

5.1 Basic Trigonometry

5.1.1 Trigonometry - Definitions / 5.1.2 Right-Angled Triangles / 5.1.3 Non-Right-Angled Triangles

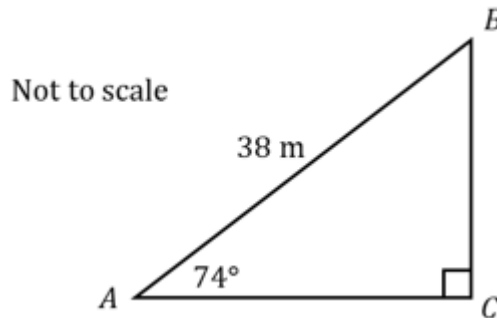
Easy (11 questions)	/35
Medium (12 questions)	/66
Hard (11 questions)	/64
Very Hard (9 questions)	/51
Total Marks	/216

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Easy Questions

- 1 ABC is a right-angled triangle. $AB = 38$ m and angle $CAB = 74^\circ$.

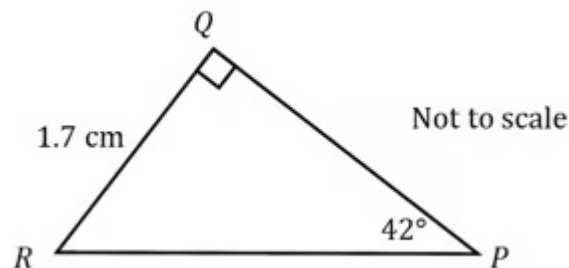


Calculate the length of AC .

Give your answer correct to one decimal place.

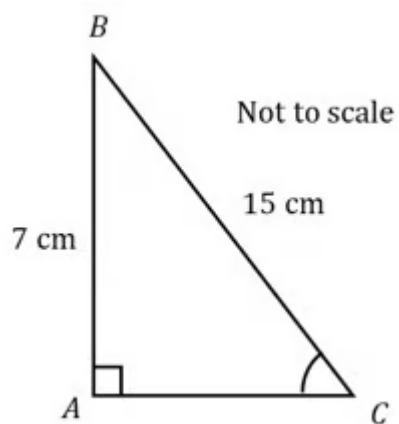
(2 marks)

- 2 Find the length of the side PQ in the triangle PQR below, giving your answer to one decimal place.



(2 marks)

- 3 ABC is a right-angled triangle. $BC = 15$ cm, $AB = 7$ cm and angle $BAC = 90^\circ$.

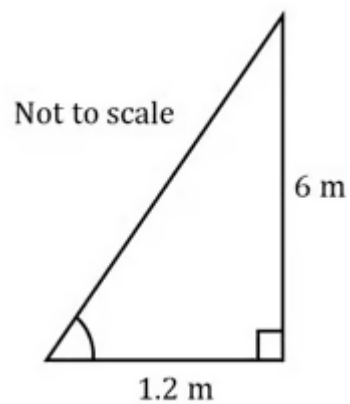


Calculate the size of angle ACB .

Give your answer correct to three significant figures.

(2 marks)

- 4 (a)** A ladder is placed against a wall. The base of the ladder is 1.2 m away from the base of the wall and it reaches 6 m up the wall.



To be safe to climb, the angle between the ladder and the ground must be between 65° and 75° .

Is the ladder safe to climb? You must show your working.

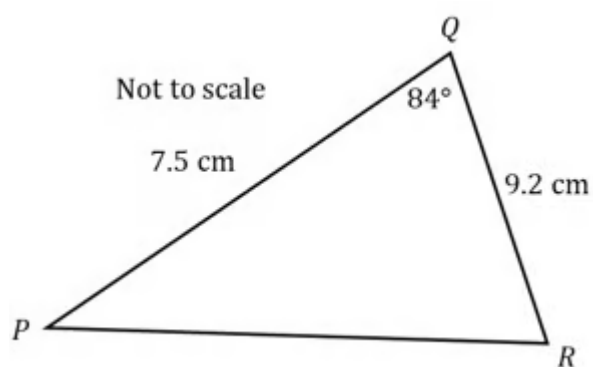
(3 marks)

- (b)** Calculate the length of the ladder, give your answer to the nearest cm.

(3 marks)

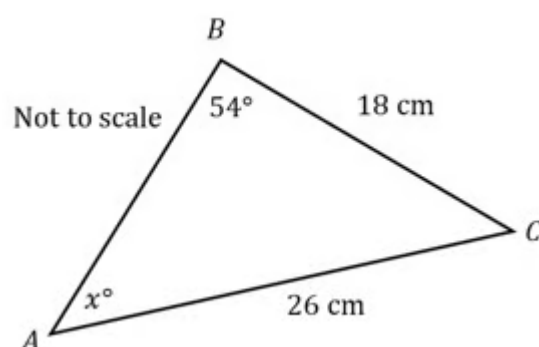
- 5** PQR is a triangle with angle $PQR = 84^\circ$ and side lengths $PQ = 7.5$ cm and $QR = 9.2$ cm.

Use cosine rule to calculate the length of PR .



(3 marks)

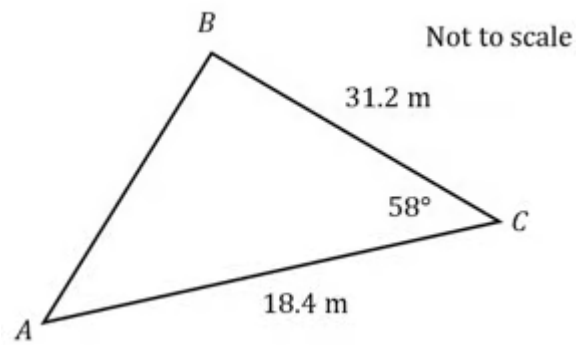
6



x is an acute angle. Use sine rule to calculate the angle x° . Give your answer to the nearest degree.

(3 marks)

- 7 A triangular field is shown in the diagram below. Calculate the area of the field, give your answer to the nearest square metre.



(3 marks)

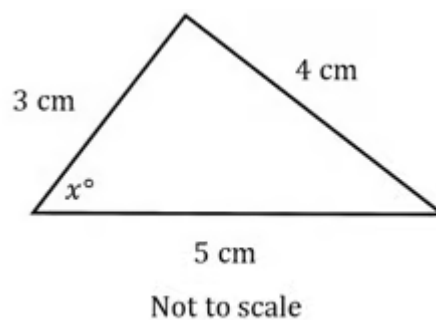
- 8 PQR is a triangle with angle $PQR = 39^\circ$ and angle $RPQ = 128^\circ$. $PR = 2.6\text{ cm}$.

Calculate the length of QR , correct to 3 significant figures.

(3 marks)

- 9 A student is calculating the angles in a triangle with side lengths 3 cm , 4 cm and 5 cm , as shown in the diagram below.

She uses cosine rule to find x° to the nearest degree.



Another student uses SOH CAH TOA to calculate the same angle.

- (i) Show clearly how both students can achieved the same answer using either method.
- (ii) State which is the most efficient method in this case and why.

(5 marks)

10 The area of a triangle WXY is 75 cm^2 . $XY = 14.3 \text{ cm}$ and angle $WXY = 104^\circ$.

Using the formula $A = \frac{1}{2} ab \sin C$, calculate the length of WX . Give your answer to three significant figures.

(3 marks)

11 Show that the cosine formula $a^2 = b^2 + c^2 - 2bc \cos A$ can be rearranged into the form

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

(3 marks)

Medium Questions

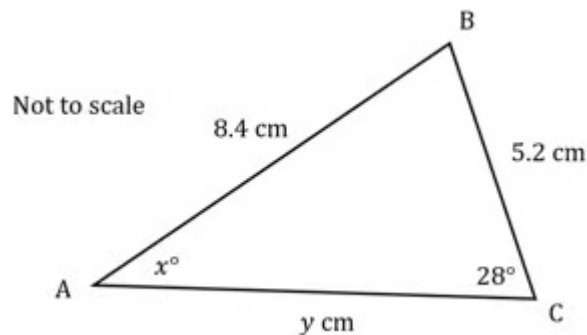
- 1 (a) A triangle ABC has side lengths $AB = 5$ cm, $BC = 4$ cm and $AC = 7$ cm.
Calculate the size of the angle BAC , giving your answer to the nearest degree.

(2 marks)

- (b) A triangle PQR has side lengths $PQ = 12$ cm, $QR = 8$ cm and angle $PQR = 60^\circ$.
Calculate the length of RP , giving your answer to three significant figures.

(2 marks)

- 2 Calculate the values of x and y in the triangle below. Giving your answers to 3 significant figures.



(4 marks)

- 3 (a)** Two sides of a triangular garden are 2.8 m and 12 m long, they meet at an angle of 67° .

Calculate the area of the garden, giving your answer to 3 significant figures.

(2 marks)

- (b)** Calculate the length of the third side of the garden, giving your answer to 3 significant figures.

(2 marks)

- 4** A triangle ABC has sides of 4 cm, 5 cm and 6 cm respectively.

- (i) Show that, for the angle between sides A and B , $\cos \theta = \frac{1}{8}$
- (ii) Find the value of $\cos \theta$ for the other two angles.

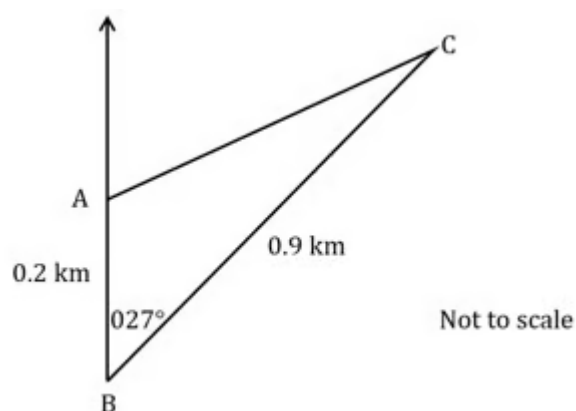
(3 marks)

- 5** Two triangles both have sides $AB = 5.3$ cm, $BC = 6.4$ cm and angle $ACB = 38^\circ$.

- (i) Show that the angle BAC for one of the triangles is 132° , to 3 s.f.
- (ii) Find the angle ABC for the other triangle.

(4 marks)

- 6 Three cruise ships are sailing around the coast. Ship B is 0.2 km south of Ship A . Ship C is 0.9 km from Ship B on a bearing of 027° .



Calculate the distance between Ship A and Ship C .

(3 marks)

- 7 Three telephone masts are used to triangulate locations. Mast B is due west of Mast A . Mast C is 0.6 km from Mast A and 0.7 km from Mast B on a bearing of 136° .

Show that the bearing of Mast C from Mast A is 213° .

(3 marks)

- 8 (a)** A triangular field has an area of 10m^2 . The field has two side lengths of 3.2 m and 8.4 m which have an angle θ between them.

Show that one possible value for θ is 48.1° to three significant figures.

(3 marks)

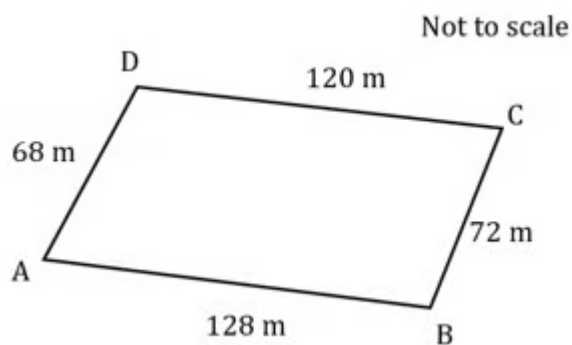
- (b)** Show that there is another possible value that works for θ . You must show all your working.

(2 marks)

- (c)** Using $\theta = 48.1^\circ$. Calculate the perimeter of the field. Giving your answer to three significant figures.

(3 marks)

- 9 (a)** Alpacas are kept in a field as shown in the diagram below. The angle between fence AB and BC is 86° .



Find the length AC , to the nearest m.

(3 marks)

- (b)** Find the angle between the fences AD and CD .

(3 marks)

- (c)** Calculate the area of the field. Giving your answer to three significant figures.

(3 marks)

10 (a) A triangle ABC has sides $AB = x \text{ cm}$, $AC = (x + 8) \text{ cm}$ and angle $BAC = 150^\circ$

The area of the triangle is $2\frac{1}{4} \text{ cm}^2$.

Show that x satisfies the equation $x^2 + 8x = 9$

(3 marks)

(b) Hence, or otherwise find the value of x

(2 marks)

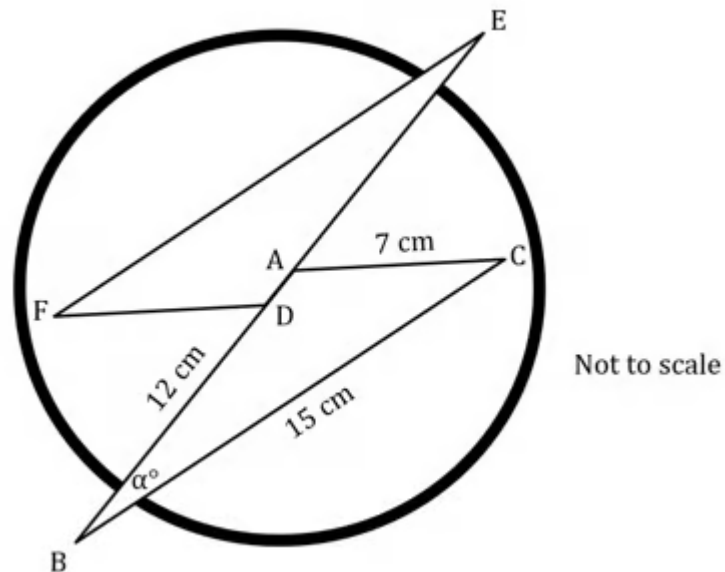
(c) Find the perimeter of the triangle, to three significant figures.

(3 marks)

(d) Write the ratio of the angles of the triangle, to the nearest degree. Leave your answer in simplest form.

(3 marks)

- 11 (a)** The Save My Exams logo is made up of a blue circle with a black lightning bolt through the centre. The CEO, Jamie, is preparing a giant version of this logo for a company banner. Using a small version of the logo, he models the lightning bolt as two congruent triangles ABC and DEF with side lengths $AB = DE = 12$ cm, $BC = EF = 15$ cm and $AC = DF = 7$ cm as shown in the diagram below.



Calculate the size of the angle α° . Give your answer in degrees to 1 decimal place

(2 marks)

- (b)** For the banner, Jamie wants to increase the side lengths of the triangle by a scale factor of 10. Find the area the lightning bolt will take up on the banner, giving your answer in m^2 .

(3 marks)

- 12 (a)** A triangle ABC has side lengths $AB = 10$ cm and $AC = 17$ cm, with angle BAC being an acute angle. The area of triangle ABC is 40 cm^2 .

Find the angle BAC correct to the nearest whole degree.

(2 marks)

- (b)** Show that the side length BC is 9.43 cm, correct to 3 significant figures.

(2 marks)

- (c)** Find the angle BCA , giving your answer to 3 significant figures.

(2 marks)

- (d)** A point D is placed on the side AC such that the side length BD is equal to the side length BC .

Find the area of triangle BCD , giving your answer to 3 significant figures.

(2 marks)

Hard Questions

- 1 (a) A triangle has side lengths 7.3 cm, 9.8 cm and 10.6 cm. Calculate the size of the largest angle.

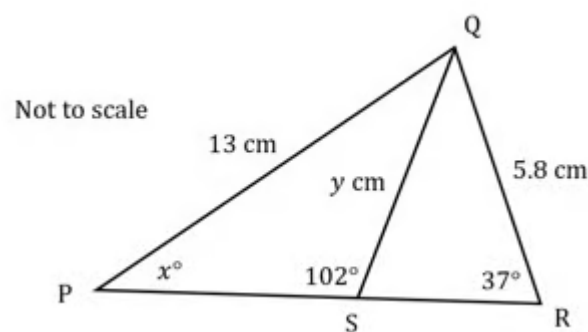
(2 marks)

- (b) A triangle has side lengths 3 m and 5 m with an angle between them of 45° .

Calculate the length of the third side, giving your answer to 3 significant figures.

(2 marks)

- 2 Calculate the values of x and y in the diagram below. Giving your answers to 3 significant figures.



(4 marks)

- 3 (a)** A triangle ABC has side lengths $AB = 2x$ cm, $BC = (x + 5)$ cm and $AC = 7$ cm. The angle $ABC = 60^\circ$

Find the value of x , giving your answer as a simplified surd.

(3 marks)

- (b)** The area of the triangle can be written in the form $a\sqrt{6} + b\sqrt{3}$, where a and b are integers. Find the values of a and b

(3 marks)

- 4** A triangle PQR has sides of 4 cm, 3 cm and 2 cm respectively.

- (i) Find the value of $\cos \theta$ for the each of the angles in the triangle.
- (ii) Between which two sides is the biggest angle?

(4 marks)

- 5** Two triangles both have sides $AB = 2.8$ cm, $BC = 3.5$ cm and angle $ACB = 43^\circ$.

Find the largest angle in each of the triangles.

(4 marks)

- 6** Three ships are sailing through a harbour. At all times ships must be at least 50 m apart to avoid collisions. Ship *A* is 127 m east of Ship *B*. Ship *C* is 98 m from Ship *B* on a bearing of 058°

Are all the ships following the safety guidance of staying at least 50 m apart?

(4 marks)

- 7** Three telephone masts are used to triangulate locations. Mast *A* is due north of Mast *B*. Mast *C* is 7.2 km from Mast *B* on a bearing of 026° and 3.6 km from Mast *A*.

- (i) Find the two possible bearings of Mast *C* from Mast *A*.
- (ii) Given that Mast *A* and Mast *B* are the furthest distance apart of all three masts, find the distance between them.

(4 marks)

- 8 (a)** A triangular field has an area of 157 m^2 . Two of the side lengths are 13.2 m and 28.4 m . Angle θ is between the two given sides

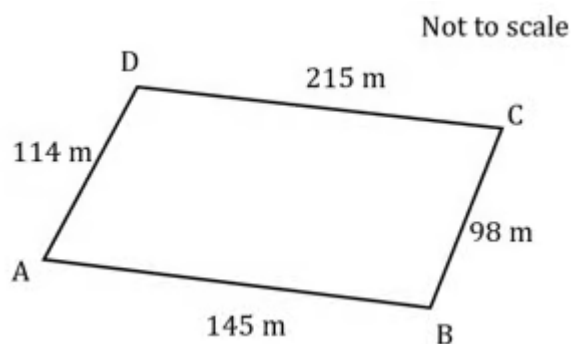
Find the two possible angles for θ .

(4 marks)

- (b)** Given that θ is acute, calculate the perimeter of the field. Giving your answer to the nearest m.

(3 marks)

- 9 (a)** Unicorns are kept in a field as shown in the diagram below. The angle between fence AB and AD is 102° .



Find the angle between the fences BC and CD .

(5 marks)

- (b)** Unicorns need at least 1234 m^2 each to be happy. Calculate the maximum number of unicorns that can be happily kept in the field.

(4 marks)

10 (a) A triangle ABC has sides $AB = 2x \text{ cm}$, $AC = (x + 6) \text{ cm}$ and angle $BAC = 30^\circ$.

The area of the triangle is $5\frac{3}{4} \text{ cm}^2$.

Show that x satisfies the equation $2x^2 + 12x - 23 = 0$.

(3 marks)

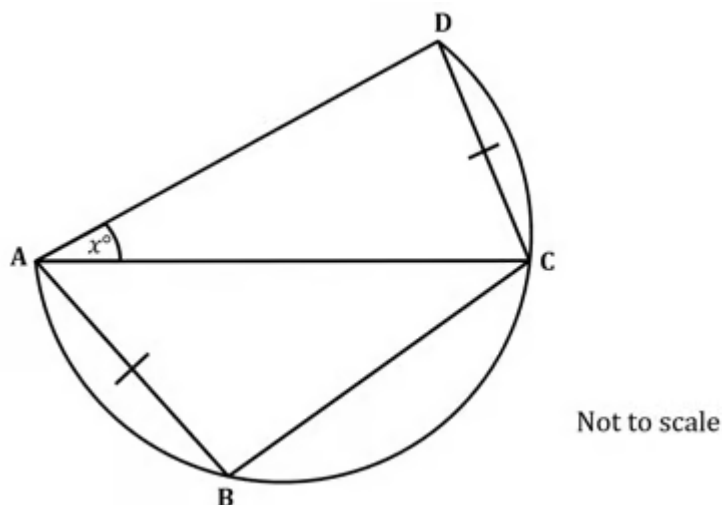
(b) Hence, or otherwise, find the perimeter of the triangle. Giving your answer to 3 significant figures.

(3 marks)

(c) Given angle ABC is obtuse, find the ratio of the angles of the triangle, to the nearest degree.

(3 marks)

11 (a) A car company is making a design for a new metal logo as shown in the image below.



Points A , B , C and D all lie on the circumference of a circle. AB , AC , AD , BC , and CD are chords with $AB = CD$. The company wishes to have lines $AB:BC:AC$ in the ratio 2:4:5.

The machine which makes the logo requires the angle ABC to be input accurate to 1 decimal place.

Calculate the angle ABC that should be input into the machine.

(2 marks)

- (b)** The acceptable error range of angle CAD is 1 degree. If a logo is tested and found to be outside of this range the machine requires calibration.

Find the acceptable range for x° to 1 decimal place

(4 marks)

- (c) Given that the company wishes BC to be 1 inch, use the angles correct to 1 decimal place found in parts (a) and (b) to calculate the area of the quadrilateral $ABCD$.

(3 marks)

Very Hard Questions

- 1 An isosceles triangle has side lengths 7.3 cm and 9.8 cm. Calculate the difference between the two possible smallest angles.

(4 marks)

2 (a) A triangle ABC has side lengths $AB = 3x$ cm, $BC = 5x$ cm and $AC = 6x$ cm.

Calculate the size of the angle BAC to two decimal places.

(2 marks)

(b) Given that the total perimeter of the triangle is 37.8 cm, find the area of the triangle, correct to three significant figures.

(4 marks)

3 (a) In a triangle ABC , $AB = 2x$ cm, $BC = 10$ cm and $AC = (20 - 2x)$ cm, angle $ABC = \theta^\circ$.

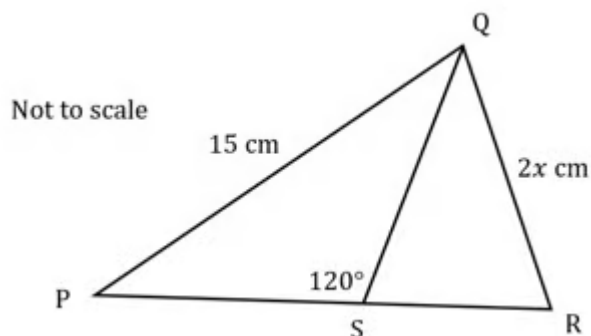
Show that $\cos \theta = \frac{4x - 15}{2x}$.

(2 marks)

(b) Given that $\cos \theta = -\frac{1}{2}$, find the area of the triangle.

(4 marks)

- 4 (a)** Triangle PSQ and SQR are such that $PS = SQ = QR$. Sides $PQ = 15$ cm and $QR = 2x$ cm. Angle $PSQ = 120^\circ$.



Calculate the exact value of x .

(3 marks)

- (b)** Calculate the area of the triangle PQR . Leaving your answer in surd form.

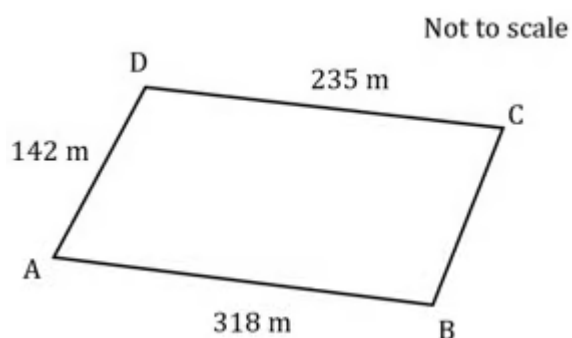
(2 marks)

- 5** An artist is designing a triangular sculpture, made using three equal lengths of metal piping. When laid flat the sculpture covers 21.8 m².

Calculate the total length of metal piping needed. Giving your answer to the nearest cm.

(5 marks)

- 6 Unicorns are kept in a field as shown in the diagram below. The angle between fence AB and AD is 92° . AB and CD are parallel.



To be happy unicorns need at least 2222 m^2 each. Calculate the maximum number of unicorns that can happily be kept in the field.

(9 marks)

- 7 (a)** An emergency call is picked up by an ambulance and a police car about an accident. The police car is 15 miles due east of the ambulance and on a bearing of 038° from the accident. The ambulance is on a bearing of 325° from the accident.

If both vehicles take the shortest distance to drive to the accident who will get there first? You must show all working.

(4 marks)

- (b)** State one assumption you have made for your answer in part (a).

(1 mark)

- 8** A triangle ABC has sides $AB = x$ cm, $BC = (4 - x)$ cm, angle $BAC = \theta$ and angle $BCA = 30^\circ$.

Given that $\sin \theta = \frac{1}{\sqrt{2}}$, show that $x = 4(\sqrt{2} - 1)$.

(5 marks)

- 9** A triangle ABC has sides $AB = 3x$ cm, $AC = (x + 5)$ cm and angle $BAC = 150^\circ$.

The area of the triangle is $7\frac{1}{4}$ cm².

Find the ratio of the angles of the triangle, to the nearest degree.

Leave your answer in simplest form.

(6 marks)