Instructions: All work is to be shown, done in pencil, legible, simplified and answers/solutions are to be boxed in the space provided. You are to work alone and any student caught cheating will receive a zero. You are allowed to only use a scientific calculator! Answers/solutions to word problems are to be written in a complete sentence with the correct units. Moreover, you will be allotted 2 hours for this exam. If you finish early, then go back and check your work and answers. Students are not allowed to leave the room and return. So, if you have to use the restroom, please use it before starting the exam. Before you begin, remember to turn all phones off. Failure to comply with any of these instructions may result in a zero.
1. (2 pts) In the adjoining figure, \( r \) and \( s \) are parallel lines and \( t \) is the transversal. Assuming that \( A = (5x + 70)^\circ \) and \( B = (4x + 29)^\circ \), find the measure of \( \alpha \) and \( \beta \).

\[
\begin{align*}
A + B &= 180 \\
5x + 70 + 4x + 29 &= 180 \\
9x + 99 &= 180 \\
9x &= 81 \\
x &= 9
\end{align*}
\]

\( A = 5(9) + 70 = 115^\circ \) and \( B = 4(9) + 29 = 65^\circ \)

2. (1 pt each) Find the exact value of each expression

a) \( 2 \sin 45^\circ \cos 45^\circ \)

\[
= 2 \left( \frac{1}{\sqrt{2}} \right) \left( \frac{1}{\sqrt{2}} \right) = \frac{\sqrt{2}}{2} \cdot \frac{1}{2} = \frac{\sqrt{2}}{4}
\]

b) \( \sin 60^\circ + \sin 30^\circ \)

\[
= \frac{\sqrt{3}}{2} + \frac{1}{2} = \frac{\sqrt{3} + 1}{2}
\]

c) \( (\sin 30^\circ + \cos 30^\circ)^2 \)

\[
= \sin^2 30^\circ + 2 \sin 30^\circ \cos 30^\circ + \cos^2 30^\circ
= 1 + 2 \left( \frac{1}{2} \right) \left( \frac{\sqrt{3}}{2} \right)
= 1 + \frac{\sqrt{3}}{2}
= \frac{2 + \sqrt{3}}{2}
\]
3. (2pts) Find the values of $x$ assuming that the point $(x,-5)$ is on the terminal side of $	heta$ and $\sin \theta = -\frac{5}{13}$.

\[
\begin{array}{c}
\text{y} \\
12 \\
-12 \\
\text{x} \\
13 \\
-5 \\
-5
\end{array}
\]

\[\theta \circ \quad x = -12 \text{ or } x = 12\]

4. (2pts) Find the exact value of the remaining trigonometric function of $\theta$ if $\tan \theta = -\frac{3}{4}$ and $\cos \theta < 0$.

\[
\begin{array}{c}
\sin \theta = \frac{3}{5} \\
\cos \theta = -\frac{4}{5} \\
\tan \theta = -\frac{3}{4} \\
\csc \theta = \frac{5}{3} \\
\sec \theta = -\frac{5}{4} \\
\cot \theta = -\frac{4}{3}
\end{array}
\]
5. (2 pts each) Simplify to find the numerical value of each expression.

a) \((\sin \theta + \csc \theta)^2 + (\cos \theta + \sec \theta)^2 - \tan^2 \theta - \cot^2 \theta\)

\[= \frac{\sin^2 \theta + 2 \sin \theta \csc \theta + \csc^2 \theta + \cos^2 \theta + 2 \cos \theta \sec \theta + \sec^2 \theta}{\csc^2 \theta - \tan^2 \theta - \cot^2 \theta}\]

\[= 3 + 2 \sin \theta \csc \theta + 2 \cos \theta \sec \theta\]

\[= 3 + 2 + 2\]

\[= 7\]

b) \(\frac{\sec^2 \theta + 2 \tan^2 \theta}{1 + 3 \tan^2 \theta}\)

\[= \frac{1 + \tan^2 \theta + 2 \tan^2 \theta}{1 + 3 \tan^2 \theta}\]

\[= \frac{1 + 3 \tan^2 \theta}{1 + 3 \tan^2 \theta}\]

\[= 1\]

6. (2 pts) Assuming that \(\cot \theta = \frac{1}{\sqrt{3}}\) and \(\sin \theta > 0\), find the value of \(\frac{1 - \cos^2 \theta}{2 + \sin^2 \theta}\).

\[= \frac{1 - \left(\frac{1}{2}\right)^2}{2 + \left(\frac{\sqrt{3}}{2}\right)^2}\]

\[= 1 - \frac{\frac{1}{4}}{\frac{3}{4}}\]

\[= \frac{4 - 1}{8 + 3}\]

\[= \frac{3}{11}\]
7. (2pts) Through how many degrees does the minute hand of a clock move from 4:20pm to 5:10pm?

\[ \text{let } x = \text{degrees rotated by min. hand} \]
\[ \frac{10}{12} = \frac{x}{360} \]
\[ 12x = 3600 \]
\[ x = 300^\circ \]

\[ \text{The minute hand rotated } 300^\circ \]

8. (2pts) A ladder leaning against a vertical wall makes an angle of 37° with the ground. The foot of the ladder is 9 feet from the wall. Find the length of the ladder to the nearest tenth.

\[ \cos 37^\circ = \frac{9}{x} \]
\[ x = \frac{9}{\cos 37^\circ} \]
\[ x \approx 11.3 \text{ ft} \]

\[ \text{The ladder is about } 11.3 \text{ ft} \]

9. (2pts) A car is pushed 150 feet on a level street by a force of 60 pounds at angle of 18° with the horizontal. Find the work done pushing the car to the nearest tenth.

\[ W = (F \cos \theta) \cdot d \]
\[ W = (60 \cos 18^\circ) (150) \]
\[ W = 8559.5 \text{ ft-lb} \]

\[ \text{The work done pushing the car is about } 8559.5 \text{ ft-lb}. \]
10. (3pts) A camera is attached to a traffic signal 18 feet above the road. What angle to the nearest degree does the camera's line of sight make with the vertical when a car at a horizontal distance of 40 feet from the base of the signal is viewed?

\[ \tan \theta = \frac{40}{18} \]

\[ \theta \approx 66^\circ \]

The camera makes a 66° angle with the vertical.
11. (3 pts) From an observation tower 35 feet above a swamp, a tourist sees an alligator at an angle of depression of 20.5°. How far to the nearest foot is the alligator from the base of the tower?

Let \( x \) = distance of alligator from base.

\[
\tan 20.5^\circ = \frac{35}{x}
\]

\[x = \frac{35}{\tan 20.5^\circ}
\]

\[x \approx 94 \text{ ft}
\]

The alligator is about 94 ft away from the base of the tower.
12. (3pts) Two ships leave port at the same time, one sailing at a bearing of S23°W at 14 mph and the other sailing at a bearing of N67°W at 20 mph. What is the bearing to the nearest tenth from the second ship to the first ship after an hour?

We need to find \( m \angle B \).

\[
\tan B = \frac{14}{20}
\]

\( B \approx 35.0^\circ \)

The bearing of the first ship from the second ship is S32°E or 58° south of east.