Name: $\qquad$ Date: $\qquad$ Period: $\qquad$

### 7.7 MAT: Exploring the graphs of the Tangent and Cotangent functions

## Prerequisite Skills Review: (Do NOT use a calculator)

© State the zeros and the vertical asymptotes (VA) for each of the rational function below:

1. $y=\frac{x-3}{x+4}$
2. $y=\frac{x+5}{x-1}$
3. $y=\frac{x+1}{(x-2)(x+2)}$
4. $y=\frac{x+2}{x(x-3)}$
© Tell whether the function is even, odd, or neither:
5. $y=\sqrt[3]{x-4}+7$
6. $y=\frac{1}{x}$
7. $y=x^{2}+4$
© Evaluate:
8. $\cos 0=$
9. $\sin \frac{\pi}{6}=$
10. $\tan \frac{\pi}{4}=$
11. $\csc \frac{\pi}{3}=$
12. $\sec \frac{\pi}{2}=$
13. $\cot \frac{3}{2} \pi=$
14. $\tan -\frac{7}{6} \pi=$
15. $\cot \frac{\pi}{4}=$
16. $\sec \frac{13}{4} \pi=$
17. $\sin -\frac{17}{3} \pi=$
© State the period of the function:
18. $y=\cos (2 x)$
19. $y=\sin (3 x)$
20. $y=\sin \left(\frac{1}{3} X\right)$
21. $y=\cos \left(\frac{1}{2} X\right)$
22. What is the domain and range of the parent functions $y=\sin (x)$ and $y=\cos (x)$ ?
23. Is the domain and range you just stated for $\# 22$ also true for $y=\tan (x)$ and for $y=\cot (x)$ ?

Now you may get out the calculator (and/or use your unit circle) ©
I. Fill in the table for $y=\tan (x)$ in order to help sketch a graph of the function on the next page:

| Radians | 0 | $\frac{\pi}{6}$ | $\frac{\pi}{4}$ | $\frac{\pi}{3}$ | $\frac{\pi}{2}$ | $\frac{2}{3} \pi$ | $\frac{3}{4} \pi$ | $\frac{5}{6} \pi$ | $\pi$ | $\frac{7}{6} \pi$ | $\frac{5}{4} \pi$ | $\frac{4}{3} \pi$ | $\frac{3}{2} \pi$ | $\frac{5}{3} \pi$ | $\frac{7}{4} \pi$ | $\frac{11}{6} \pi$ | $2 \pi$ |
| :---: | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| X <br> degrees |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| y <br> Round to <br> tenths |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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II. Use the fact that $\tan (x)=\frac{\sin (x)}{\cos (x)}$ in order to find the zeros and the vertical asymptotes for $y=\tan (x)$ from $0 \leq x \leq 2 \pi$. (then compare your results to the points in your table or values)

Zeros:
VA:


## III. Graph $y=\tan (x)$

Recall that vertical asymptotes occur at values for $x$ that are not in the domain of the function, which also shows where the function is undefined. Include the vertical asymptotes in your graph and connect the points you plotted carefully showing how $y=\tan (x)$ infinitely approaches the VA, but never actually reaches it.
IV. a) What is the domain of $y=\tan (x)$ ?
b) What is the range of $y=\tan (x)$ ?
c) Is the graph $y=\tan x$ increasing or decreasing from left to right?
d) What is the period for $y=\tan (x)$ ? Where do you think the "usual" cycle starts and finishes?

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Important Properties of the Tangent Function:
1.
4.
7.
2.
5.
3.
6.

## Graphing $y=\cot (x)$

I. We can use the previous table of values that we already made along with the fact that $\cot (x)=\frac{1}{\tan (x)}$ in order to make a table of values for $\boldsymbol{y}=\cot (x)$ :
II. We can also use the fact that $\cot (x)=\frac{\cos (x)}{\sin (x)}$ in order to find the zeros and the vertical asymptotes for $y=\cot (x)$ from $0 \leq x \leq 2 \pi$. (compare your results to the points you find in your table or values)

Zeros: VA:

| Radians |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |


| $1.8{ }^{+}$ | + | + | + | + | + | + | + | + | + | + | + | + | 1 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1.6 | + | + | + | + | + | + | + | + | + | + | + | + | , |
| $1.4-$ | + | + | + | + | + | + | + | + | + | + | + | + | , |
| $1.2-$ | + | + | + | + | + | + | + | + | + | + | + | + | + |
| $1.0-$ | + | + | + | + | + | + | + | + | + | + | + | + | , |
| $0.8-$ | + | + | + | + | + | + | + | + | + | + | + | + | , |
| $0.6-$ | + | + | + | + | + | + | + | + | + | + | + | + | , |
| $0.4-$ | + | + | + | + | + | + | + | + | + | + | + | + | . |
| 0.2- | + | + | + | + | + | + | + | + | + | + | + | + | + |
|  | 30 | 6 | $9{ }^{1}$ | ${ }_{120}^{12}$ | 150 | 180 | 210 | 240 | 270 | 300 | 330 | 360 | $\xrightarrow{+1}$ |
| - | + | + | + | + | + | + | + | + | + | + | + | + | + |
| - | + | + | + | + | + | + | + | + | + | + | + | + | , |
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| - | + | + | + | + | + | + | + | + | + | $+$ | + | + | , |

Name: $\qquad$ Date: $\qquad$ Period: $\qquad$
III. a) What is the domain of $y=\cot (x)$ ?
b) What is the range of $y=\cot (x)$ ?
c) Is the graph $y=\cot x$ increasing or decreasing from left to right?
d) What is the period for $y=\cot (x)$ ? Where do you think the "usual" cycle starts and finishes?

## Important Properties of the Cotangent Function:

1. 
2. 
3. 
4. 
5. 
6. 

$$
y=A \tan (\omega x)+B
$$

and

$$
y=A \cos (\omega x)+B
$$

7. 

$\omega$ $\qquad$ B $\qquad$
IV. Graph $y=-2 \tan x$ by using its parent function as a reference:
a) Label axes: use a scale of $\frac{\pi}{2}$ on the $x$-axis and 0.5 on the $y$-axis
b) Graph $y=\tan (x)$ from $-3 \pi \leq x \leq 3 \pi$ :
-Include $x$-intercepts and the VA's
-Use the key points that occur at odd multiples of $\frac{\pi}{4}$
c) Graph $y=-2 \tan x$ by implementing the appropriate transformations (use a different color)

V. Graph $y=\cot (x)+3$ by using its parent function as a reference:
c) Label axes: use a scale of $\frac{\pi}{2}$ on the $x$-axis and 0.5 on the $y$-axis
d) Graph $y=\cot (x)$ from $-3 \pi \leq x \leq 3 \pi$ :
-Include $x$-intercepts and the VA's
-Use the key points that occur at odd multiples of $\frac{\pi}{4}$
c) Graph $y=\cot (x)+3$ by implementing the appropriate transformations (use a different color)
$\qquad$ Period: $\qquad$
Practice with multiple transformations()

1. Use the key points of the parent functions as reference in order to graph $y=-\tan (4 x)+2$

Determine the period, then scale and label the axes accordingly; include at least 3 full cycles. Use dashed lines for the VA's

2. Use the key points of the parent functions as reference in order to $\operatorname{graph} y=-3 \cot \left(\frac{1}{2} x\right)-1$

Determine the period, then scale and label the axes accordingly; include at least 3 full cycles. Use dashed lines for the VA's


