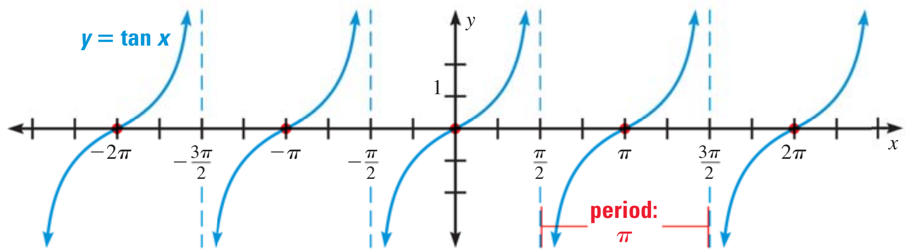
✓ GUIDED PRACTICE for Examples 2 and 3

Graph the function.

5. $y = \frac{1}{4}\sin \pi x$ **6.** $y = \frac{1}{3}\cos \pi x$ **7.** $f(x) = 2\sin 3x$ **8.** $g(x) = 3\cos 4x$

9. **WHAT IF?** In Example 3, how would the function change if the audiometer produced a pure tone with a frequency of 1000 hertz?

GRAPH OF $Y = \tan X$ The graphs of all tangent functions are related to the graph of the parent function $y = \tan x$, which is shown below.



FIND ODD MULTIPLES

Odd multiples of $\frac{\pi}{2}$ are values such as these:

$\pm 1 \cdot \frac{\pi}{2} = \pm\frac{\pi}{2}$

$\pm 3 \cdot \frac{\pi}{2} = \pm\frac{3\pi}{2}$

$\pm 5 \cdot \frac{\pi}{2} = \pm\frac{5\pi}{2}$

The function $y = \tan x$ has the following characteristics:

1. The domain is all real numbers except odd multiples of $\frac{\pi}{2}$. At these x-values, the graph has vertical asymptotes.
2. The range is all real numbers. So, the function $y = \tan x$ does not have a maximum or minimum value, and therefore the graph of $y = \tan x$ does not have an amplitude.
3. The graph has a period of π.
4. The x-intercepts of the graph occur when $x = 0, \pm\pi, \pm 2\pi, \pm 3\pi, \ldots$.

KEY CONCEPT — *For Your Notebook*

Characteristics of $y = a\tan bx$

The period and vertical asymptotes of the graph of $y = a\tan bx$, where a and b are nonzero real numbers, are as follows:

- The period is $\frac{\pi}{|b|}$.
- The vertical asymptotes are at odd multiples of $\frac{\pi}{2|b|}$.

GRAPHING KEY POINTS The graph at the right shows five key x-values that can help you sketch the graph of $y = a\tan bx$ for $a > 0$ and $b > 0$. These are the **x-intercept**, the x-values where the **asymptotes** occur, and the x-values **halfway between** the x-intercept and the asymptotes. At each halfway point, the function's value is either a or $-a$.