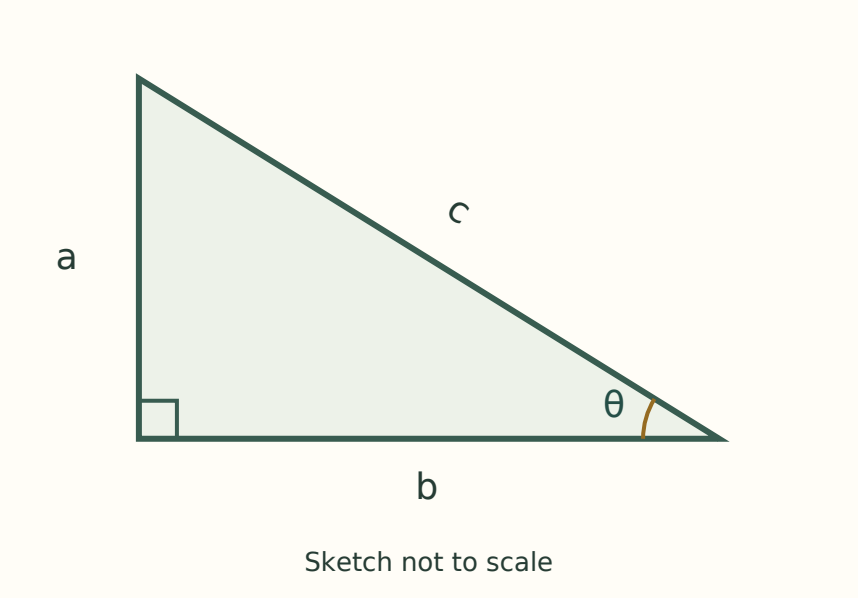
Pythagoras and Trigonometry - Applications paper

16 questions | 59 marks | 60 minutes

Apply right-triangle geometry to diagrams, lengths, angles and contextual decisions.

Equivalent correct methods earn the corresponding marks.

1. In the sight-line model, state what each side represents. [3 marks]



Sketch not to scale

The sight line is hypotenuse; the other sides are perpendicular.

Answer: a: vertical height above eyes; b: horizontal distance; c: sight-line length

2. A garden drawing is a 3 cm by 4 cm rectangle at scale $1:200$. Find the actual diagonal in metres. [3 marks]

Drawing diagonal $=\sqrt{9+16}=5$ cm.

Actual $=5\times200=1000\ \text{cm}=10\ \text{m}$.

Answer: 10 m

3. A square has diagonal 12 cm. Find its side as an exact square root, then to two decimal places. [3 marks]

$s^2 + s^2 = 144$, so $s^2 = 72$.

$s = \sqrt{72} \approx 8.49$ cm.

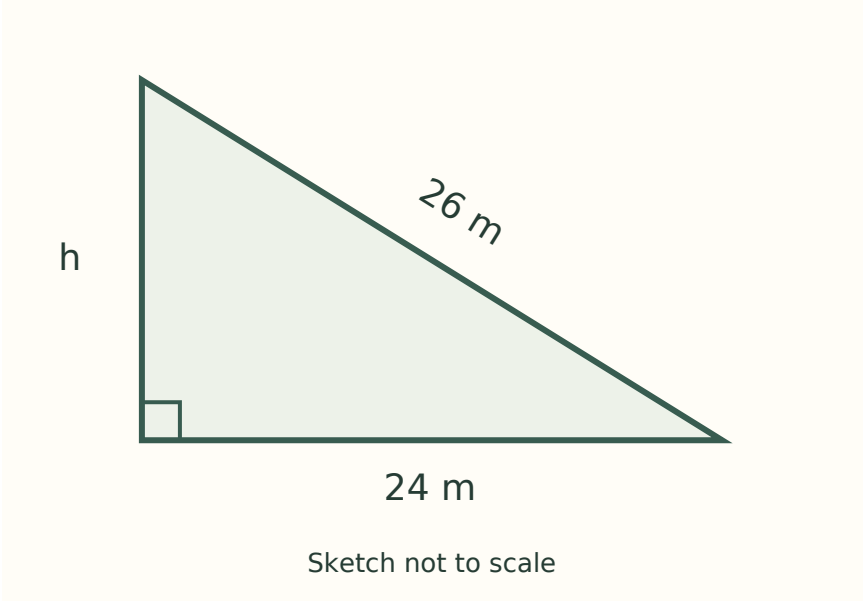
Answer: $\sqrt{72}$ cm; 8.49 cm

4. A rectangular frame is 0.9 m high and 1.2 m wide. Find one diagonal brace length. [3 marks]

$L = \sqrt{0.81 + 1.44} = \sqrt{2.25} = 1.5$ m.

Answer: 1.5 m

5. A taut 26 m cable runs from level ground to the top of a vertical mast. Its anchor is 24 m horizontally from the base. Find the height. [3 marks]



Sketch not to scale

$h = \sqrt{26^2 - 24^2} = 10$ m.

Answer: 10 m

6. A straight hill rises 9 m over 15 m horizontally. Find its inclination to two decimal places. [3 marks]

$\theta = \tan^{-1}\left(\frac{9}{15}\right)$.

Answer: 30.96°

7. A 20 m ladder slides from having its foot 12 m from the wall to 16 m from it. How far does the top drop? [4 marks]

First height $= \sqrt{400 - 144} = 16$ m.

Second height $= \sqrt{400 - 256} = 12$ m.

Drop $= 16 - 12 = 4$ m.

Answer: 4 m

8. A vertical tree casts an 8 m shadow on level ground. The Sun's elevation is 35°. Find the height to two decimal places. [3 marks]

$h = 8\tan 35^\circ$.

Answer: 5.60 m

9. A kite is 45 m vertically above its ground-level anchor and has a taut 60 m string. Find its angle to horizontal to two decimal places. [3 marks]

$\sin\theta = \frac{45}{60}$.

$\theta = \sin^{-1}\left(\frac{45}{60}\right)$.

Answer: 48.59°

10. An observer is 24 m above a level beach. A boat is seen at 18° below horizontal. Find the horizontal distance to two decimal places. [4 marks]

The angle of elevation from the boat is also 18°.

$\tan 18^\circ = \frac{24}{d}$, so $d = \frac{24}{\tan 18^\circ}$.

Answer: 73.86 m

11. An observer's eyes are 1.4 m above level ground, 10 m horizontally from a wall. The top is at 35° above horizontal. Find wall height to two decimal places. [4 marks]

Height above eyes $= 10\tan 35^\circ$.

Total height $= 1.4 + 10\tan 35^\circ$.

Answer: 8.40 m

12. A tree top is seen from ground level at 27°, 20 m from the base. A nearer point on the same line sees it at 45°. How much closer is the nearer point? Give two decimal places. [5 marks]

$h = 20\tan 27^\circ \approx 10.1905$ m.

At 45°, $\frac{h}{d} = 1$, so $d = h$.

Closer by $20 - 20\tan 27^\circ \approx 9.81$ m.

Answer: 9.81 m

13. A park is an 84 m by 112 m rectangle. How much shorter is its diagonal than walking along two adjacent sides? [4 marks]

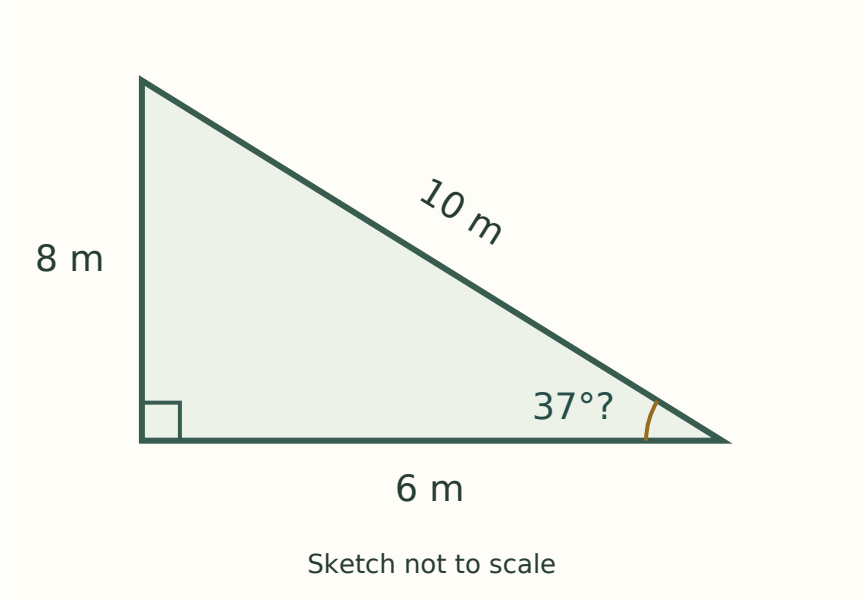
Diagonal $= \sqrt{84^2 + 112^2} = 140$ m.

Two sides total 196 m.

Saving $= 196 - 140 = 56$ m.

Answer: 56 m

14. A survey sketch labels opposite 8 m, adjacent 6 m and $\theta = 37^\circ$. Is the angle consistent? Explain. [4 marks]



Sketch not to scale

$\theta = \tan^{-1}\left(\frac{8}{6}\right) \approx 53.13^\circ$.

37° is approximately the other acute angle.

Answer: No; $\theta \approx 53.13^\circ$

15. Similar triangles have $\theta = 25^\circ$ and hypotenuses 10 cm and 20 cm. Answer each part. [5 marks]

(a) Find both opposite lengths to two decimal places. [3 marks]

$o_1 = 10\sin 25^\circ$; $o_2 = 20\sin 25^\circ$.

Answer: 4.23 cm and 8.45 cm

(b) Why is $\frac{\text{opposite}}{\text{hypotenuse}}$ unchanged? [2 marks]

Same acute angle means similar right triangles.

Answer: Both ratios equal $\sin 25^\circ$.

16. A window is 18 m above level ground. An observer’s eyes are 1.5 m above the same ground and see it at 40° above horizontal. Find horizontal distance to two decimal places. [5 marks]

The height difference is $18 - 1.5 = 16.5$ m.

$\tan 40^\circ = \frac{16.5}{d}$.

$d = \frac{16.5}{\tan 40^\circ} \approx 19.66$ m.

Answer: 19.66 m