

Trigonometry Team

SCHOOL _____

All answers must be exact unless otherwise stated, i.e., they may contain π , radicals, fractions, terminating or repeating decimals, but they may NOT contain decimal approximations. Fractions must be expressed in lowest terms (e.g., $\frac{1}{2}$ instead of $\frac{4}{8}$) and radicals must be expressed in simplest radical form (e.g., $2\sqrt{2}$ instead of $\sqrt{8}$). Place all answers in the blank space provided. Include units in your answers where appropriate.

1. **A Tall Tale:** On a sunny day, a 3-meter-tall streetlight casts a 2-meter shadow. If a nearby tree casts a 7-meter shadow, how tall is the tree? *Round the answer to one decimal place value.*

1 _____

2. **Slippery Slope:** A road climbs up a hill at an angle of 12° with the horizontal. If the road extends 500 meters, how much vertical elevation does it gain? *Round the answer to two decimal place value.*

2 _____

3. **Lighthouse Rotation:** A lighthouse beacon completes one full rotation every 15 seconds. What is the angular speed of the beacon in radians per minute?

3 _____

4. **Cosine Composition:** Express $\cos^2\left(\frac{4\pi}{9}\right) - \sin^2\left(\frac{4\pi}{9}\right)$ as a single trigonometric function.

4 _____

5. **The Missing Fence:** A homeowner has a square garden with a diagonal measuring 20 feet. They want to determine the length of each side of the garden to plan for a fence installation.

5 _____

6. **Hanging by a Rope:** A 10-foot rope swings in a pendulum motion, forming a maximum angle of 30° from the vertical. How high does the end of the rope rise from its lowest position? *Round the answer to two decimal place value.*

6 _____

7. **Time for a Turn:** The hour hand of a clock is 4 inches long. How far does the tip of the hand travel from 1:00 PM to 4:00 PM, in terms of π ?

7 _____

8. **Breaking Free:** A roller coaster drops at an angle of 60° down a 45-meter descent. How far does it travel horizontally before leveling out? *Round the answer to one decimal place value.*

8 _____

9. **Tricky Tangents:** Evaluate $\tan\left[\cot^{-1}\left(\frac{8}{15}\right)\right]$ exactly.

9 _____

10. **Secret Sin:** If $\sin(\theta) = \frac{-4}{5}$ and θ lies in the third quadrant, find $\cos(2\theta)$ exactly.

10 _____