

4) An airplane is flying at an altitude of 10,000 feet over a flat desert. In other words, its height from the ground is always 10,000 feet as far as we're concerned. It is flying on a line that takes it directly over an observer. (16 points total)

a) If the angle of elevation from the observer (specifically, the observer's shoes) to the plane is 53° , what is the distance from the observer to the plane? Round off your answer to the nearest foot.

b) Let's assume that, after some time has elapsed, the plane is now 12,000 feet away from the observer. The angle of elevation from the observer to the plane is no longer 53° , as it was in part a). Find the new angle of elevation. Round off your answer to the nearest tenth of a degree.

MIDTERM 3 – PART 2

(CHAPTER 4)

INTRODUCTION TO TRIGONOMETRY; MATH 141 – SPRING 2026 – KUNIYUKI

150 POINTS TOTAL: 30 FOR PART 1, AND 120 FOR PART 2

Show all work, simplify as appropriate, and use “good form and procedure” (as in class).

Box in your final answers!

No notes or books allowed.

PART 2: NO CALCULATORS ALLOWED! (120 POINTS)

If you are asked to evaluate an expression that is undefined, write “und.”

- 5) Fill out the table below. Rationalize denominators and simplify wherever appropriate. You do not have to show work. (28 points total)

θ	$\sin(\theta)$	$\cos(\theta)$	$\tan(\theta)$	$\sec(\theta)$
0				
$\frac{\pi}{6}$				
$\frac{\pi}{4}$				
$\frac{\pi}{3}$				
$\frac{\pi}{2}$				
xxx	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx	xxxxxxxxxxxx
$\frac{7\pi}{6}$				
$\frac{3\pi}{2}$				

6) Convert 80° into radians. (3 points)

7) Assuming $\tan(\theta) = 5$, find $\cot(-\theta)$. (3 points)

8) Assuming $\cos(\theta) = \frac{4}{5}$, find $\sec(-\theta)$. (3 points)

9) Complete the Identities. Fill out the table below so that, for each row, the left side is equivalent to the right side, based on the type of identity (ID) given in the last column. (8 points total)

Left Side	Right Side	Type of Identity (ID)
$\cot(\theta)$		Quotient ID
$\tan^2(\theta) + 1$		Pythagorean ID
$1 + \cot^2(\theta)$		Pythagorean ID
$\sec\left(\frac{\pi}{2} - \theta\right)$		Cofunction ID

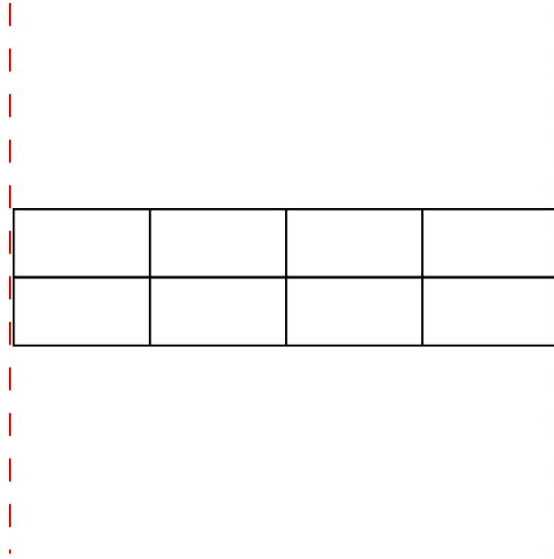
- 10) Fill out the table below. Use interval form (the one with parentheses and/or brackets) except where indicated. You do not have to show work. (24 points)

$f(x)$	Domain	Range
$\cos(x)$		
$\tan(x)$	Use set-builder form.	
$\cot(x)$	Use set-builder form.	
$\sec(x)$	Use set-builder form.	
$\sin^{-1}(x)$		
$\cos^{-1}(x)$		

- 11) Evaluate $\cot\left(\frac{7\pi}{2}\right)$. (3 points)

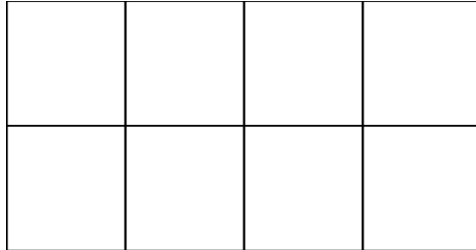
12) Graph one cycle of $y = 4 \tan\left(\frac{x}{3}\right)$.

Simplify and clearly label all key x - and y -coordinates next to each corresponding grid line. Superimpose the x - and y -axes. If you do not use the frame, make sure you provide all required information. (10 points)

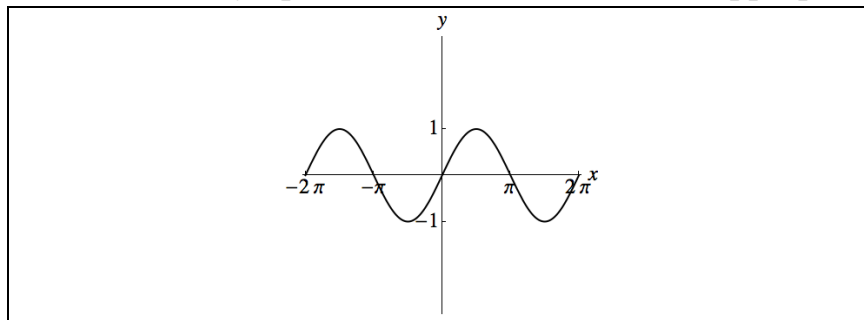


13) Graph one cycle of $y = -3\cos\left(5x - \frac{\pi}{2}\right) - 1$.

Simplify and clearly label all key x - and y -coordinates next to each corresponding grid line. Superimpose the x - and y -axes. If you do not use the frame, make sure you provide all required information. (16 points)



- 14) The graph of $y = \sin(x)$ appears in the box below. Graph two cycles of the graph of $y = \csc(x)$ in the box below by using the graph of $y = \sin(x)$ as a guide. Draw vertical asymptotes as dashed lines where appropriate. (5 points)



- 15) Evaluate $\arccos\left(-\frac{1}{2}\right)$, also written as $\cos^{-1}\left(-\frac{1}{2}\right)$. (2 points)
- 16) Evaluate $\arcsin\left(\sin\left(\frac{4\pi}{3}\right)\right)$, also written as $\sin^{-1}\left(\sin\left(\frac{4\pi}{3}\right)\right)$. (2 points)
- 17) Graph $y = \tan^{-1}(x)$, also known as $y = \arctan(x)$, in the usual xy -plane. Draw in the x - and y -axes, and clearly indicate any asymptotes and their corresponding coordinates. (6 points)

- 18) Write $\sec\left(\sin^{-1}\left(\frac{x}{3}\right)\right)$, also written as $\sec\left(\arcsin\left(\frac{x}{3}\right)\right)$, as an equivalent algebraic expression, as in class. Assume x is in the domain of the expression. (7 points)