

Angle of Elevation and Angle of Depression

Some Applications of Trigonometry · concept summary & worked example

The three terms that start every problem

Line of sight

The straight line from the observer's eye to the point on the object being viewed.

Angle of elevation

Angle the line of sight makes with the horizontal when the object is *above* eye level — you look **up**.

Angle of depression

Angle the line of sight makes with the horizontal when the object is *below* eye level — you look **down**.

Core formulas

THE WORKHORSE RATIO

$$\tan \theta = \frac{\text{opposite}}{\text{adjacent}} = \frac{\text{height}}{\text{horizontal distance}}$$

Use tan whenever a height and a base distance are both involved. Use sin or cos only when a slant length (ladder, rope, wire) is given as the hypotenuse.

THE EQUAL-ANGLE RULE

$$\text{angle of depression (from the top)} = \text{angle of elevation (from the bottom)}$$

The observer's horizontal and the ground are parallel; the line of sight is a transversal — so the two angles are alternate interior angles. This is what lets you copy a depression angle down into the ground-level right triangle.

STANDARD ANGLE VALUES YOU MUST KNOW

$$\tan 30^\circ = \frac{1}{\sqrt{3}} \cdot \tan 45^\circ = 1 \cdot \tan 60^\circ = \sqrt{3}$$

$\sqrt{3} \approx 1.732$ and $1/\sqrt{3} \approx 0.577$. Almost every board question uses 30° , 45° or 60° .

Elevation vs depression at a glance

Feature	Angle of elevation	Angle of depression
Object is	above eye level	below eye level
You	raise your head	lower your head
Typical set-up	observer on ground looks at a tower top	observer on a height looks at a car below

Key Takeaways

- ▶ The angle is always **at the observer's eye** — never at the top of the object.
- ▶ **Looking up = elevation. Looking down = depression.** The object's own height is irrelevant.
- ▶ A depression angle given "up high" must be **copied down** as the equal elevation angle before you can solve.
- ▶ Height (opposite) + base distance (adjacent) $\Rightarrow$ **use $\tan \theta$** .
- ▶ If the observer's eye is above the ground, **add that height back** at the end.

Worked example — using the equal-angle rule

QUESTION

From the top of a **30 m** tall building, the angle of depression of a car parked on the road is **30°**. How far is the car from the base of the building?

- 1 **Draw the figure.** The building is vertical, the road is horizontal. Mark the horizontal line through the observer at the top, and the line of sight running down to the car.
- 2 **Move the angle down.** The 30° is a depression angle at the top. By the equal-angle rule, the angle of *elevation* of the building's top, seen from the car, is also **30°**. Mark it at the car.
- 3 **Name the sides.** In the right triangle at ground level, the 30 m height is **opposite** the 30° angle, and the required distance d is **adjacent** to it.
- 4 **Choose the ratio.** Opposite and adjacent together $\Rightarrow$ use **tan**: $\tan 30^\circ = 30 \div d$
- 5 **Solve.** $d = 30 \div \tan 30^\circ = 30 \div (1/\sqrt{3}) = 30\sqrt{3}$

Answer: $d = 30\sqrt{3} \text{ m} \approx 30 \times 1.732 \approx \mathbf{51.96 \text{ m}}$. The car is about 52 m from the base of the building.

Where marks are lost: leaving the 30° at the top and trying to solve a triangle that has no right angle in the right place. Copy the angle down first — then the problem becomes a one-line tan calculation.

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