

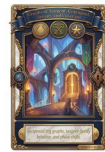
# Graphs of Tangent, Cotangent, Secant, and Cosecant

Reciprocal trig graphs, tangent-family behavior, and phase shifts.

Name \_\_\_\_\_ Date \_\_\_\_\_

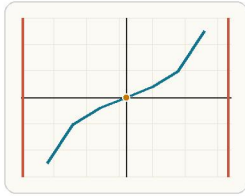
32 main 2-up grid 11 pages visible side quests

## Completion Reward



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### 1. What is the period of $y = \tan(x)$ ?



The basic tangent graph has period  $\pi$  and repeats from one asymptote interval to the next.

- A.  $2\pi$
- B.  $\pi / 2$
- C.  $\pi$
- D. 1

### 1.3. What is $\tan(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

### 2. Why does $y = \tan(x)$ have vertical asymptotes?

- A. Because sine is always 0.
- B. Because tangent is always negative.
- C. Because tangent never repeats.
- D. Because  $\tan(x) = \sin(x) / \cos(x)$  and cosine can be 0.

### 2.3. What is $\tan(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

### 3. What is $\sec(x)$ ?

- A.  $1 / \sin(x)$
- B.  $\cos(x) / \sin(x)$
- C.  $\sin(x) / \cos(x)$
- D.  $1 / \cos(x)$

### 3.3. What sign does $\sec(x)$ have in Quadrant II?

- A. positive
- B. negative
- C. undefined everywhere
- D. always 0

### 1.1. The period of $y = \tan(x)$ is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

### 1.4. At which angle is $\tan(x)$ undefined?

- A. 0
- B.  $\pi / 4$
- C.  $\pi / 2$
- D.  $\pi$

### 2.1. The period of $y = \tan(x)$ is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

### 2.4. At which angle is $\tan(x)$ undefined?

- A. 0
- B.  $\pi / 4$
- C.  $\pi / 2$
- D.  $\pi$

### 3.1. $\sec(x)$ is the reciprocal of:

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\csc(x)$

### 3.4. Why does a secant graph look like separate branches?

- A. cosine changes sign and passes through 0
- B. the period is not constant
- C. it has a midline of  $x = 0$
- D. it never repeats

### 1.2. $\tan(x)$ has vertical asymptotes because:

- A.  $\sin(x)$  can be 0
- B.  $\cos(x)$  can be 0
- C.  $\tan(x)$  is not periodic
- D. all trig graphs have them

### 1.5. When sketching $y = \tan(x)$ , a good first step is to:

- A. mark its vertical asymptotes
- B. find its amplitude
- C. identify its midline
- D. locate its maximum

### 2.2. $\tan(x)$ has vertical asymptotes because:

- A.  $\sin(x)$  can be 0
- B.  $\cos(x)$  can be 0
- C.  $\tan(x)$  is not periodic
- D. all trig graphs have them

### 2.5. When sketching $y = \tan(x)$ , a good first step is to:

- A. mark its vertical asymptotes
- B. find its amplitude
- C. identify its midline
- D. locate its maximum

### 3.2. $\sec(x)$ has a break wherever:

- A.  $\sin(x) = 0$
- B.  $\cos(x) = 0$
- C.  $\tan(x) = 1$
- D.  $x = 0$

### 3.5. What is $\sec(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

**4. What is  $\csc(x)$ ?**

- A.  $1 / \sin(x)$
- B.  $1 / \cos(x)$
- C.  $\cos(x) / \sin(x)$
- D.  $\sin(x) / \cos(x)$

**4.1.  $\csc(x)$  is the reciprocal of:**

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\cot(x)$

**4.2.  $\csc(x)$  is undefined wherever:**

- A.  $\cos(x) = 0$
- B.  $\sin(x) = 0$
- C.  $\tan(x) = 1$
- D.  $x = \pi / 4$

**4.3. In Quadrant III,  $\csc(x)$  is:**

- A. positive
- B. negative
- C. undefined
- D. always 0

**4.4. What is  $\csc(\pi / 2)$ ?**

- A. 0
- B. 1
- C. -1
- D. undefined

**4.5. Why does  $y = \csc(x)$  form separate branches?**

- A. it is not periodic
- B. it is the reciprocal of sine, so it breaks at sine zeros
- C. it always has slope 0
- D. it has no symmetry

**5. What is  $\cot(x)$ ?**

- A.  $\cos(x) / \sin(x)$
- B.  $\sin(x) / \cos(x)$
- C.  $1 / \cos(x)$
- D.  $1 / \sin(x)$

**5.1.  $\cot(x)$  equals:**

- A.  $\sin(x) / \cos(x)$
- B.  $\cos(x) / \sin(x)$
- C.  $1 / \cos(x)$
- D.  $1 / \sin(x)$

**5.2. The period of  $y = \cot(x)$  is:**

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

**5.3.  $\cot(x)$  is undefined wherever:**

- A.  $\sin(x) = 0$
- B.  $\cos(x) = 0$
- C.  $\tan(x) = 1$
- D.  $x = \pi / 4$

**5.4. What is  $\cot(\pi / 4)$ ?**

- A. 0
- B. 1
- C. -1
- D. undefined

**5.5. Compared to tangent, a basic cotangent graph:**

- A. also has period  $\pi$
- B. has no asymptotes
- C. never crosses the x-axis
- D. is not related to reciprocal trig

**6. Which statement about  $y = \tan(x)$  is true?**

- A. It starts at a maximum value of 1.
- B. It is defined for every real  $x$ .
- C. It crosses the origin and has repeating vertical asymptotes.
- D. It never changes sign.

**6.1. The period of  $y = \tan(x)$  is:**

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

**6.2.  $\tan(x)$  has vertical asymptotes because:**

- A.  $\sin(x)$  can be 0
- B.  $\cos(x)$  can be 0
- C.  $\tan(x)$  is not periodic
- D. all trig graphs have them

**6.3. What is  $\tan(0)$ ?**

- A. 0
- B. 1
- C. -1
- D. undefined

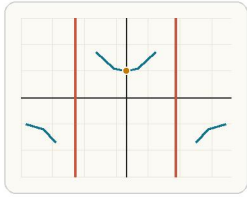
**6.4. At which angle is  $\tan(x)$  undefined?**

- A. 0
- B.  $\pi / 4$
- C.  $\pi / 2$
- D.  $\pi$

**6.5. When sketching  $y = \tan(x)$ , a good first step is to:**

- A. mark its vertical asymptotes
- B. find its amplitude
- C. identify its midline
- D. locate its maximum

**7. Why do secant graphs have branches instead of one connected curve?**



Secant is the reciprocal of cosine, so the graph separates into branches at the angles where cosine is 0.

- A. Because secant is always positive.
- B. Because secant has no period.
- C. Because secant is undefined where cosine is 0.
- D. Because secant equals tangent squared.

**7.3. What sign does  $\sec(x)$  have in Quadrant II?**

- A. positive
- B. negative
- C. undefined everywhere
- D. always 0

**7.1.  $\sec(x)$  is the reciprocal of:**

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\csc(x)$

**7.2.  $\sec(x)$  has a break wherever:**

- A.  $\sin(x) = 0$
- B.  $\cos(x) = 0$
- C.  $\tan(x) = 1$
- D.  $x = 0$

**7.4. Why does a secant graph look like separate branches?**

- A. cosine changes sign and passes through 0
- B. the period is not constant
- C. it has a midline of  $x = 0$
- D. it never repeats

**7.5. What is  $\sec(0)$ ?**

- A. 0
- B. 1
- C. -1
- D. undefined

**8. What is  $\tan(0)$ ?**

- A. 1
- B. -1
- C. undefined
- D. 0

**8.1. The period of  $y = \tan(x)$  is:**

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

**8.2.  $\tan(x)$  has vertical asymptotes because:**

- A.  $\sin(x)$  can be 0
- B.  $\cos(x)$  can be 0
- C.  $\tan(x)$  is not periodic
- D. all trig graphs have them

**8.3. What is  $\tan(0)$ ?**

- A. 0
- B. 1
- C. -1
- D. undefined

**8.4. At which angle is  $\tan(x)$  undefined?**

- A. 0
- B.  $\pi / 4$
- C.  $\pi / 2$
- D.  $\pi$

**8.5. When sketching  $y = \tan(x)$ , a good first step is to:**

- A. mark its vertical asymptotes
- B. find its amplitude
- C. identify its midline
- D. locate its maximum

**9. At which angle is  $y = \tan(x)$  undefined?**

- A.  $\pi / 4$
- B. 0
- C.  $\pi / 2$
- D.  $\pi / 6$

**9.1. The period of  $y = \tan(x)$  is:**

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

**9.2.  $\tan(x)$  has vertical asymptotes because:**

- A.  $\sin(x)$  can be 0
- B.  $\cos(x)$  can be 0
- C.  $\tan(x)$  is not periodic
- D. all trig graphs have them

**9.3. What is  $\tan(0)$ ?**

- A. 0
- B. 1
- C. -1
- D. undefined

**9.4. At which angle is  $\tan(x)$  undefined?**

- A. 0
- B.  $\pi / 4$
- C.  $\pi / 2$
- D.  $\pi$

**9.5. When sketching  $y = \tan(x)$ , a good first step is to:**

- A. mark its vertical asymptotes
- B. find its amplitude
- C. identify its midline
- D. locate its maximum

**10. Where does  $\sec(x)$  have a break?**

- A. Where  $\sin(x) = 0$
- B. Where  $\tan(x) = 0$
- C. Where  $\cos(x) = 0$
- D. Everywhere  $x = 0$

10.1.  $\sec(x)$  is the reciprocal of:

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\csc(x)$

10.2.  $\sec(x)$  has a break wherever:

- A.  $\sin(x) = 0$
- B.  $\cos(x) = 0$
- C.  $\tan(x) = 1$
- D.  $x = 0$

10.3. What sign does  $\sec(x)$  have in Quadrant II?

- A. positive
- B. negative
- C. undefined everywhere
- D. always 0

10.4. Why does a secant graph look like separate branches?

- A. cosine changes sign and passes through 0
- B. the period is not constant
- C. it has a midline of  $x = 0$
- D. it never repeats

10.5. What is  $\sec(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

**11. Where does  $\csc(x)$  have a break?**

- A. Where  $\cos(x) = 0$
- B. Where  $\tan(x) = 0$
- C. Where  $\sin(x) = 0$
- D. Everywhere  $x = \pi$

11.1.  $\csc(x)$  is the reciprocal of:

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\cot(x)$

11.2.  $\csc(x)$  is undefined wherever:

- A.  $\cos(x) = 0$
- B.  $\sin(x) = 0$
- C.  $\tan(x) = 1$
- D.  $x = \pi / 4$

11.3. In Quadrant III,  $\csc(x)$  is:

- A. positive
- B. negative
- C. undefined
- D. always 0

11.4. What is  $\csc(\pi / 2)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

11.5. Why does  $y = \csc(x)$  form separate branches?

- A. it is not periodic
- B. it is the reciprocal of sine, so it breaks at sine zeros
- C. it always has slope 0
- D. it has no symmetry

**12. Which value equals  $\cot(\pi / 4)$ ?**

- A. 0
- B. 1
- C. 2
- D. undefined

12.1.  $\cot(x)$  equals:

- A.  $\sin(x) / \cos(x)$
- B.  $\cos(x) / \sin(x)$
- C.  $1 / \cos(x)$
- D.  $1 / \sin(x)$

12.2. The period of  $y = \cot(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

12.3.  $\cot(x)$  is undefined wherever:

- A.  $\sin(x) = 0$
- B.  $\cos(x) = 0$
- C.  $\tan(x) = 1$
- D.  $x = \pi / 4$

12.4. What is  $\cot(\pi / 4)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

12.5. Compared to tangent, a basic cotangent graph:

- A. also has period  $\pi$
- B. has no asymptotes
- C. never crosses the x-axis
- D. is not related to reciprocal trig

13. What sign does  $\sec(x)$  have in Quadrant II?

- A. Positive
- B. Zero
- C. Undefined everywhere
- D. Negative

13.1.  $\sec(x)$  is the reciprocal of:

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\csc(x)$

13.2.  $\sec(x)$  has a break wherever:

- A.  $\sin(x) = 0$
- B.  $\cos(x) = 0$
- C.  $\tan(x) = 1$
- D.  $x = 0$

13.3. What sign does  $\sec(x)$  have in Quadrant II?

- A. positive
- B. negative
- C. undefined everywhere
- D. always 0

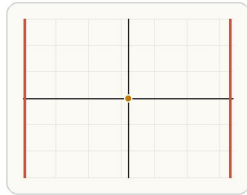
13.4. Why does a secant graph look like separate branches?

- A. cosine changes sign and passes through 0
- B. the period is not constant
- C. it has a midline of  $x = 0$
- D. it never repeats

13.5. What is  $\sec(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

14. What is the best first step when sketching  $y = \tan(x)$ ?



The key structure of tangent comes from its x-intercepts and the vertical asymptotes between repeated branches.

- A. Find the amplitude.
- B. Graph a parabola first.
- C. Reflect across the x-axis immediately.
- D. Mark the vertical asymptotes and the zeros.

14.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

14.2.  $\tan(x)$  has vertical asymptotes because:

- A.  $\sin(x)$  can be 0
- B.  $\cos(x)$  can be 0
- C.  $\tan(x)$  is not periodic
- D. all trig graphs have them

14.3. What is  $\tan(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

14.4. At which angle is  $\tan(x)$  undefined?

- A. 0
- B.  $\pi / 4$
- C.  $\pi / 2$
- D.  $\pi$

14.5. When sketching  $y = \tan(x)$ , a good first step is to:

- A. mark its vertical asymptotes
- B. find its amplitude
- C. identify its midline
- D. locate its maximum

15. A student says  $\tan(x)$  has period  $2\pi$  because sine and cosine do. What is the mistake?

- A. Tangent repeats every  $\pi$ , not  $2\pi$ .
- B. Tangent is not periodic.
- C. Tangent should be treated like cosine only.
- D. Tangent repeats every  $\pi / 2$ .

15.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

15.2.  $\tan(x)$  has vertical asymptotes because:

- A.  $\sin(x)$  can be 0
- B.  $\cos(x)$  can be 0
- C.  $\tan(x)$  is not periodic
- D. all trig graphs have them

15.3. What is  $\tan(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

15.4. At which angle is  $\tan(x)$  undefined?

- A. 0
- B.  $\pi / 4$
- C.  $\pi / 2$
- D.  $\pi$

15.5. When sketching  $y = \tan(x)$ , a good first step is to:

- A. mark its vertical asymptotes
- B. find its amplitude
- C. identify its midline
- D. locate its maximum

16. Find  $\tan(\pi/4)$ . Answer with a number.

16.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi/2$
- D.  $4\pi$

16.2.  $\tan(x)$  has vertical asymptotes because:

- A.  $\sin(x)$  can be 0
- B.  $\cos(x)$  can be 0
- C.  $\tan(x)$  is not periodic
- D. all trig graphs have them

16.3. What is  $\tan(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

16.4. At which angle is  $\tan(x)$  undefined?

- A. 0
- B.  $\pi/4$
- C.  $\pi/2$
- D.  $\pi$

16.5. When sketching  $y = \tan(x)$ , a good first step is to:

- A. mark its vertical asymptotes
- B. find its amplitude
- C. identify its midline
- D. locate its maximum

17. Find  $\tan(0)$ . Answer with a number.

17.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi/2$
- D.  $4\pi$

17.2.  $\tan(x)$  has vertical asymptotes because:

- A.  $\sin(x)$  can be 0
- B.  $\cos(x)$  can be 0
- C.  $\tan(x)$  is not periodic
- D. all trig graphs have them

17.3. What is  $\tan(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

17.4. At which angle is  $\tan(x)$  undefined?

- A. 0
- B.  $\pi/4$
- C.  $\pi/2$
- D.  $\pi$

17.5. When sketching  $y = \tan(x)$ , a good first step is to:

- A. mark its vertical asymptotes
- B. find its amplitude
- C. identify its midline
- D. locate its maximum

18. Find  $\sec(\pi/3)$ . Answer with a number.

18.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi/2$
- D.  $4\pi$

18.2. Why does  $\tan(x)$  have vertical asymptotes?

- A. Its denominator cosine can be 0
- B. Its numerator sine is always 0
- C. It is not periodic
- D. It is always negative

18.3.  $\sec(x)$  is the reciprocal of:

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\csc(x)$

18.4.  $\csc(x)$  is the reciprocal of:

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\cot(x)$

18.5.  $\cot(x)$  equals:

- A.  $\sin(x) / \cos(x)$
- B.  $\cos(x) / \sin(x)$
- C.  $1 / \cos(x)$
- D.  $1 / \sin(x)$

19. Find  $\csc(\pi/6)$ . Answer with a number.

19.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi/2$
- D.  $4\pi$

19.2. Why does  $\tan(x)$  have vertical asymptotes?

- A. Its denominator cosine can be 0
- B. Its numerator sine is always 0
- C. It is not periodic
- D. It is always negative

19.3.  $\sec(x)$  is the reciprocal of:

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\csc(x)$

19.4.  $\csc(x)$  is the reciprocal of:

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\cot(x)$

19.5.  $\cot(x)$  equals:

- A.  $\sin(x) / \cos(x)$
- B.  $\cos(x) / \sin(x)$
- C.  $1 / \cos(x)$
- D.  $1 / \sin(x)$

20. Find  $\cot(\pi/4)$ . Answer with a number.

20.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi/2$
- D.  $4\pi$

20.2.  $\tan(x)$  has vertical asymptotes because:

- A.  $\sin(x)$  can be 0
- B.  $\cos(x)$  can be 0
- C.  $\tan(x)$  is not periodic
- D. all trig graphs have them

20.3. What is  $\tan(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

20.4. At which angle is  $\tan(x)$  undefined?

- A. 0
- B.  $\pi/4$
- C.  $\pi/2$
- D.  $\pi$

20.5. When sketching  $y = \tan(x)$ , a good first step is to:

- A. mark its vertical asymptotes
- B. find its amplitude
- C. identify its midline
- D. locate its maximum

21. What is the period of  $y = \tan(3x)$ ? Enter as a decimal. Answer with a number.

21.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi/2$
- D.  $4\pi$

21.2.  $\tan(x)$  has vertical asymptotes because:

- A.  $\sin(x)$  can be 0
- B.  $\cos(x)$  can be 0
- C.  $\tan(x)$  is not periodic
- D. all trig graphs have them

21.3. What is  $\tan(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

21.4. At which angle is  $\tan(x)$  undefined?

- A. 0
- B.  $\pi/4$
- C.  $\pi/2$
- D.  $\pi$

21.5. When sketching  $y = \tan(x)$ , a good first step is to:

- A. mark its vertical asymptotes
- B. find its amplitude
- C. identify its midline
- D. locate its maximum

22. What is  $\sec(\pi)$ ? Answer with a number.

22.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

22.2. Why does  $\tan(x)$  have vertical asymptotes?

- A. Its denominator cosine can be 0
- B. Its numerator sine is always 0
- C. It is not periodic
- D. It is always negative

22.3.  $\sec(x)$  is the reciprocal of:

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\csc(x)$

22.4.  $\csc(x)$  is the reciprocal of:

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\cot(x)$

22.5.  $\cot(x)$  equals:

- A.  $\sin(x) / \cos(x)$
- B.  $\cos(x) / \sin(x)$
- C.  $1 / \cos(x)$
- D.  $1 / \sin(x)$

23. What is  $\csc(3\pi / 2)$ ? Answer with a number.

23.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

23.2. Why does  $\tan(x)$  have vertical asymptotes?

- A. Its denominator cosine can be 0
- B. Its numerator sine is always 0
- C. It is not periodic
- D. It is always negative

23.3.  $\sec(x)$  is the reciprocal of:

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\csc(x)$

23.4.  $\csc(x)$  is the reciprocal of:

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\cot(x)$

23.5.  $\cot(x)$  equals:

- A.  $\sin(x) / \cos(x)$
- B.  $\cos(x) / \sin(x)$
- C.  $1 / \cos(x)$
- D.  $1 / \sin(x)$

24. Which student correctly finds  $\sec(\pi / 3)$ ?

24.1.  $\sec(x)$  is the reciprocal of:

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\csc(x)$

24.2.  $\sec(x)$  has a break wherever:

- A.  $\sin(x) = 0$
- B.  $\cos(x) = 0$
- C.  $\tan(x) = 1$
- D.  $x = 0$

- A. Student B:  $\sec(\pi / 3) = \cos(\pi / 3) = 1 / 2$ .
- B. Student C:  $\sec(\pi / 3) = \tan(\pi / 3) = \sqrt{3}$ .
- C. Student D:  $\sec(\pi / 3)$  is undefined.
- D. Student A:  $\cos(\pi / 3) = 1 / 2$ , so  $\sec(\pi / 3) = 2$ .

24.3. What sign does  $\sec(x)$  have in Quadrant II?

- A. positive
- B. negative
- C. undefined everywhere
- D. always 0

24.4. Why does a secant graph look like separate branches?

- A. cosine changes sign and passes through 0
- B. the period is not constant
- C. it has a midline of  $x = 0$
- D. it never repeats

24.5. What is  $\sec(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

25. State the period of  $y = \tan(x)$ . Answer with your final expression.

25.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

25.2.  $\tan(x)$  has vertical asymptotes because:

- A.  $\sin(x)$  can be 0
- B.  $\cos(x)$  can be 0
- C.  $\tan(x)$  is not periodic
- D. all trig graphs have them

25.3. What is  $\tan(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

25.4. At which angle is  $\tan(x)$  undefined?

- A. 0
- B.  $\pi / 4$
- C.  $\pi / 2$
- D.  $\pi$

25.5. When sketching  $y = \tan(x)$ , a good first step is to:

- A. mark its vertical asymptotes
- B. find its amplitude
- C. identify its midline
- D. locate its maximum

26. State the period of  $y = \cot(x)$ . Answer with your final expression.

26.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

26.2.  $\tan(x)$  has vertical asymptotes because:

- A.  $\sin(x)$  can be 0
- B.  $\cos(x)$  can be 0
- C.  $\tan(x)$  is not periodic
- D. all trig graphs have them

26.3. What is  $\tan(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

26.4. At which angle is  $\tan(x)$  undefined?

- A. 0
- B.  $\pi / 4$
- C.  $\pi / 2$
- D.  $\pi$

26.5. When sketching  $y = \tan(x)$ , a good first step is to:

- A. mark its vertical asymptotes
- B. find its amplitude
- C. identify its midline
- D. locate its maximum

27. State one vertical asymptote of  $y = \tan(x)$ . Answer with your final expression.

27.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

27.2.  $\tan(x)$  has vertical asymptotes because:

- A.  $\sin(x)$  can be 0
- B.  $\cos(x)$  can be 0
- C.  $\tan(x)$  is not periodic
- D. all trig graphs have them

27.3. What is  $\tan(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

27.4. At which angle is  $\tan(x)$  undefined?

- A. 0
- B.  $\pi / 4$
- C.  $\pi / 2$
- D.  $\pi$

27.5. When sketching  $y = \tan(x)$ , a good first step is to:

- A. mark its vertical asymptotes
- B. find its amplitude
- C. identify its midline
- D. locate its maximum

28. Write  $\sec(x)$  in terms of cosine. Answer as an equation.

28.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

28.2. Why does  $\tan(x)$  have vertical asymptotes?

- A. Its denominator cosine can be 0
- B. Its numerator sine is always 0
- C. It is not periodic
- D. It is always negative

28.3.  $\sec(x)$  is the reciprocal of:

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\csc(x)$

28.4.  $\csc(x)$  is the reciprocal of:

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\cot(x)$

28.5.  $\cot(x)$  equals:

- A.  $\sin(x) / \cos(x)$
- B.  $\cos(x) / \sin(x)$
- C.  $1 / \cos(x)$
- D.  $1 / \sin(x)$

29. Write  $\csc(x)$  in terms of sine. Answer as an equation.

29.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

29.2. Why does  $\tan(x)$  have vertical asymptotes?

- A. Its denominator cosine can be 0
- B. Its numerator sine is always 0
- C. It is not periodic
- D. It is always negative

29.3.  $\sec(x)$  is the reciprocal of:

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\csc(x)$

29.4.  $\csc(x)$  is the reciprocal of:

- A.  $\sin(x)$
- B.  $\cos(x)$
- C.  $\tan(x)$
- D.  $\cot(x)$

29.5.  $\cot(x)$  equals:

- A.  $\sin(x) / \cos(x)$
- B.  $\cos(x) / \sin(x)$
- C.  $1 / \cos(x)$
- D.  $1 / \sin(x)$

30. Write  $\cot(x)$  in terms of tangent. Answer as an equation.

30.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

30.2.  $\tan(x)$  has vertical asymptotes because:

- A.  $\sin(x)$  can be 0
- B.  $\cos(x)$  can be 0
- C.  $\tan(x)$  is not periodic
- D. all trig graphs have them

30.3. What is  $\tan(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

30.4. At which angle is  $\tan(x)$  undefined?

- A. 0
- B.  $\pi / 4$
- C.  $\pi / 2$
- D.  $\pi$

30.5. When sketching  $y = \tan(x)$ , a good first step is to:

- A. mark its vertical asymptotes
- B. find its amplitude
- C. identify its midline
- D. locate its maximum

**31. State another vertical asymptote of  $y = \tan(x)$ . Answer with your final expression.**

31.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

31.2.  $\tan(x)$  has vertical asymptotes because:

- A.  $\sin(x)$  can be 0
- B.  $\cos(x)$  can be 0
- C.  $\tan(x)$  is not periodic
- D. all trig graphs have them

31.3. What is  $\tan(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

31.4. At which angle is  $\tan(x)$  undefined?

- A. 0
- B.  $\pi / 4$
- C.  $\pi / 2$
- D.  $\pi$

31.5. When sketching  $y = \tan(x)$ , a good first step is to:

- A. mark its vertical asymptotes
- B. find its amplitude
- C. identify its midline
- D. locate its maximum

**32. State the period of  $y = \tan(2x)$ . Answer with your final expression.**

32.1. The period of  $y = \tan(x)$  is:

- A.  $\pi$
- B.  $2\pi$
- C.  $\pi / 2$
- D.  $4\pi$

32.2.  $\tan(x)$  has vertical asymptotes because:

- A.  $\sin(x)$  can be 0
- B.  $\cos(x)$  can be 0
- C.  $\tan(x)$  is not periodic
- D. all trig graphs have them

32.3. What is  $\tan(0)$ ?

- A. 0
- B. 1
- C. -1
- D. undefined

32.4. At which angle is  $\tan(x)$  undefined?

- A. 0
- B.  $\pi / 4$
- C.  $\pi / 2$
- D.  $\pi$

32.5. When sketching  $y = \tan(x)$ , a good first step is to:

- A. mark its vertical asymptotes
- B. find its amplitude
- C. identify its midline
- D. locate its maximum