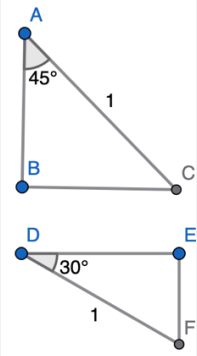


Check Your Understanding 7.4

Show all work. Estimate from the class trig table before using a calculator.

Basic	Intermediate	Advanced
Row 2 Spiral — Solving for Missing Sides → Using invariants		
<i>Basic — Spiral</i> 1. Estimate first, then solve. (a) Right triangle: 57° angle, hyp = 14 m. Find both legs. (b) Ramp: 12° angle, horizontal = 8 m. Find height and slope length.	<i>Intermediate — Spiral</i> 2. An airplane climbs at 14° for 2 km along its flight path. How high has it climbed? What is its horizontal distance? 3. A person 40 m from a building: angle of elevation to the top is 53° , to a window is 22° . Find the window height.	<i>Advanced — Spiral</i> 4. A ship travels 28° from north for 60 km, then due east for 45 km. How far is it from the start? What bearing returns it to the start?
Row 3 Spiral — Solving for Missing Angles → Inverting the function		
<i>Basic — Spiral</i> 5. A 10 m ladder leans against a wall, base 4 m from the wall. (a) How high does the ladder reach? (b) Angle with the ground? (c) Angle with the wall?	<i>Intermediate — Spiral</i> 6. A cable car travels 800 m along a slope, rising 310 m vertically. Find the angle and horizontal distance covered.	<i>Advanced — Spiral</i> 7. Two ships leave port simultaneously. Ship A heads due north at 18 km/h. Ship B heads due east at 24 km/h. After 3 hours, find the straight-line distance between the two ships. Then find the angle that the line connecting the two ships makes with Ship A's northward path, measured at Ship A's position.
Special Right Triangles → Exact values worth deriving		
<i>Basic</i> 8. Fill in all side lengths exactly. No decimals.	<i>Intermediate</i> 11. A square has diagonal 8 cm. Find the exact side length. 12. An equilateral triangle has side 12. Find its exact height.	<i>Advanced</i> 14. Reconstruct the 30-60-90 derivation from scratch. Start from an equilateral triangle, justify every step, include a labeled diagram.

Basic	Intermediate	Advanced
 9. 45-45-90 triangle with hypotenuse 6. Find both legs exactly. 10. 30-60-90 triangle with hypotenuse 10. Find both legs exactly.	13. Without a calculator, is $\sin 50^\circ$ closer to 0.707 or 0.866? Explain.	15. Verify $\sin^2 60^\circ + \cos^2 60^\circ = 1$ using exact values. Give a geometric argument for why this holds for any acute θ.
Algebra Spiral Factor	<i>Algebra Spiral</i> Factor each expression completely. (a) $x^2 - x - 30$ (b) $6m^2 - 24m$ (c) $5n^2 - 45$	

Answers — CYU 7.4**Row 2 Spiral**

- 1a. opp = $14 \sin 57^\circ \approx 11.74$ m, adj = $14 \cos 57^\circ \approx 7.62$ m.
 1b. $h = 8 \tan 12^\circ \approx 1.70$ m. Slope = $8/\cos 12^\circ \approx 8.18$ m.
 2. Height = $2 \sin 14^\circ \approx 0.484$ km. Horizontal = $2 \cos 14^\circ \approx 1.941$ km.
 3. Top = $40 \tan 53^\circ \approx 53.1$ m. Window = $40 \tan 22^\circ \approx 16.2$ m.
 4. $E = 60 \sin 28^\circ \approx 28.2$, $N = 60 \cos 28^\circ \approx 53.0$. Total E = 73.2, N = 53.0. Dist = $\sqrt{(73.2^2 + 53.0^2)} \approx 90.5$ km.

Row 3 Spiral

- 5a. $\sqrt{84} \approx 9.17$ m.
 5b. $\cos^{-1}(4/10) \approx 66.4^\circ$.
 5c. 23.6° .
 6. $\sin^{-1}(310/800) \approx 22.8^\circ$. Horizontal ≈ 738 m.
 7. 90 km. The angle at Ship A between its path (north) and the line to Ship B = $\arctan(72/54) \approx 53.1^\circ$.

Special Right Triangles

8. 45-45-90: legs = $\sqrt{2}/2$. 30-60-90: short = $1/2$, long = $\sqrt{3}/2$.
 9. $3\sqrt{2}$.
 10. Short = 5, long = $5\sqrt{3}$.
 11. $4\sqrt{2}$.
 12. $6\sqrt{3}$.
 13. $\sin 45^\circ \approx 0.707$ and $\sin 60^\circ \approx 0.866$. 50° is between, closer to 45° , so closer to 0.707.
 14. Equilateral $\triangle$ side 2. Altitude bisects base. Right $\triangle$: hyp = 2, short = 1. $h^2 = 4 - 1 = 3$. $h = \sqrt{3}$. Sides: 1, $\sqrt{3}$, 2. ■
 15. $(\sqrt{3}/2)^2 + (1/2)^2 = 3/4 + 1/4 = 1$. ✓. Geometric: hyp = 1, legs = $\sin \theta$ and $\cos \theta$. Pythagoras gives $\sin^2 \theta + \cos^2 \theta = 1$.

Algebra Spiral

- (a) $(x-6)(x+5)$
 (b) $6m(m-4)$
 (c) $5(n-3)(n+3)$