Trigonometry with obtuse angles

Worked solutions

GCSE Maths topic practice

This topic online

1 $\sin 35° = \sin x°$, where x is an obtuse angle.

Write down the value of x. (1 mark)

$\sin(180° - x) = \sin x$

$x = 180 - 35$

$\boxed{x = 145}$

2 Correct to 3 decimal places, $\sin 40° = 0.643$, $\cos 40° = 0.766$ and $\tan 40° = 0.839$

Write down the value of

a. $\sin 140°$

b. $\cos 140°$

c. $\tan 140°$ (3 marks)

$140° = 180° - 40°$

a) sine stays the same

$\boxed{\sin 140° = 0.643}$

b) cosine changes sign

$\boxed{\cos 140° = -0.766}$

c) tangent changes sign

$\boxed{\tan 140° = -0.839}$

3 $\sin x° = 0.4$ and $0 \leq x \leq 180$

Find both possible values of x. Give your answers correct to 1 decimal place.

a. the acute value of x

b. the obtuse value of x (2 marks)

a)

$x = \sin^{-1}(0.4) = 23.578...$

$\boxed{x = 23.6}$

b) $\sin(180° - x) = \sin x$

$x = 180 - 23.578...$

$\boxed{x = 156.4}$

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4 In each part, $0 \leq x \leq 180$

a. $\cos x° = -0.5$

Find the value of x.

b. $\tan x° = -2.5$

Find the value of x. Give your answer correct to 1 decimal place.

(3 marks)

a) negative cos means x is obtuse

$x = \cos^{-1}(-0.5)$

$\boxed{x = 120}$

b) negative tan means x is obtuse

$\tan^{-1}(2.5) = 68.19...$

$x = 180 - 68.19...$

$\boxed{x = 111.8}$

5 The angle x is obtuse and $\sin x = \frac{5}{13}$

Find the exact value of

a. $\cos x$

b. $\tan x$

(3 marks)

Acute angle $y = 180° - x$ has the same sine

Right-angled triangle: opp 5, hyp 13

$adj = \sqrt{(13^2 - 5^2)} = \sqrt{144} = 12$

a) cos is negative for an obtuse angle

$\cos x = -\cos y = -\frac{12}{13}$

$\boxed{\cos x = -\frac{12}{13}}$

b) tan is negative for an obtuse angle

$\tan x = -\tan y = -\frac{5}{12}$

$\boxed{\tan x = -\frac{5}{12}}$

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6 In triangle ABC, AB = 9 cm, AC = 6.5 cm and angle BAC = 130°.

Work out the area of triangle ABC. Give your answer correct to 1 decimal place. (2 marks)

Area = $\frac{1}{2}$ ab sin C, the angle between the two sides

$$\text{Area} = \frac{1}{2} \times 9 \times 6.5 \times \sin 130^\circ$$

$$= 22.406...$$

$22.4\ \text{cm}^2$

7 In triangle PQR, PQ = 5 cm, QR = 7 cm and PR = 10.5 cm.

Work out the size of angle PQR. Give your answer correct to 1 decimal place. (3 marks)

Cosine rule, angle Q is opposite PR

$$\cos Q = \frac{5^2 + 7^2 - 10.5^2}{2 \times 5 \times 7}$$

$$= \frac{-36.25}{70}$$

$$= -0.5178...$$

Negative cos, so Q is obtuse

$$Q = \cos^{-1}(-0.5178...) = 121.18...^\circ$$

121.2°

8 In triangle ABC, AB = 8 cm, BC = 5 cm and angle BAC = 32°.

Angle ACB is obtuse.

Work out the size of angle ACB. Give your answer correct to 1 decimal place. (3 marks)

Sine rule: C is opposite AB, A is opposite BC

$$\frac{\sin C}{8} = \frac{\sin 32^\circ}{5}$$

$$\sin C = \frac{8 \times \sin 32^\circ}{5} = 0.8478...$$

$$\sin^{-1}(0.8478...) = 57.98...^\circ$$

C is obtuse, so take it from 180°

$$C = 180^\circ - 57.98...^\circ = 122.01...^\circ$$

122.0°

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9 In triangle DEF, DE = 11 cm, EF = 7 cm and angle EDF = 25°.

Angle DFE is obtuse.

a. Work out the size of angle DFE. Give your answer correct to 1 decimal place.

b. Work out the length of DF. Give your answer correct to 1 decimal place.

(5 marks)

a) Sine rule: F is opposite DE, D is opposite EF

$$\frac{\sin F}{11} = \frac{\sin 25^\circ}{7}$$

$$\sin F = \frac{11 \times \sin 25^\circ}{7} = 0.6641...$$

$$\sin^{-1}(0.6641...) = 41.61...^\circ$$

F is obtuse, so take it from 180°

$$F = 180^\circ - 41.61...^\circ = 138.38...^\circ$$

$\boxed{138.4^\circ}$

b) Angles in a triangle add to 180°

$$E = 180^\circ - 25^\circ - 138.38...^\circ = 16.61...^\circ$$

Sine rule again: DF is opposite E

$$\frac{DF}{\sin 16.61...^\circ} = \frac{7}{\sin 25^\circ}$$

$$DF = \frac{7 \times \sin 16.61...^\circ}{\sin 25^\circ} = 4.735...$$

$\boxed{4.7 \text{ cm}}$

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10 A triangular field ABC has AB = 120 m and AC = 85 m.

Angle ABC = 38° and angle ACB is obtuse.

Work out the area of the field. Give your answer in m^2 correct to 3 significant figures. (5 marks)

Sine rule: C is opposite AB, B is opposite AC

$$\frac{\sin C}{120} = \frac{\sin 38^\circ}{85}$$

$$\sin C = \frac{120 \times \sin 38^\circ}{85} = 0.8691...$$

$$\sin^{-1}(0.8691...) = 60.36...^\circ$$

C is obtuse, so take it from 180°

$$C = 180^\circ - 60.36...^\circ = 119.63...^\circ$$

Need the angle between AB and AC

$$A = 180^\circ - 38^\circ - 119.63...^\circ = 22.36...^\circ$$

$$\text{Area} = \frac{1}{2} \times 120 \times 85 \times \sin 22.36...^\circ$$

$$= 1940.35...$$

$$\boxed{1940\ m^2}$$

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