HIGHER

7.13 The Cosine Rule: 1-hour Pack

EDEXCEL 1MA1 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

The Cosine Rule: Fluency and Exam Drill

Revision Library original resource, written for Edexcel 1MA1 (Higher tier)

The cosine rule connects the three sides of a triangle with one of its angles. For a triangle with sides a, b and c, and angle A opposite side a:

a^2 = b^2 + c^2 - 2*b*c*cos(A)

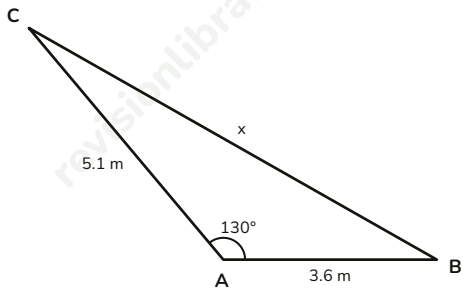
Rearranged to find an angle when all three sides are known:

cos(A) = (b^2 + c^2 - a^2) / (2*b*c)

Use the cosine rule whenever you know two sides and the included angle (to find the third side), or all three sides (to find any angle). A calculator is allowed and expected throughout; give lengths correct to 3 significant figures and angles correct to 1 decimal place unless told otherwise. Questions 1 to 14 build fluency with the rule in both directions. Questions 15 to 20 apply it to exam-style problems, including bearings, perimeters, a combined area calculation, a two-triangle quadrilateral problem and an algebraic setup. The final two questions are grade 9 stretch problems requiring an exact surd answer and multi-step reasoning.

1 A roof truss has two struts of length 3.6 m and 5.1 m, meeting at an angle of 130 degrees. Work out the length of the third side of the triangular truss. Give your answer correct to 3 significant figures.

Diagram NOT accurately drawn

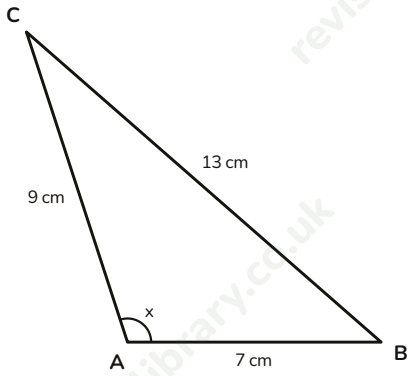


(Total for Question 1 is 2 marks)

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2 A triangle has sides of length 7 cm, 9 cm and 13 cm. Calculate the size of the largest angle in the triangle. Give your answer correct to 1 decimal place.

Diagram NOT accurately drawn

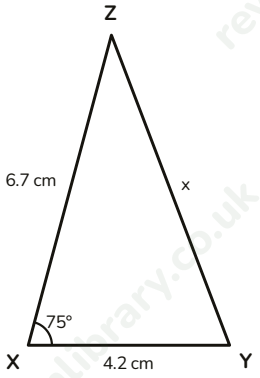


(Total for Question 2 is 3 marks)

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3 In triangle XYZ, XY = 4.2 cm, XZ = 6.7 cm and angle YXZ = 75 degrees. Work out the length of YZ. Give your answer correct to 3 significant figures.

Diagram NOT accurately drawn

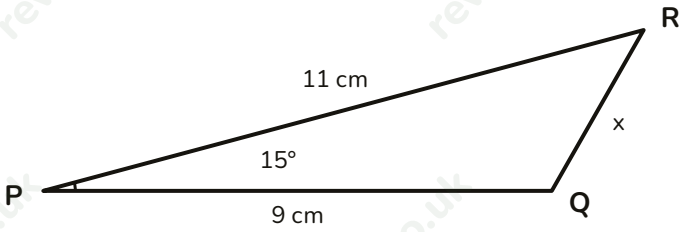


(Total for Question 3 is 2 marks)

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4 In triangle PQR, PQ = 9 cm, PR = 11 cm and angle QPR = 15 degrees. Calculate the length of QR. Give your answer correct to 3 significant figures.

Diagram NOT accurately drawn

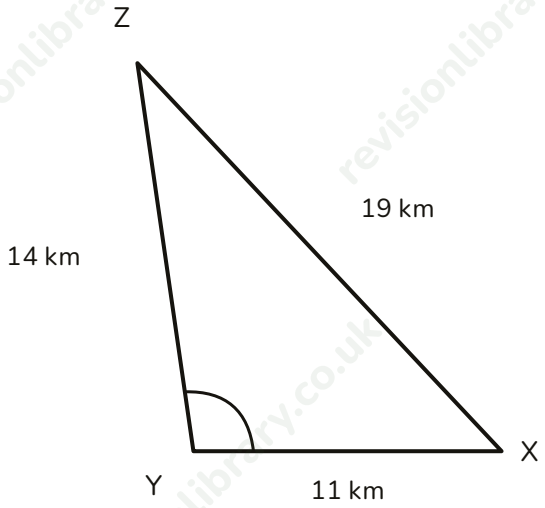


(Total for Question 4 is 2 marks)

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5 Three towns X, Y and Z are positioned so that XY = 11 km, YZ = 14 km and XZ = 19 km. Calculate the size of angle XYZ. Give your answer correct to 1 decimal place.

Diagram NOT accurately drawn

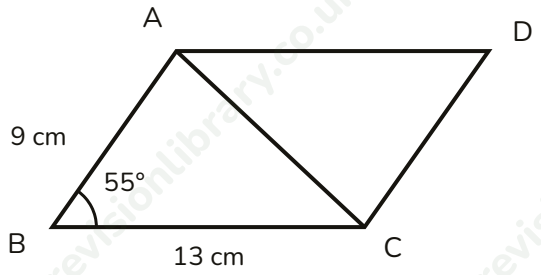


(Total for Question 5 is 3 marks)

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6 ABCD is a parallelogram with AB = 9 cm, BC = 13 cm and angle ABC = 55 degrees. Calculate the length of the diagonal AC. Give your answer correct to 3 significant figures.

Diagram NOT accurately drawn

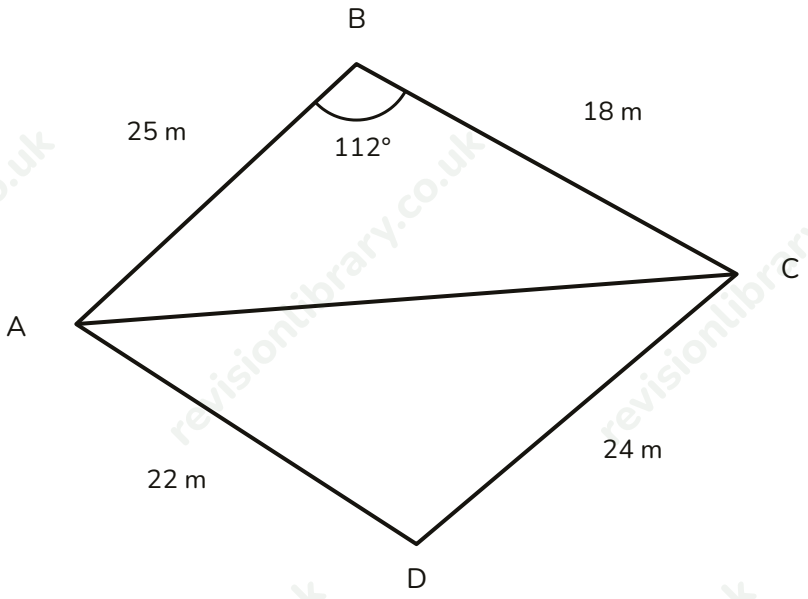


(Total for Question 6 is 3 marks)

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7 The diagram shows quadrilateral ABCD, made up of triangle ABC and triangle ACD joined along the diagonal AC. In triangle ABC, AB = 25 m, BC = 18 m and angle ABC = 112 degrees. In triangle ACD, AD = 22 m and DC = 24 m.

Diagram NOT accurately drawn



(a) Calculate the length of AC. Give your answer correct to 3 significant figures. **(3)**

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(b) Using your unrounded answer to part (a), calculate the size of angle ADC. Give your answer correct to 1 decimal place. **(3)**

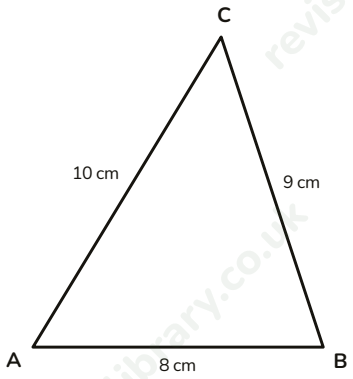
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(Total for Question 7 is 6 marks)

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8 In triangle ABC, BC = 9 cm, AC = 10 cm and AB = 8 cm. Work out the exact value of cos A. Give your answer as a fraction in its simplest form.

Diagram NOT accurately drawn

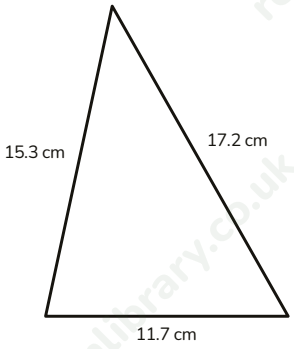


(Total for Question 8 is 3 marks)

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9 The sides of a triangle are 11.7 cm, 15.3 cm and 17.2 cm. Work out the size of the largest angle in the triangle. Give your answer correct to 1 decimal place.

Diagram NOT accurately drawn

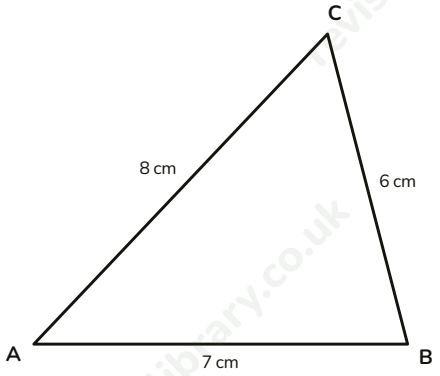


(Total for Question 9 is 3 marks)

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10 In triangle ABC, BC = 6 cm, AC = 8 cm and AB = 7 cm. Work out the exact value of cos A. Give your answer as a fraction in its simplest form.

Diagram NOT accurately drawn

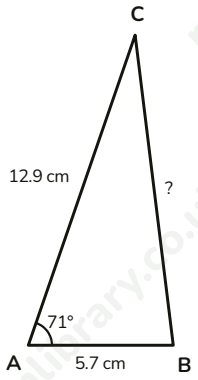


(Total for Question 10 is 3 marks)

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11 In triangle ABC, AC = 12.9 cm, AB = 5.7 cm and angle BAC = 71 degrees. Work out the length of BC. Give your answer correct to 3 significant figures.

Diagram NOT accurately drawn

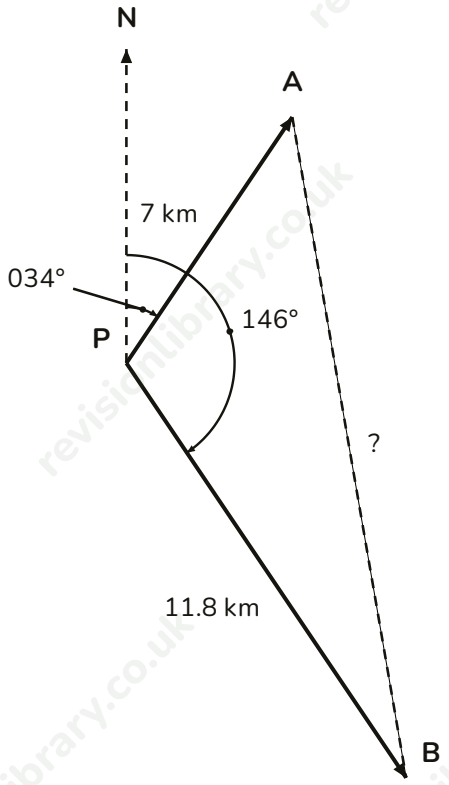


(Total for Question 11 is 3 marks)

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12 Two ships leave port P at the same time. Ship A sails 7 km on a bearing of 034 degrees. Ship B sails 11.8 km on a bearing of 146 degrees. Work out the distance between the two ships. Give your answer correct to 3 significant figures.

Diagram NOT accurately drawn

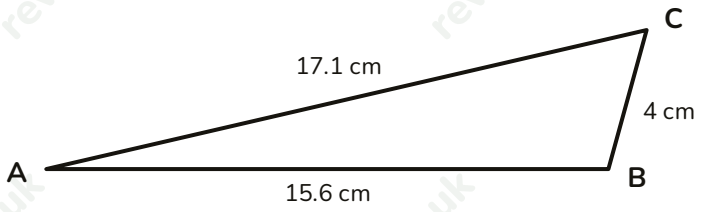


(Total for Question 12 is 4 marks)

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13 In triangle ABC, BC = 4 cm, AC = 17.1 cm and AB = 15.6 cm. Work out the size of angle BAC. Give your answer correct to 1 decimal place.

Diagram NOT accurately drawn

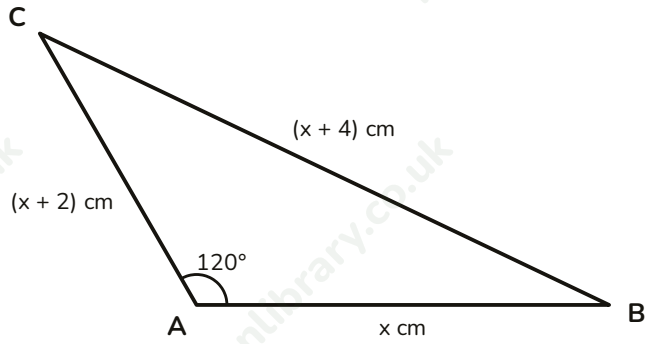


(Total for Question 13 is 3 marks)

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14 Chidi is designing a triangular metal bracket with sides of length x cm, (x + 2) cm and (x + 4) cm. The angle between the two shorter sides is 120 degrees, and this angle is opposite the longest side.

Diagram NOT accurately drawn



(a) Show that x satisfies the equation $x^2 - x - 6 = 0$. **(3)**

(b) Hence find the value of x, and state the three side lengths of the bracket. **(3)**

(Total for Question 14 is 6 marks)

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Mark scheme · 7.13 The Cosine Rule: 1-hour Pack

Question 1

correct substitution, e.g. third side^2 = 3.6^2 + 5.1^2 - 2*3.6*5.1*cos(130) oe	**M1**
7.91 m (awrt 7.91), cao	**A1**

Answer: Third side = 7.91 m (3 s.f.)

Question 2

identifies that the largest angle is opposite the longest side (13 cm) and attempts cos C = (a^2+b^2-c^2)/(2ab) with correct values, e.g. cos C = (7^2+9^2-13^2)/(2*7*9)	**M1**
cos C = -39/126 oe (awrt -0.310)	**M1**
C = 108.0 degrees (awrt 108)	**A1**

Answer: Largest angle = 108.0 degrees (1 d.p.)

Question 3

correct substitution, e.g. YZ^2 = 4.2^2 + 6.7^2 - 2*4.2*6.7*cos(75) oe	**M1**
YZ = 6.93 cm (awrt 6.93), cao	**A1**

Answer: YZ = 6.93 cm (3 s.f.)

Question 4

correct substitution, e.g. QR^2 = 9^2 + 11^2 - 2*9*11*cos(15) oe	**M1**
QR = 3.28 cm (awrt 3.28), cao	**A1**

Answer: QR = 3.28 cm (3 s.f.)

Question 5

cos(XYZ) = (11^2 + 14^2 - 19^2) / (2 x 11 x 14) oe	**M1**
cos(XYZ) = -0.143 awrt (dep)	**M1**
98.2 degrees awrt	**A1**

Answer: 98.2 degrees (1 dp)

Question 6

AC^2 = 9^2 + 13^2 - 2 x 9 x 13 x cos55 oe	**M1**
AC^2 = 116 awrt (dep)	**M1**
10.8 cm awrt	**A1**

Answer: 10.8 cm (3 sf)

Question 7

(a) AC^2 = 25^2 + 18^2 - 2 x 25 x 18 x cos112 oe	**M1**
(a) AC^2 = 1290 awrt (dep)	**M1**
(a) 35.9 m awrt	**A1**

(a) Answer: 35.9 m (3 sf)

(b) cos(ADC) = (22^2 + 24^2 - their AC^2) / (2 x 22 x 24) oe ft	**M1**
(b) cos(ADC) = -0.214 awrt (dep, ft)	**M1**
(b) 102.4 degrees awrt (ft their AC)	**A1**

(b) Answer: 102.4 degrees (1 dp)

Question 8

cosine rule with correct values	**M1**
cos A = 83/160	**M1**
83/160 oe	**A1**

Answer: 83/160

Question 9

identifies the largest angle as opposite the longest side	**M1**
cosine rule with correct values	**M1**
77.9 degrees cao	**A1**

Answer: 77.9 degrees

Question 10

cosine rule with correct values	**M1**
cos A = 77/112	**M1**
11/16 oe	**A1**

Answer: 11/16

Question 11

a^2 = 12.9^2 + 5.7^2 - 2 x 12.9 x 5.7 x cos 71	**M1**
a^2 = 151.022 evaluated	**M1**
12.3 cm cao	**A1**

Answer: 12.3 cm

Question 12

angle between the two paths = 112 degrees	**B1**
cosine rule with correct values	**M1**
evaluates the square of the distance	**M1**
15.8 km cao	**A1**

Answer: 15.8 km

Question 13

cos A = (b^2 + c^2 - a^2)/(2bc) with correct values	**M1**
cos A = 0.9742 or equivalent	**M1**
13.0 degrees cao	**A1**

Answer: 13.0 degrees

Question 14

(a) correct cosine rule statement with cos(120) = -1/2 substituted, e.g. (x+4)^2 = x^2+(x+2)^2 - 2*x*(x+2)*(-1/2)	**M1**
(a) correct expansion of both sides, e.g. x^2+8x+16 = 3x^2+6x+4 oe	**M1**
(a) correct rearrangement to x^2 - x - 6 = 0 (cso, all algebraic steps shown)	**A1**

(a) Answer: Shown: x^2 - x - 6 = 0

(b) correct factorisation (x-3)(x+2) = 0, or correct use of the quadratic formula	**M1**
(b) x = 3, rejecting x = -2 since a length cannot be negative	**A1**
(b) side lengths 3 cm, 5 cm and 7 cm (ft their x)	**B1**

(b) Answer: x = 3; side lengths are 3 cm, 5 cm and 7 cm

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