Practical trigonometry - Practice test 4: design and survey

10 questions | 50 marks | 75 minutes

Use degree mode. Give calculated lengths and angles to one decimal place unless stated otherwise; bearings use three digits to the nearest degree. In triangle ABC, a is opposite A, b opposite B and c opposite C. Show working, units and reasons for rejected solutions.

Equivalent correct methods earn the corresponding marks.

1. Two similar triangular panels have corresponding length ratio 3:7. The smaller panel has a side of 21 cm and area 45 cm². [4 marks]

(a) Find the corresponding larger side. [2 marks]

The enlargement factor is 7/3.

21×7/3=49.

Answer: 49 cm

(b) Find the larger area. [2 marks]

Area factor=(7/3)²=49/9.

45×49/9=245.

Answer: 245 cm²

2. A symmetrical roof section has horizontal span 10 m and vertical rise 3 m. A vertical line through the centre divides it into equal right triangles. [5 marks]

(a) Find each sloping roof length. [2 marks]

Each half has legs 5 m and 3 m.

L=√(5²+3²).

Answer: 5.8 m

(b) Find the roof angle above horizontal and the triangular cross-sectional area. [3 marks]

θ=tan⁻¹(3/5).

K=½×10×3=15 m².

Answer: 31.0°; 15 m².

3. A rectangular floor is 18 m by 24 m. A post 7 m high stands vertically at one corner. A cable runs from its top to the opposite floor corner. [5 marks]

(a) Find the floor diagonal. [2 marks]

$d=\sqrt{(18^2+24^2)}=30$.

Answer: 30 m

(b) Find the cable length. [3 marks]

The vertical post and floor diagonal are perpendicular.

$L=\sqrt{(30^2+7^2)}=\sqrt{949}$.

Answer: 30.8 m

4. A ramp rises 0.75 m. Its design limit is a rise of 1 m for every 12 m horizontally. Use the limiting slope. [5 marks]

(a) Find the required horizontal run and the sloping length. [3 marks]

Horizontal run$=0.75\times12=9$ m.

Length$=\sqrt{(9^2+0.75^2)}$.

Answer: 9 m; 9.0 m.

(b) Find the ramp angle above horizontal. [2 marks]

$\tan\theta=0.75/9=1/12$.

Answer: 4.8°

5. An observer’s eyes are 1.65 m above level ground. A building is 25 m horizontally away. Elevation to its roof is 22°. [4 marks]

(a) Find building height. [2 marks]

Rise above eyes=25tan22°.

H=1.65+25tan22°.

Answer: 11.8 m

(b) If the observer steps 5 m farther away along the same level line, does the elevation increase or decrease? Explain. [2 marks]

The same vertical rise is divided by a larger horizontal distance.

The tangent ratio, hence the acute elevation angle, decreases.

Answer: It decreases.

6. A vessel travels 12 km on bearing 350°, then 9 km on bearing 080°. [6 marks]

(a) Show the two travel directions are perpendicular, then find direct distance from the start. [3 marks]

The clockwise change across north is 10°+80°=90°.

$d=\sqrt{(12^2+9^2)}=15$ km.

Answer: 90° apart; direct distance 15 km.

(b) Find the final bearing from the start. [3 marks]

E=12sin350°+9sin80°≈6.8 km.

N=12cos350°+9cos80°≈13.4 km.

The point is north-east; bearing=$\tan^{-1}(E/N)$.

Answer: 027°

7. A triangular solar plot has sides 40 m and 55 m enclosing 70°. [5 marks]

(a) Calculate the area. [2 marks]

K=½×40×55sin70°.

Answer: 1033.7 m²

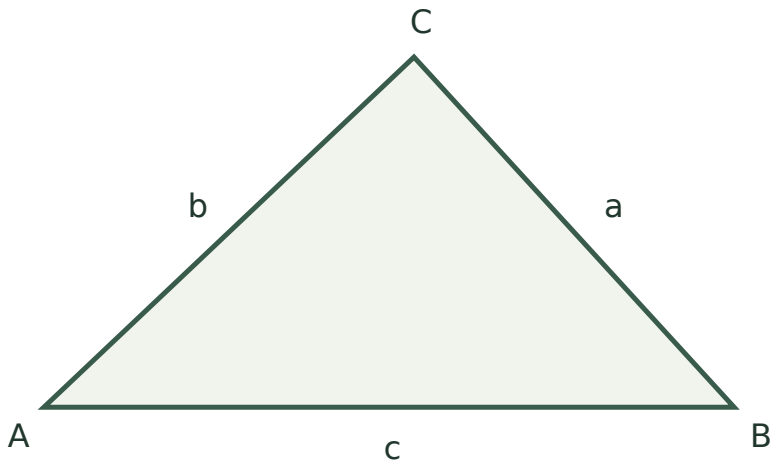
(b) Fencing is required on the third side only. Find that side and its cost at 18 dollars per metre. [3 marks]

Use cosine rule for the third side.

Multiply its unrounded length by 18 and round money to cents.

Answer: 55.9 m; 1005.44 dollars.

8. Triangle ABC has A=37°, B=83° and b=18 m. [5 marks]



Sketch not to scale

(a) Find C and a. [3 marks]

C=180°−37°−83°=60°.

a=18sin37°/sin83°.

Answer: 60°; a=10.9 m.

(b) Find c and check which side should be longest. [2 marks]

c=18sin60°/sin83°.

B=83° is the largest angle, so b=18 m must be longest.

Answer: c=15.7 m; b is longest.

9. A triangle has sides 6 cm, 11 cm and 14 cm. [5 marks]

(a) Find its largest angle. [2 marks]

The largest angle is opposite side 14.

$\cos A=(6^2+11^2-14^2)/(2\times6\times11)$.

Answer: 107.2°

(b) Find its area without treating any two sides as perpendicular. [3 marks]

The angle found is included between sides 6 and 11.

$K=\frac{1}{2}\times6\times11\sin A$.

Answer: 31.5 cm²

10. A 45 m straight baseline AB and marker P form a triangle, with $PAB=48°$ and $PBA=72°$. All measurements are horizontal. [6 marks]

(a) Find angle P and AP. [3 marks]

$P=180°-48°-72°=60°$.

$AP=45\sin72°/\sin60°$.

Answer: 60°; AP=49.4 m.

(b) Find perpendicular distance from P to AB, and state one practical assumption. [3 marks]

$h=AP\sin48°$, using unrounded AP.

A suitable assumption connects the ideal triangle to the survey.

Answer: 36.7 m. Assume the baseline/sightings represent straight lines on a level horizontal plane.