

1. Let  $f(x) = \sec\left(\frac{1}{2}x\right)$ . Which of the following is a vertical asymptote on the graph of  $f$ ?

- (A)  $x = 0$                       (B)  $x = \frac{\pi}{4}$                       (C)  $x = \frac{\pi}{2}$                       (D)  $x = \pi$

2. In the  $xy$ -plane, the graph of which of the following functions has a vertical asymptote at  $x = \frac{\pi}{2}$ ?

- (A)  $f(x) = \csc(x)$                       (B)  $f(x) = \csc(2x)$                       (C)  $f(x) = \sec\left(x - \frac{\pi}{2}\right)$                       (D)  $f(x) = \sec\left(\frac{1}{2}x\right)$

3. In the  $xy$ -plane, the graph of which of the following functions has a vertical asymptote at  $x = 2$ ?

- (A)  $f(x) = \csc\left(\frac{1}{2}x\right)$                       (B)  $f(x) = \csc(2x)$                       (C)  $f(x) = \sec(\pi x)$                       (D)  $f(x) = \sec\left(\frac{\pi}{4}x\right)$

4. Let  $g(x) = \cot(2x)$ . Which of the following is a vertical asymptote on the graph of  $g$ ?

- (A)  $x = \frac{\pi}{6}$                       (B)  $x = \frac{\pi}{4}$                       (C)  $x = \frac{\pi}{3}$                       (D)  $x = \frac{\pi}{2}$

5. Let  $h(x) = 3\sec(4x) + 1$ . Which of the following statements about the graph of  $h$  is correct?

- (A) The graph of  $h$  has vertical asymptotes when  $x = \frac{\pi}{8} + \frac{\pi}{4}k$ , where  $k$  is an integer.
- (B) The graph of  $h$  has vertical asymptotes when  $x = \frac{\pi}{4} + \frac{\pi}{2}k$ , where  $k$  is an integer.
- (C) The graph of  $h$  has vertical asymptotes when  $x = \frac{\pi}{2} + \frac{\pi}{4}k$ , where  $k$  is an integer.
- (D) The graph of  $h$  has vertical asymptotes when  $x = 2\pi + 4\pi k$ , where  $k$  is an integer.

6. Let  $h(x) = 5 \sec\left(\frac{1}{2}x\right)$ . Which of the following gives the range of  $h$ ?

- (A)  $(-\infty, -1] \cup [1, \infty)$       (B)  $(-\infty, -5] \cup [5, \infty)$       (C)  $(-\infty, -2] \cup [2, \infty)$       (D)  $[-5, 5]$

7. Let  $k(x) = 4 \csc(2x) - 1$ . Which of the following gives the range of  $k$ ?

- (A)  $(-\infty, -1] \cup [1, \infty)$       (B)  $(-\infty, -4] \cup [4, \infty)$       (C)  $(-\infty, -5] \cup [3, \infty)$       (D)  $\left(-\infty, -\frac{1}{2}\right] \cup \left[\frac{1}{2}, \infty\right)$

8. Let  $f(x) = 2 \sec(x) - 5$  and  $g(x) = -1$ . In the  $xy$ -plane, what are the  $x$ -coordinates of the points of intersection of the graphs of  $f$  and  $g$  for  $0 \leq x < 2\pi$ ?

9. Let  $h(x) = 2 - 3 \csc x$  and  $k(x) = 5$ . In the  $xy$ -plane, what are the  $x$ -coordinates of the points of intersection of the graphs of  $h$  and  $k$  for  $0 \leq x < 2\pi$ ?

10. Let  $m(x) = 3 \csc^2 x - 2$  and  $p(x) = 2$ . In the  $xy$ -plane, what are the  $x$ -coordinates of the points of intersection of the graphs of  $m$  and  $p$  for  $0 \leq x < 2\pi$ ?



11. Let  $f(x) = 2 + 3.1 \cot(0.3x + 5)$ . In the  $xy$ -plane, what are the  $x$ -coordinates of the points of where  $f(x) = -6$  for  $0 \leq x < 2\pi$ ?