
$$= 2359.13586$$
$$\approx 2360\,\text{m}^2 \text{ or } 2359\,\text{m}^2$$

(b) Let d be the shortest distance from B to AC.

$$d = 55\sin 75$$
$$= 53.126\,\text{m}$$

$$\tan 43.3 = \frac{\text{height of tower}}{d}$$
$$\text{height of tower} = 50.1\,\text{m}$$

Question 31

(a)

$$(CG)^2 = 957^2 + 1125^2 - 2(957)(1125)\cos 60$$
$$CG = 1051.118m$$
$$\approx 1051.1 \quad (1\,\text{decimal place}) \quad \text{(Shown)}$$

(b) (i)
$$\frac{1125}{\sin \angle ECG} = \frac{1051.118}{\sin 60}$$
$$\angle ECG = 67.956°$$
$$\approx 68.0° \quad (1\,\text{decimal place})$$

(ii) $360° - 135° - 60° = 165°$

Bearing of E from C
$= 180° - 165°$
$= 015°$

(iii)
$$\angle EGC = 180° - 60° - 67.956°$$
$$= 52.04°$$

Bearing of C from G
$= 360° - 52.04° - (180° - 135°)$
$= 262.95°$
$\approx 263.0°$

(iv)
$$\sin 60° = \frac{x}{957}$$
$$x = 828.786 \text{ m}$$
$$= 829 \text{ m} \quad (3\,\text{sig. fig.})$$

(c)
$$\tan\theta = \frac{60}{957}$$
$$\theta = 3.5875°$$
$$= 3.6° \quad (1\,\text{decimal place})$$

Question 33

(a)
$$PS^2 = 52^2 + 75^2 - 2(52)(75)\cos 72°$$
$$PS = 76.932$$
$$= 76.9 \text{ m} \quad (3\,\text{sig. fig.})$$

(b)

$$\frac{\sin \angle RQS}{40} = \frac{\sin 54°}{75}$$
$$\angle RQS = 25.561°$$

$$\text{Bearing of } Q \text{ from } R = 180° + 108° - 25.561°$$
$$= 262.4°$$

(c)

$$\text{Area of land} = \frac{1}{2}(52)(75)\sin 72° + \frac{1}{2}(40)(75)\sin(180° - 54° - 25.561°)$$
$$= 3329.7$$
$$= 3330\,\text{m}^2 \quad (3\,\text{sig. fig.})$$

(d)

$$\tan 13° = \frac{h}{52}$$
$$\text{height of rock wall} = 52 \times \tan 13°$$
$$= 12.0\,\text{m} \quad (3\,\text{sig. fig.})$$

Question 34

(a) (i)

$$175^2 = 220^2 + 70^2 - 2(220)(70)\cos A\hat{B}X$$
$$\cos A\hat{B}X = 0.736201$$

$$A\hat{B}X = \cos^{-1} 0.736201$$
$$= 42.5911°$$
$$= 42.6°$$

(ii) Bearing of C from B
$= 270° - 42.5911°$
$= 227°$

(iii)

$$\text{Area of } \Delta ABX = \frac{1}{2}(220)(70)\sin 42.5911^{\circ}$$
$$= 5211.06\,\text{m}^2$$
$$= 5210\,\text{m}^2$$

(b) (i)

$$\frac{1}{2}(220)(\text{shortest distance}) = 5211.06$$
$$\text{shortest distance} = 47.373$$
$$= 47.4\,\text{m}$$

(ii)

$$\tan\theta = \frac{10}{47.373}$$
$$\theta = 11.9°$$

Question 35

(a) (i) $\angle APB = 45°$

$$\frac{400}{\sin B} = \frac{312}{\sin 45°}$$
$$\sin B = \frac{\sin 45°}{312} \times 400$$
$$= 0.906547$$
$$B = 65.032°$$

$$\text{obtuse } \angle PBA = 180° - 65.032°$$
$$= 114.968°$$
$$\approx 115.0°$$

(ii)

$$\text{Area of } \Delta ABP = \frac{1}{2}(400)(312)\sin 20.032°$$
$$\approx 21400 \text{ m}^2$$

(b)

$$\angle ABC = 360° - 135° - 114.968°$$
$$= 110.032°$$

$$AC^2 = 200^2 + 312^2 - 2(200)(312)\cos 110.032°$$
$$AC = 424.37436 \text{ m}$$
$$\approx 424 \text{ m}$$

(c)

$$\text{Height of lighthouse} = 325\tan 30°$$
$$\approx 188 \text{ m}$$

Question 36

(a) (i)

$$\angle PQR = 100° - 44°$$
$$= 56°$$

Using cosine rule,

$$PR^2 = 750^2 + 1050^2 - 2(750)(1050)\cos 56°$$
$$= 784217.17$$
$$PR = 885.6\text{ m}$$
$$\approx 886\text{ m} \quad (3\text{ sig. fig.})$$

(ii) Using sine rule,

$$\frac{\sin \angle QRP}{750} = \frac{\sin 56°}{885.6°}$$
$$\sin \angle QRP = 0.702$$
$$\angle QRP = 44.6° \quad (1\text{ dec. pl.})$$

(iii)

$$\text{Bearing of } R \text{ from } P = 136° + 79.4°$$
$$= 215.4° \quad (1\text{ dec. pl.})$$

(b) (i) Angle of depression, θ, such that

$$\tan\theta = \frac{250}{1250}$$
$$\theta = 13.39$$
$$\approx 13.4° \quad (1\text{ dec. pl.})$$

(ii) For greatest elevation, QT is shortest distance

$$\sin 44.6° = \frac{QT}{1050}$$
$$QT = 737.3\text{ m}$$

Angle of elevation, x, such that

$$\tan x = \frac{250}{737.3}$$
$$x = 18.73°$$
$$= 18.7° \quad (1\text{ dec. pl.})$$

Question 38

(a)

$$PR = \frac{11.9 \times \sin 82°}{\sin 32°}$$
$$= 22.2377$$
$$= 22.24\text{ m} \quad (\text{shown})$$

(b) (i)

$$\text{Bearing} = 180° + 32°$$
$$= 212°$$

(ii)

$$PQ^2 = 16.8^2 + 22.24^2 - 2(16.8)(22.24)\cos 18°$$
$$= 66.1673$$

$$PQ = 8.1343$$
$$= 8.13\,\text{m}$$

(iii)

$$\text{Shortest distance} = 16.8 \times \sin 18°$$
$$= 5.1914$$
$$= 5.19\,\text{m}$$

(c)

$$\text{Area } PQR = \frac{1}{2} \times 16.8 \times 22.24 \times \sin 18°$$
$$= 57.7293$$
$$= 57.7\,\text{m}^2$$

(d)

$$\text{Angle of elevation} = \tan^{-1} \frac{8}{5.1914}$$
$$= 57.019°$$
$$= 57.0°$$

Question 39

(a) (i) Using Pythagoras theorem,

$$XZ^2 = 3.8^2 + 2.5^2$$
$$XZ = 4.55\,\text{km} \quad (3\,\text{sig. fig.})$$

(ii)

$$\tan \angle YXZ = \frac{3.8}{2.5}$$
$$\angle YXZ = 56.659°$$

$$\text{Bearing of } Z \text{ from } X = 110° + 0.56659°$$
$$= 166.7° \quad (1\,\text{dec. pl.})$$

(iii)

$$\text{Area of } \Delta XYZ = \frac{1}{2}(3.8)(2.5)$$
$$= 4.75\,\text{km}^2$$

(b) Let the angle of elevation be θ.

$$\tan\theta = \frac{0.068}{2.5}$$
$$\theta = 1.6° \quad (1\,\text{dec.pl.})$$

Question 40

(a) (i) $217° + 75° = 292°$

(ii)
$$YZ^2 = 60^2 + 72^2 - 2\times 60\times 72\cos 75°$$
$$YZ = \sqrt{6547.80345}$$
$$YZ = 80.9\,\text{m}$$

(iii)
$$\cos\angle XYZ = \frac{80.918^2 + 72^2 - 60^2}{2\times 80.918\times 72}$$
$$\angle XYZ = \cos^{-1}(0.69787)$$
$$\angle XYZ = 45.7°$$

(iv)
$$\text{Bearing of } Z \text{ from } Y = 180° - 68° + 45.743°$$
$$= 157.7°$$

(b)
$$\angle KXY = \frac{KY}{72}$$
$$\tan 24° = \frac{KY}{72}$$
$$KY = 72\tan 24°$$
$$KY = 32.1\,\text{m}$$

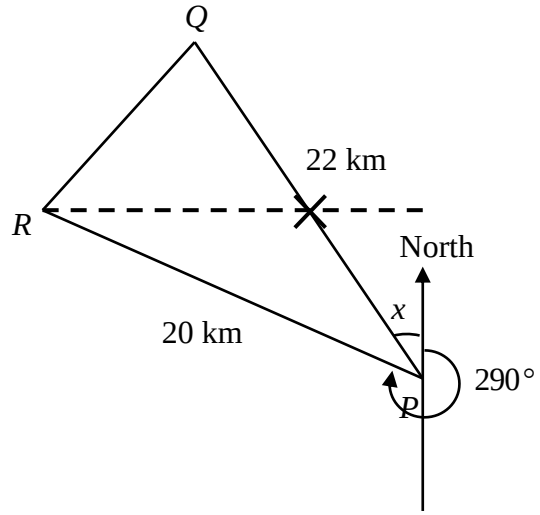
$$\tan\angle KZY = \frac{32.056}{80.9137}$$
$$\angle KZY = \tan^{-1}\left(\frac{32.056}{80.9137}\right)$$
$$\angle KZY = 21.6°$$

Question 41

(a)
$$x = 180° - 140°$$
$$= 40° \quad (\text{int.}\angle)$$

$$\text{Bearing of } Q \text{ from } P = 360° - 40°$$
$$= 320°$$

(b) (i)



(ii) $360 - 290 = 70$

$$\angle SRP = 180 - 90 - 70$$
$$= 20$$

$$\angle RSP = 90 + 40$$
$$= 130$$

$$\frac{PS}{\sin 20} = \frac{20}{\sin 130}$$
$$PS = 8.9295$$
$$= 8.93$$

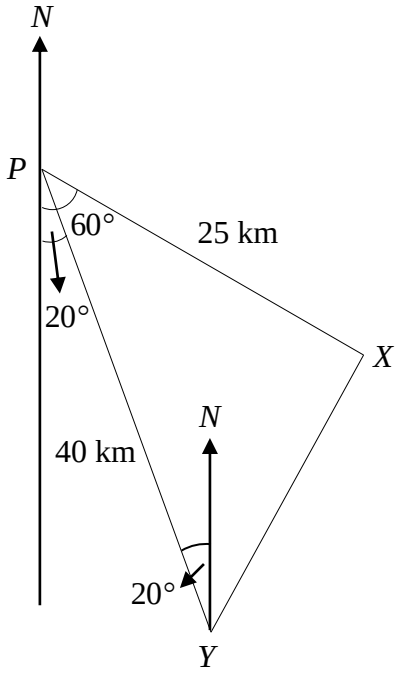
(iii)

$$\text{time} = \frac{8.9295}{10} \times 60$$
$$= 53.577$$
$$= 53.6 \text{ min}$$

(c)

$$\theta = \tan^{-1} \frac{800}{8929.5}$$
$$= 5.119$$
$$= 5.1°$$

Question 42



(a) (i)

$$XY^2 = 25^2 + 40^2 - 2(25)(40)\cos 40°$$
$$XY = 26.3\,\text{km}$$

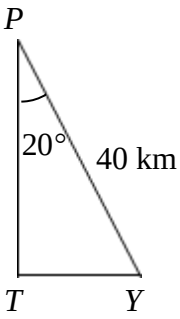
Distance between ship A and ship B = 26.3 km

(ii)

$$\frac{\sin \angle PYX}{25} = \frac{\sin 40°}{26.3}$$
$$\angle PYX = 37.7°$$

Bearing of ship A from ship B is $017.7°$.

(b)



$$\sin 20° = \frac{YT}{40}$$
$$YT = 13.7\,\text{km} \quad (3\,\text{sig. fig.})$$

Ship B is 13.68 km east of port P.

(c) Let w be the shortest distance between the ships.

$$\sin 40° = \frac{w}{40}$$
$$w = 25.7 \text{ km}$$

(d) Let the two ships meet after t hours.

$$25t + 40t = 26.3$$
$$t = 0.4046 \text{ h}$$
$$= 24 \text{ minutes}$$

They meet at 1039.

Question 43

(a) (i)

$$AB^2 = 123^2 + 120^2 - 2(123)(120)\cos 42°$$
$$AB = 87.128...$$
$$= 87.1 \text{ m} \quad (3 \text{ sig. fig.})$$

(ii)

$$\frac{\sin \angle BAC}{123} = \frac{\sin 42°}{87.128}$$
$$\sin \angle BAC = \sin^{-1}\left(\frac{123 \sin 42°}{87.128}\right)$$
$$= 70.843° \quad (3 \text{ decimal places})$$

Bearing of C from A = $070.8°$ (1 decimal place)

(b) Let the angle of depression be θ

$$\tan\theta = \frac{65}{123}$$
$$\theta = \tan^{-1}\frac{65}{123}$$
$$= 27.854...°$$
$$= 27.9° \quad (1 \text{ decimal place})$$

(c) Let the shortest distance of B from AC be d.

$$\sin 42° = \frac{d}{123}$$
$$d = 123\sin 42°$$
$$= 82.303$$
$$= 82.3\,\text{m} \quad (3\,\text{sig. fig.})$$

(d)

$$\angle ABC = 180° - 42° - 70.843° \quad (\angle \text{ sum of } \Delta)$$
$$= 67.157° \quad (3\,\text{decimal places})$$

$$\angle EAC = 67.157° - 42° \quad (\text{ext.}\angle = \text{sum of int. opp.}\angle)$$
$$= 25.157° \quad (3\,\text{decimal places})$$

$$\text{Area of } \Delta AEC = \frac{1}{2}(120)(87.128)\sin 25.157°$$
$$= 2220\,\text{m}^2 \quad (3\,\text{sig. fig.})$$

Question 44

(a) (i)

$$\text{Area of the field} = \frac{1}{2} \times 4 \times 8.35 \times \sin 73.3°$$
$$= 15.99563$$
$$\approx 16.0\,\text{cm}^2$$

(ii)

$$QR^2 = 4^2 + 8.35^2 - 2 \times 4 \times 8.35 \times \cos 73.3°$$
$$QR = \sqrt{66.52681}$$

$$\text{Total length of rope used} = \sqrt{66.52681} + 4 + 8.35$$
$$\approx 20.5\,\text{m}$$

(b) (i)

$$\text{Area of triangle} = \frac{1}{2} \times PQ \times RM$$
$$\frac{1}{2} \times 4 \times RM = 15.99563$$
$$RM = 15.99563 \div \frac{1}{2} \div 4$$
$$= 7.997815$$
$$\approx 8.00\,\text{m} \quad (3\,\text{sig. fig.})$$

Alternative method

$$\sin 73.3° = \frac{RM}{8.35}$$

$$RM = \sin 73.3° \times 8.35$$

$$= 7.997815$$

$$\approx 8.00\,\text{m} \quad (3\,\text{sig. fig.})$$

(ii)

$$PM = \frac{RM}{\tan 73.3°}$$

$$PM = \frac{7.997815}{\tan 73.3°}$$

$$= 2.3994$$

Angle of elevation from P to G

$$= \tan^{-1}\left(\frac{6.8}{2.3994}\right)$$

$$\approx 70.6°$$

Question 45

(a)

$$AC = \sqrt{10^2 + 8^2}$$

$$= \sqrt{164}$$

$$= 12.806$$

$$= 12.8\,\text{m} \quad (\text{to } 3\,\text{sig. fig.})$$

(b)

$$\angle VEM = \tan^{-1}\left(\frac{8}{\frac{1}{2}(12.806)}\right)$$

$$= 51.327°$$

$$= 51.3° \quad (\text{to } 1\,\text{decimal place})$$

(c)

$$AG = \sqrt{12^2 + 12.806^2}$$

$$= 17.5497$$

$$= 17.5\,\text{m} \quad (3\,\text{sig. fig.})$$

Or

$$AG = \sqrt{12^2 + 12.806^2}$$

$$= 17.550$$

$$= 17.6\,\text{m} \quad (3\,\text{sig. fig.})$$

Or

$$AG = \sqrt{12^2 + 164}$$
$$= 17.5499$$
$$= 17.5 \text{ m} \quad (3 \text{ sig. fig.})$$

(d)

$$\angle AGD = \sin^{-1}\left(\frac{8}{17.5497}\right) \text{ or } \sin^{-1}\left(\frac{8}{17.550}\right) \text{ or } \sin^{-1}\left(\frac{8}{17.5499}\right)$$
$$\angle AGD = 27.1195° \text{ or } 27.119° \text{ or } 27.119°$$
$$= 27.1° \quad (\text{to } 1 \text{ decimal place})$$

(e) Angle of depression of B from V

$$= \tan^{-1}\left(\frac{20}{\frac{1}{2}(12.806)}\right)$$
$$= 72.248°$$
$$= 72.2° \quad (\text{to } 1 \text{ decimal place})$$

Question 46

(a) (i) Bearing of A from B

$$= 180 + 18$$
$$= 198°$$

(ii)

$$125^2 = 50^2 + 110^2 - 2(50)(110)\cos\angle ABC$$
$$\angle ABC = 95.34668$$
$$\approx 95.3°$$

(b)

$$\text{Cost} = 48 \times \frac{1}{2} \times (50)(110)\sin 95.34668$$
$$= 131425.69$$
$$\approx \$131000$$

(c) (i) Let x be the shortest distance.

$$\sin 94.34668 = \frac{x}{50}$$
$$x = 49.782$$
$$\approx 49.8 \text{ m}$$

(ii) Let y be the greatest angle of elevation.

$$\tan y = \frac{20}{49.782}$$
$$y = 21.9° \quad (1\,\text{decimal place})$$

Question 47

(a) (i)
$$AC^2 = 45^2 + 85^2 - 2(45)(85)\cos 46°$$
$$AC = 62.7\text{ m}$$

(ii)
$$\frac{\sin \angle ADC}{85} = \frac{\sin 46°}{70}$$
$$\angle ADC = 60.9°$$

(iii) $\angle DCB = 73.1°$

$$\text{Area of triangle} = \frac{1}{2}(70)(85)\sin 73.1°$$
$$= 2850\text{ m}^2$$

(b) (i)
$$\cos 46° = \frac{BG}{85}$$
$$BG = 59.0\text{ m}$$

(ii)
$$\tan x° = \frac{2.6}{59.045 - 45}$$
$$x° = 10.5°$$

Angle of depression = $10.5°$

Question 48

(a) $180° - 130° = 50°$

$360° - 50° = 310°$

(b)
$$\angle PAB = 130° - 90°$$
$$= 40°$$

$$\angle APB = 180° - 40° - 40°$$
$$= 100°$$

$270° - 100° = 170°$

(c) Let d be the shortest distance.

$$\sin 40° = \frac{d}{300}$$
$$d = 300\sin 40°$$
$$\approx 193\,\text{m}$$

(d)

$$\tan\theta = \frac{28}{300\sin 40°}$$
$$\theta \approx 8.3°$$

(e)

$$AB = \sqrt{300^2 + 300^2 - 2(300)(300)\cos 100°}$$
$$\approx 460\,\text{m}$$

(f) $\frac{1}{2}(210)(459.6266)\sin 80° \approx 47500\,\text{m}^2$

Question 49

(a) By Cosine Rule,

$$QS^2 = 12.5^2 + 8.9^2 - 2(12.5)(8.9)\cos 53°$$
$$= 101.55616$$
$$QS = 10.0775$$
$$\approx 10.1\,\text{m} \quad (3\,\text{sig. fig.})$$

(b) By Sine Rule,

$$\frac{\sin\angle QSR}{8.9} = \frac{\sin 53°}{10.0775}$$
$$\sin\angle QSR = \frac{8.9\sin 53°}{10.0775}$$
$$\angle QSR = 44.8554°$$
$$\approx 44.9°$$

(c)

$$\text{Bearing of } S \text{ from } Q = 53° + 44.9°$$
$$= 097.9°$$

(d)

$$\tan 27° = \frac{PQ}{8.9}$$
$$PQ = 8.9\tan 27°$$
$$= 4.534777$$
$$\approx 4.53\,\text{m}$$

(e)

$$\tan\theta = \frac{PQ}{QS}$$

$$\tan\theta = \frac{4.534777}{10.0775}$$

$$\theta \approx 24.2 \quad (1\,\text{dec.pl.})$$

(f)

$$\cos 53° = \frac{d}{8.9}$$

$$d = 8.9\cos 53°$$

$$\approx 5.36\ \text{m} \quad (3\,\text{sig. fig.})$$

Question 50

(a) (i)

$$\angle ATB = 40° - 32°$$

$$= 8°$$

(ii)

$$\frac{TB}{\sin 32°} = \frac{7}{\sin 8°}$$

$$TB = 26.7\ \text{m}$$

(iii)

$$TC = TB\cos 50°$$

$$= 26.65338937\ \cos 50°$$

$$= 17.13246844$$

$$\approx 17.1\,\text{m}$$

(b)

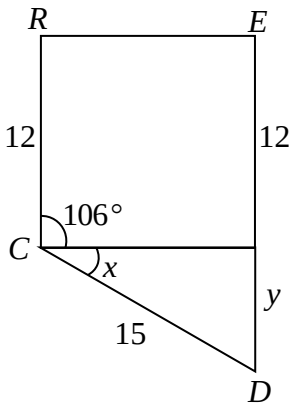
$$RD^2 = 12^2 + 15^2 - 2(12)(15)\cos 106°$$

$$= 369 - 360(-0.2756373558)$$

$$= 468.2294481$$

$$RD = 21.6\,\text{m}$$

(c)



$$x = 106° - 90°$$
$$= 16°$$

$$y = 15\sin 16°$$
$$= 4.1346$$

$$DE = 12 + y$$
$$= 16.1\,\text{m}$$