KEY

Project 2: Graph of Tangent

Read the directions carefully! Points will be deducted for missing parts. Write your group members' names on this page. This project is worth 36 points.

We're going to make a graph of the tangent function. This time, we'll measure the angles in radians.

Start by filling out the table, with inputs every $\frac{\pi}{12}$ radians (or 15°). Use your calculator to get the numbers. Round numbers to the nearest hundredth if necessary.

On page 3, graph a point for every $\frac{\pi}{12}$ radians, and then use those points to complete your tangent graph. Make sure to graph all the way from the left edge to the right edge of the page. (That means you'll need to identify the pattern that shows up in the values you've actually calculated, and continue it.)

Notice that tangent has vertical asymptotes. Use dotted lines on your graph to show them.

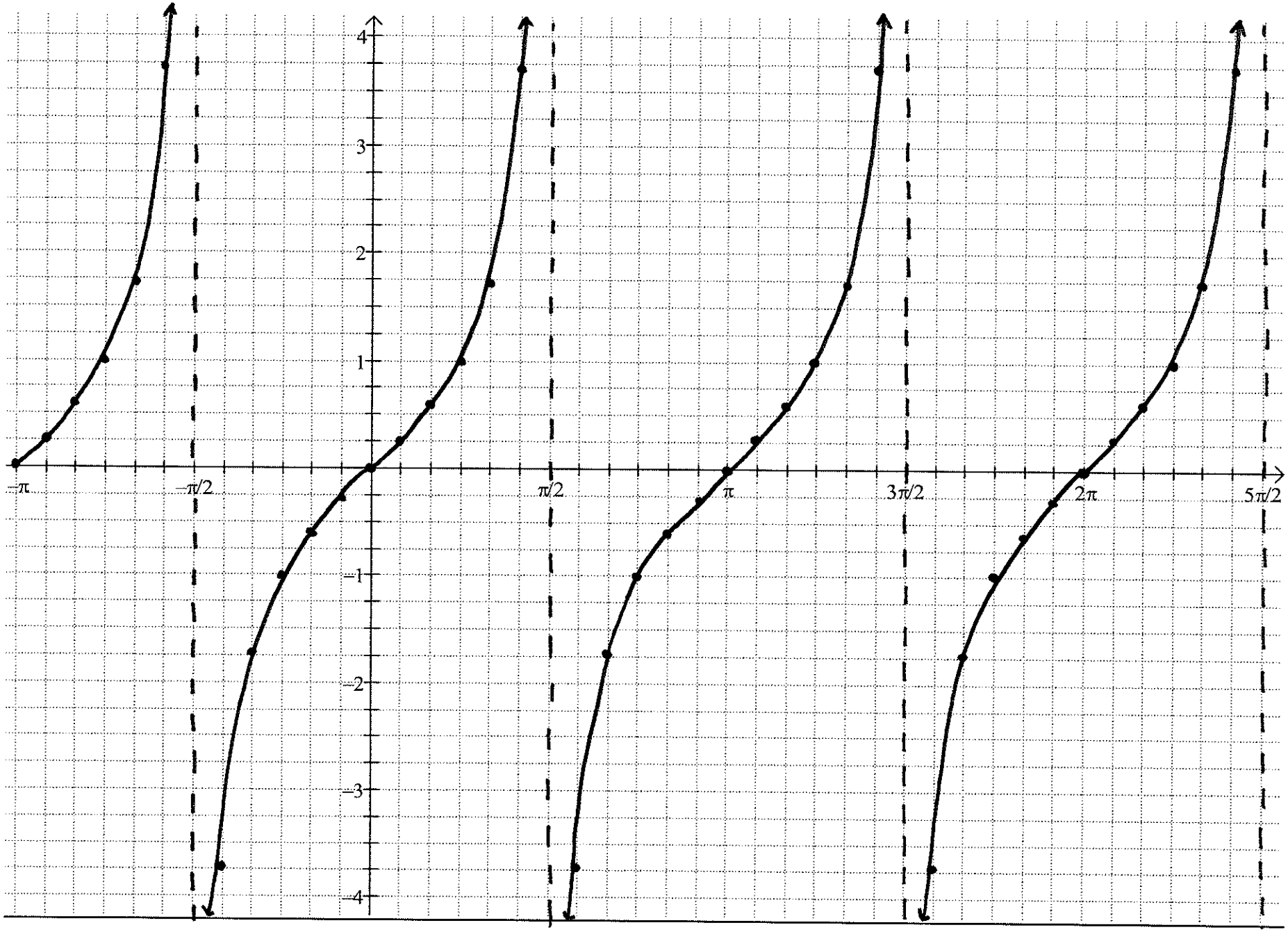
θ (in degrees)	θ (in radians)	$\tan(\theta)$ (in decimal form)
0°	0	0
15°	$\frac{\pi}{12}$	0.27
30°	$\frac{2\pi}{12} = \frac{\pi}{6}$	0.58
45°	$\frac{3\pi}{12} = \frac{\pi}{4}$	1
60°	$\frac{4\pi}{12} = \frac{\pi}{3}$	1.73
75°	$\frac{5\pi}{12}$	3.73
90°	$\frac{6\pi}{12} = \frac{\pi}{2}$	undefined
105°	$7\pi/12$	-3.73
120°	$8\pi/12 = 2\pi/3$	-1.73
135°	$9\pi/12 = 3\pi/4$	-1
150°	$10\pi/12 = 5\pi/6$	-0.58
165°	$11\pi/12$	-0.27
180°	$12\pi/12 = \pi$	0

Grading Rubric

- 6 pts for the chart
- 6 pts for the graph
- 2 pts for drawing in the asymptotes
- In questions (1) & (2):
  - 2 pts for each of the 3 ways you showed the angles
  - 3 pts for explanations
- In question (3):
  - 1 pt for period
  - 3 pts for explanation

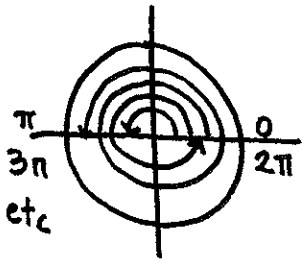
θ (in degrees)	θ (in radians)	$\tan(\theta)$ (in decimal form)
195°	$\frac{13\pi}{12}$	0.27
210°	$14\pi/12 = 7\pi/6$	0.58
225°	$15\pi/12 = 5\pi/4$	1
240°	$16\pi/12 = 4\pi/3$	1.73
255°	$17\pi/12$	3.73
270°	$18\pi/12 = 3\pi/2$	undefined
285°	$19\pi/12$	-3.73
300°	$20\pi/12 = 5\pi/3$	-1.73
315°	$21\pi/12 = 7\pi/4$	-1
330°	$22\pi/12 = 11\pi/6$	-0.58
345°	$23\pi/12$	-0.27
360°	$24\pi/12 = 2\pi$	0
375°	$25\pi/12$	0.27
390°	$26\pi/12 = 13\pi/6$	0.58
405°	$27\pi/12 = 9\pi/4$	1

Note, the boxes along the *x*-axis on the graph paper on the next page are of length $\pi/12$.


4
3
2
1
−1
−2
−3
−4
−π
−π/2
π/2
π
3π/2
2π
5π/2

After you've finished the graphs, answer the following questions. All angle measure should be in radians, and when you are asked to explain, you should do so with one or more complete sentences.

(1) When is tan $(\theta) = 0$? **Show the answer three different ways:** by sketching the unit circle and showing the angles, by writing a list of the angles (at least 5 consecutive), and by writing a formula for the angles.



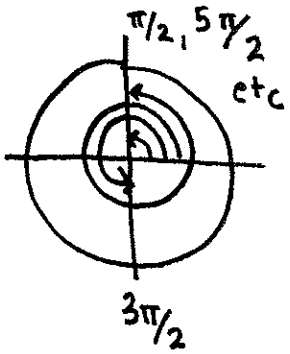
$0, \pi, 2\pi, 3\pi, 4\pi$

$n\pi$, where n is an integer

Using what you know about sine and cosine, explain why tangent equals 0 at those angles.

$\tan\theta = \frac{\sin\theta}{\cos\theta}$, so since $\sin\theta = 0$ for those angles due to their terminal sides lying on the x-axis, $\tan\theta = \frac{0}{\cos\theta} = 0$ there too.

(2) When is tan (θ) undefined? Show the answer three different ways: by sketching the unit circle and showing the angles, by writing a list of the angles (at least 5 consecutive), and by writing a formula for the angles.



$\pi/2, 3\pi/2, 5\pi/2, 7\pi/2, 9\pi/2$

$\pi/2 + n\pi$, where n is an integer

Using what you know about sine and cosine, explain why tangent is undefined at those angles.

$\cos\theta = 0$ at those angles since their terminal sides lie on the y-axis, so $\tan\theta = \frac{\sin\theta}{0}$ is undefined.

(3) What is the period of tan (θ)? That is, how often does it repeat itself?

π

Why is it different from the periods of sine and cosine?

Sine & cosine are determined by the coordinates of a point on the unit circle. That cycle does not repeat until the point travels all the way (2π radians) around the circle.

Tangent is determined by the slope of the terminal side of the angle. Since points on the opposite sides of the circle (π radians apart) are on terminal sides with the same slope, the tangent cycle repeats every π radians.