**Domain:** set of possible inputs (x–values) that have a defined output (y–value). These are independent values.

In set–builder notation: Domain of a function $f(x)$ is $\{x | f(x) \text{ is defined}\}$

**Range:** set of possible outputs (y–values) that result from evaluation of domain values by a function. These are dependent values.

In set–builder notation: Range of a function $f(x)$ is $\{y | y = f(x) \text{ for some } x \text{ in the domain}\}$

To find the domain of a function, first note that all domain values are going to come from the real numbers but that there may be restrictions due to the particular function we are looking at. We won't ever have complex numbers in the domain for Math 5A (or for 5B or 5C). Domain restrictions on the function are real numbers that cause

1. division by zero
2. a radicand of an even root to be negative
3. an argument of a logarithm function to be non-positive

in the algebraic definition of the function. The domain will be all real numbers other than these restrictions.

*Find the domain of each function.*

1. $f(x) = x^2 + 2x$

2. $g(x) = \sqrt{x^2 + 2x}$

3. $y = \sin x$

4. $y = \dfrac{\sqrt{x}}{x - 2}$

**Even Functions:** A function is **even** if for all $x$ in the domain of $f$, we have $f(-x) = f(x)$

As we saw in precalculus, this indicated the graph of the function is symmetric about the origin

**Odd Functions:** A function is **odd** if for all $x$ in the domain of $f$, we have $f(-x) = -f(x)$

Similarly from precalculus, this indicated the graph of the function is symmetric about the y–axis

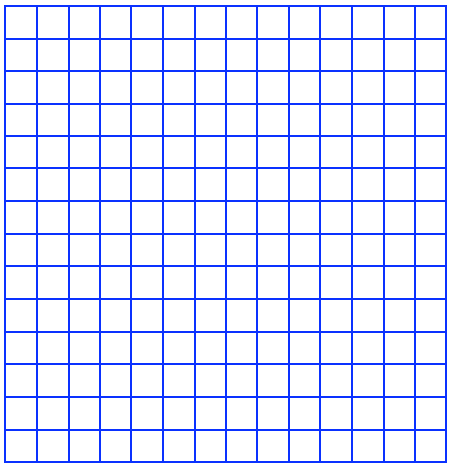
Unlike numbers, not all functions are odd or even. Some are neither even nor odd. But often in Calculus we can take advantage of symmetry when it exists to simplify calculations.

*Determine whether the following function is even, odd or neither.*

5. $f(x) = x^3 - x$

**Slope**

6. Plot the point $f(5) = -8$ and $f(-2) = 6$, then find the slope between the two points.



**The Difference Quotient**

The difference quotient is the slope between the points $(a, f(a))$ and $(a+h, f(a+h))$ for some function $f$.

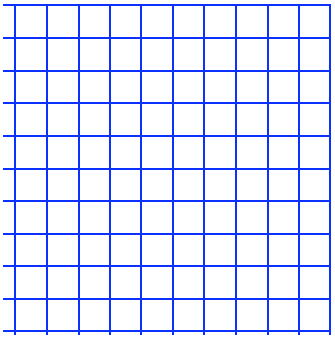
*What is $a$ and $h$ in exercise 6 above? (there are 2 answers to this question)*

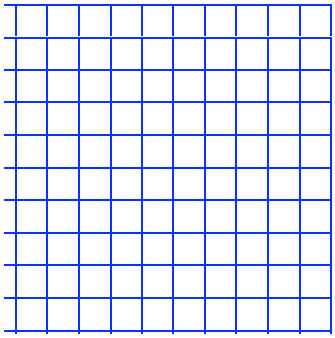
*Write down the general form of the difference quotient using the points $(a, f(a))$ and $(a+h, f(a+h))$:*

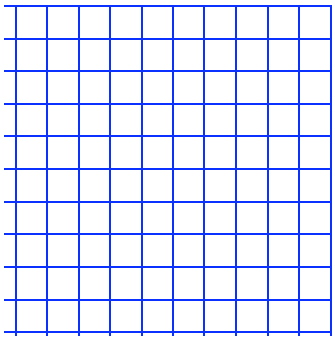
8. Evaluate $\dfrac{f(x)-f(3)}{x-3}$, $x \neq 3$ for the function $f(x)=\dfrac{1}{x}$.

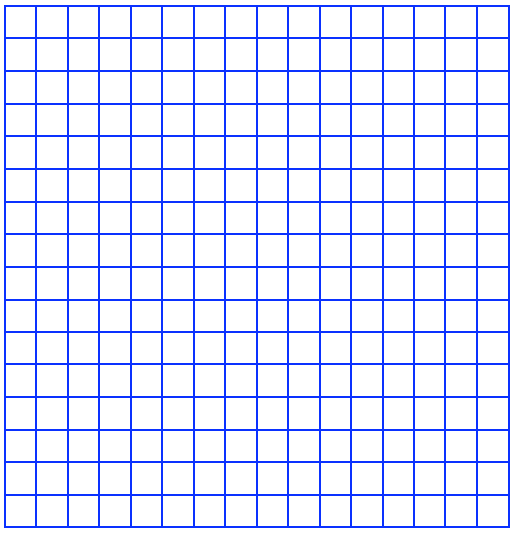
**Piecewise–defined Functions and their Graphs**

9. Graph $f(x)=\begin{cases} 2x-3 & x<-1 \\ x & |x|<1 \\ 5 & x>1 \end{cases}$









**Compositions**

*Use the functions below to find the composition $g \circ f$ and it's domain.*

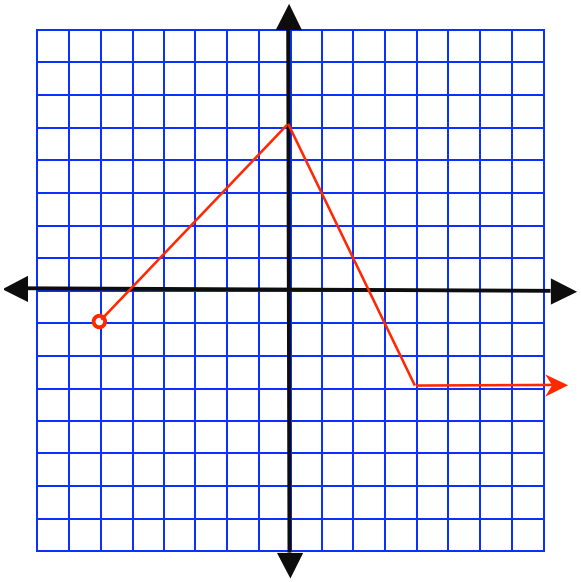
10. $f(x)=\sqrt{x+2}$ $\quad$ $g(x)=\dfrac{1}{x^2-2}$

*Express the function below in the form:* $f \circ g$

11. $u(t) = \cos\left(\sqrt{t}\right)$

12. A rectangle has a perimeter of 20 meters. Express the area of the rectangle as a function of the length of one of it's sides.

Use the graph below to answer the questions 13–18.



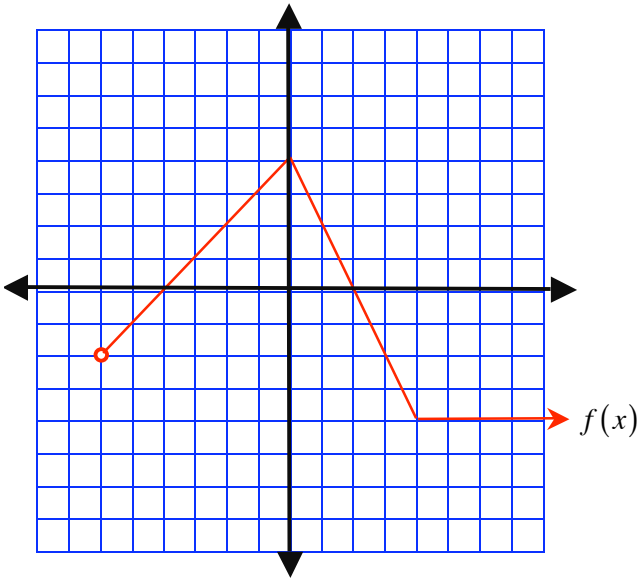
13. Find the domain of $f(x)$.

14. Find the range of $f(x)$.

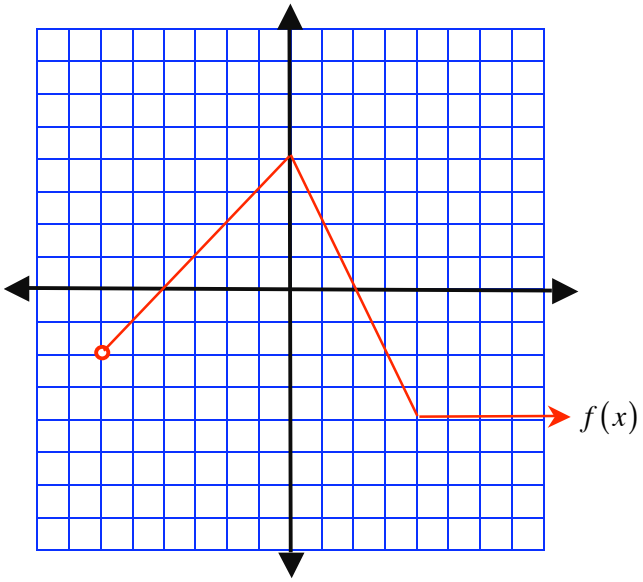
15. Find $f(0)$.

16. Find x–values, such that $f(x) = 0$

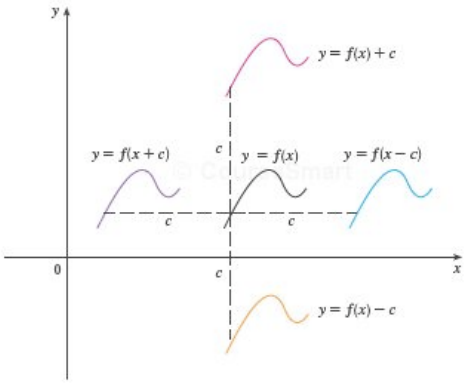
17. Sketch a graph of $y=-f(x+3)+1$ with the graph of $f(x)$ below.



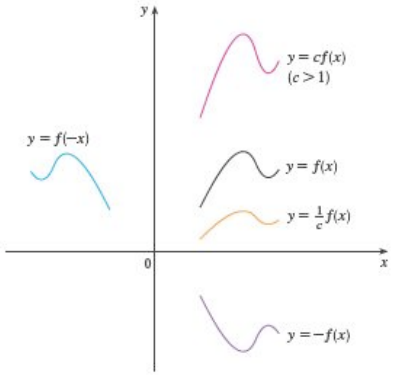

18. Sketch a graph of $y=|f(2x)|$ with the graph of $f(x)$ below.




**VERTICAL AND HORIZONTAL SHIFTS** Suppose $c > 0$. To obtain the graph of
- $y = f(x) + c$, shift the graph of $y = f(x)$ a distance $c$ units upward
- $y = f(x) - c$, shift the graph of $y = f(x)$ a distance $c$ units downward
- $y = f(x - c)$, shift the graph of $y = f(x)$ a distance $c$ units to the right
- $y = f(x + c)$, shift the graph of $y = f(x)$ a distance $c$ units to the left

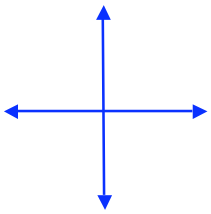



**VERTICAL AND HORIZONTAL STRETCHING AND REFLECTING** Suppose $c > 1$. To obtain the graph of
- $y = cf(x)$, stretch the graph of $y = f(x)$ vertically by a factor of $c$
- $y = (1/c)f(x)$, compress the graph of $y = f(x)$ vertically by a factor of $c$
- $y = f(cx)$, compress the graph of $y = f(x)$ horizontally by a factor of $c$
- $y = f(x/c)$, stretch the graph of $y = f(x)$ horizontally by a factor of $c$
- $y = -f(x)$, reflect the graph of $y = f(x)$ about the $x$-axis
- $y = f(-x)$, reflect the graph of $y = f(x)$ about the $y$-axis

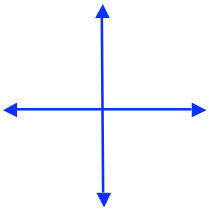


**Graphs of Basic Functions Homework Problems– 1.2** (To be turned in with first homework set)
You should be familiar with the general behavior of the following basic functions. **Without a calculator**, sketch each function.

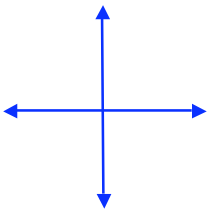
1. $y = -2x + 4$



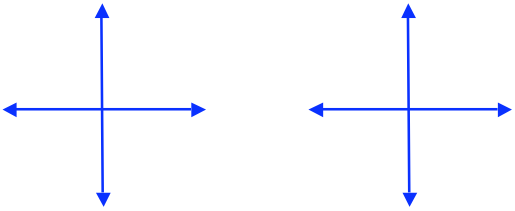
2. $y = x^2$



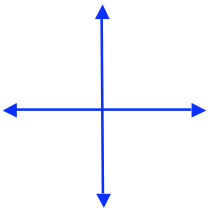
3. $y = x^3$



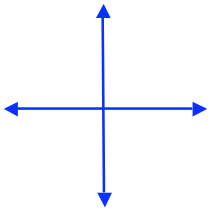
4. $y = \sqrt{x}$ (what does graph of $y = \sqrt{x^2}$ look like?)



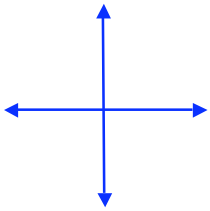
5. $y = e^x$



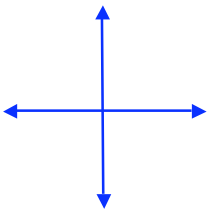
6. $y = \ln x$



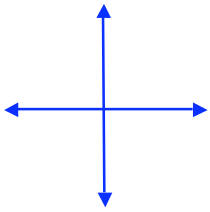
7. $y = \sin x$



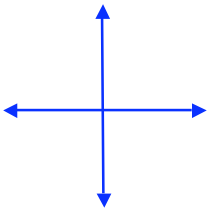
8. $y = \cos x$



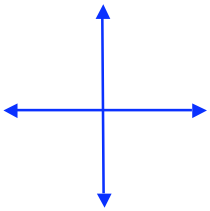
9. $y = \tan x$



10. $y = \frac{1}{x}$



11. $y = \frac{1}{x^2}$



12. $y = \sqrt{a^2 - x^2}$ where $a$ is some constant