Name: Key

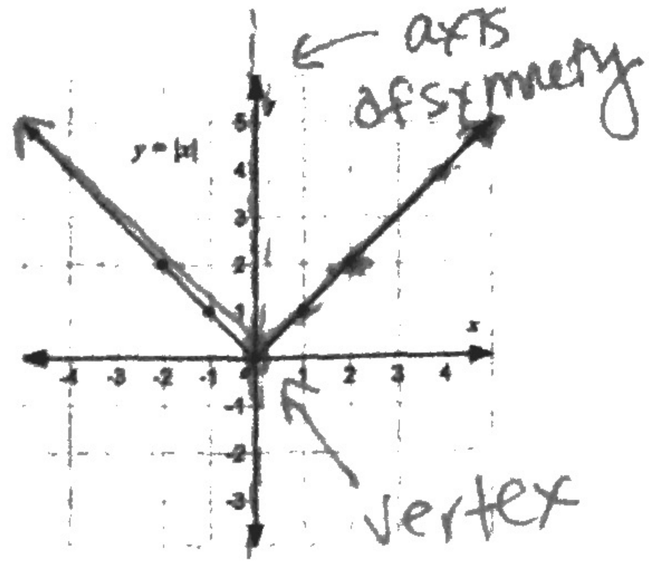
Date: _____

Serafino • Algebra 2E

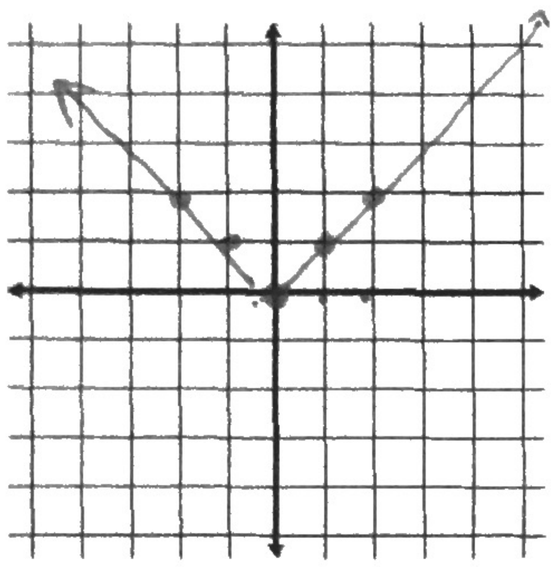
# 2C Absolute Value Functions

"Varabolas"

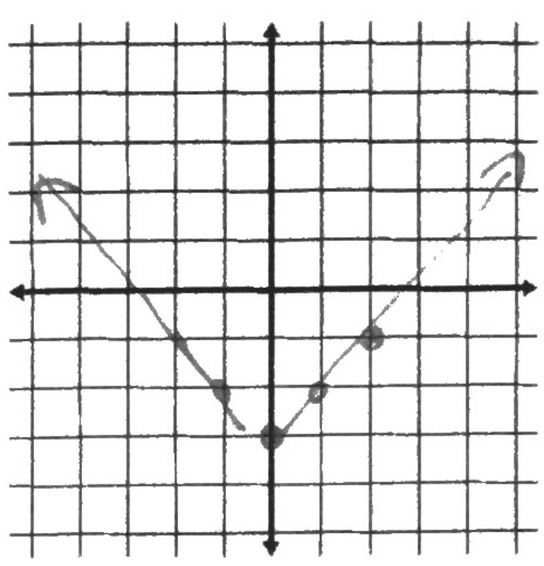
**Parent Function:**
**$y = |x|$**



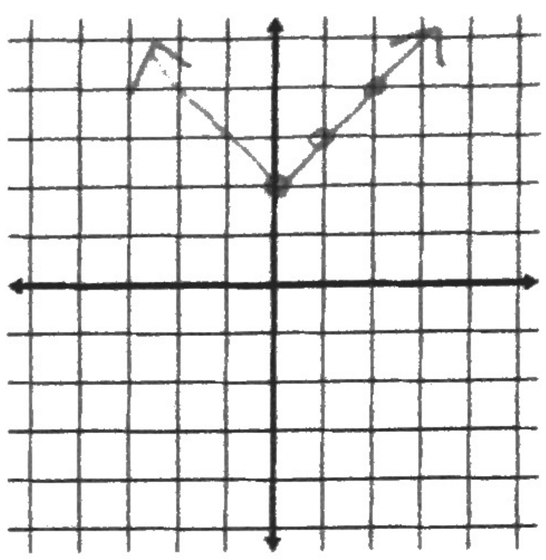

1. $f(x) = |x|$



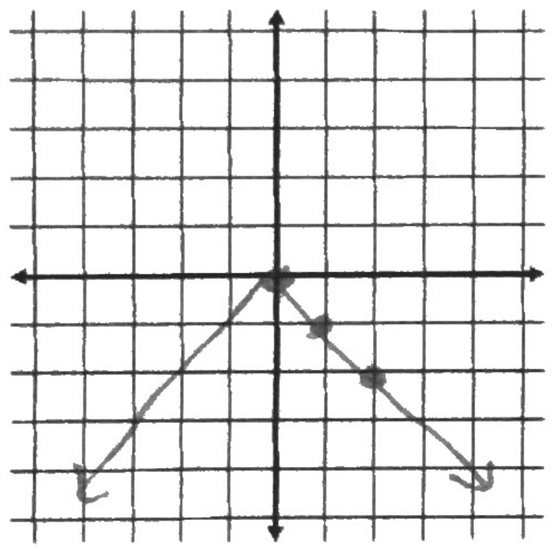
2. $f(x) = |x| - 3$



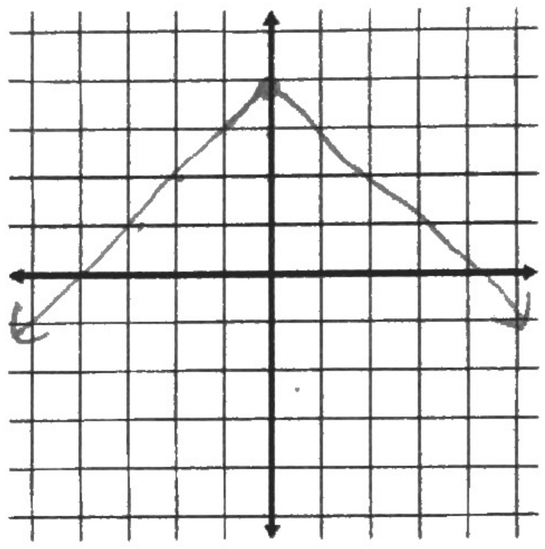
3. $f(x) = |x| + 2$



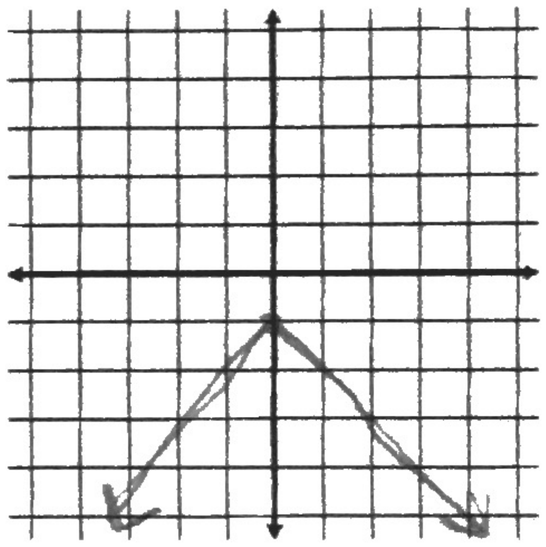
4. $f(x) = -|x|$



5. $f(x) = -|x| + 4$



6. $f(x) = -|x| - 1$



Make an observation about what happens to the graph when you have a positive sign in front of the function. What about a negative

*When the growth factor is positive →* opens upward

*When the growth factor is negative →* opend downward

} reflect over x-axis!

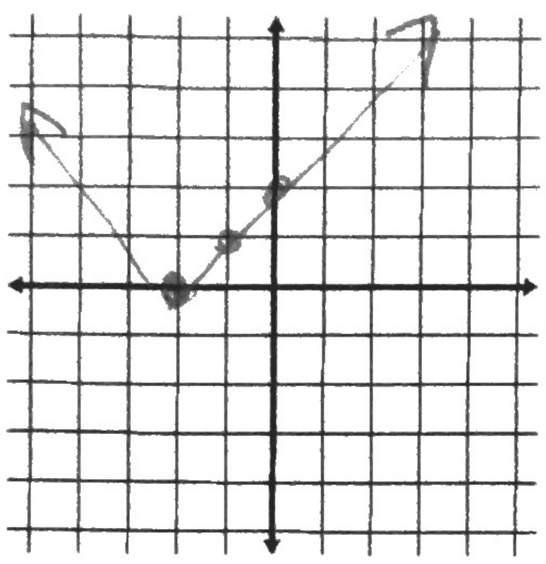
Make an observation about what happens to the graph when you add a number outside the grouping symbols. What about when you subtract?

*When you add a number to the output →* shifts/traslates up

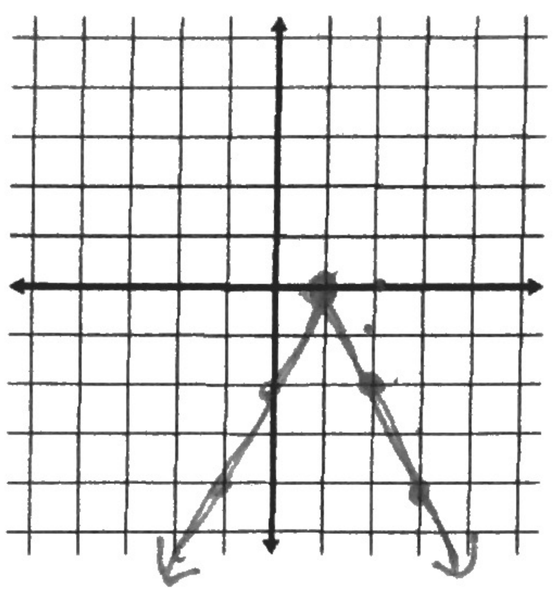
*When you subtract a number from the output →* shifts down

**Graph the following absolute value equations.**

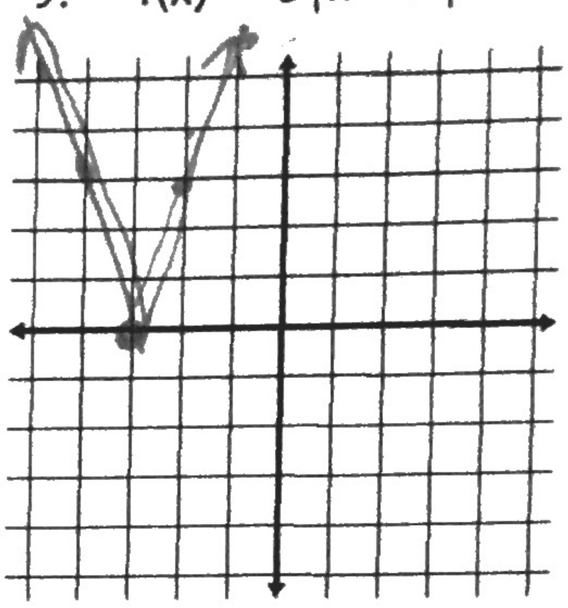
7. $f(x) = |x + 2|$ (-2,0)



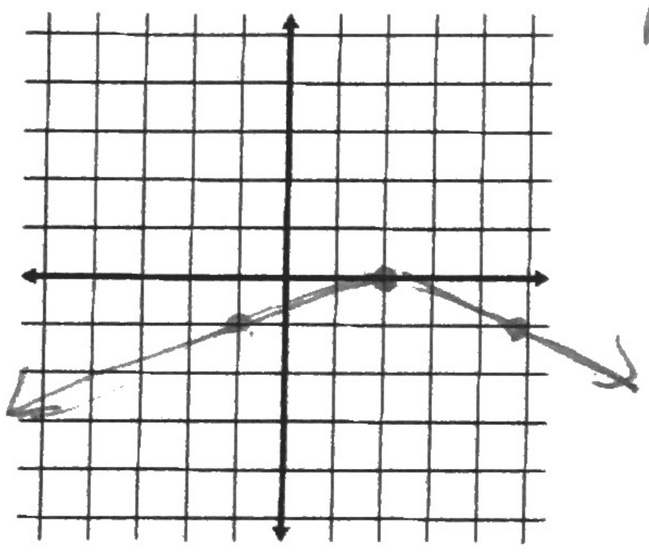
8. $f(x) = -2|x - 1|$ (1,0)



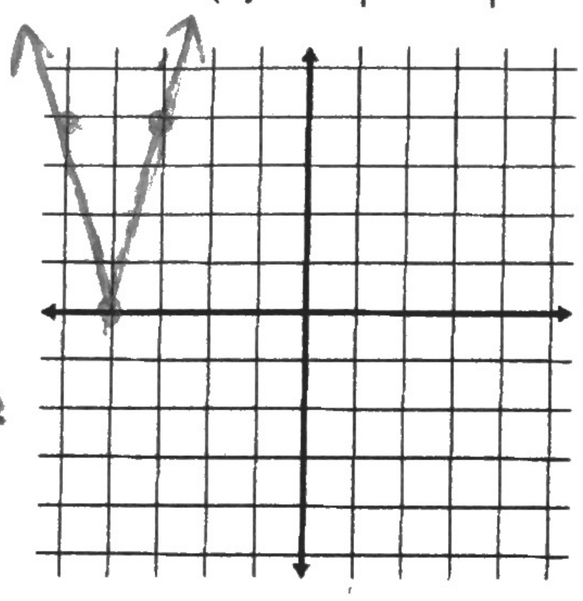
9. $f(x) = 3|x + 3|$



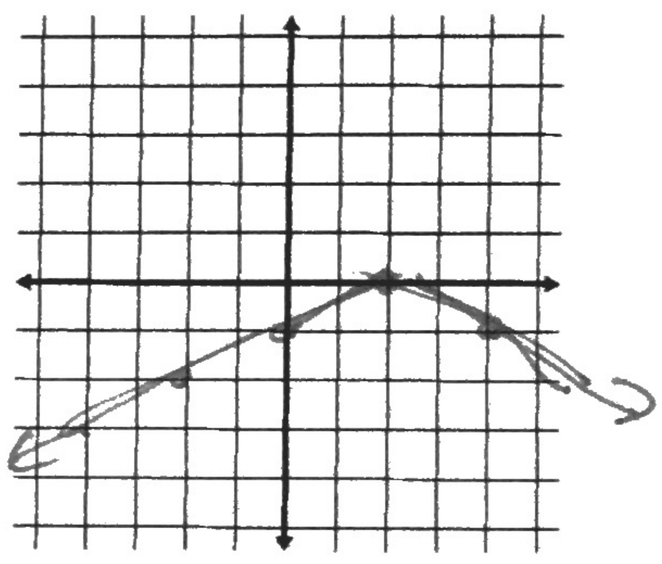
10. $f(x) = -1/3|x - 2|$



11. $f(x) = 4|x + 4|$



12. $f(x) = -1/2|x - 2|$



Make an observation about what happens to the graph when you add a number inside the absolute value signs. What about when you subtract?

*When you add a number to the input →* shifts left

*When you subtract a number from input →* shift right

Make an observation about what happens to the graph when the number before the absolute value sign gets larger? What if it gets smaller?

*As the number approaches zero→* compresses vertically

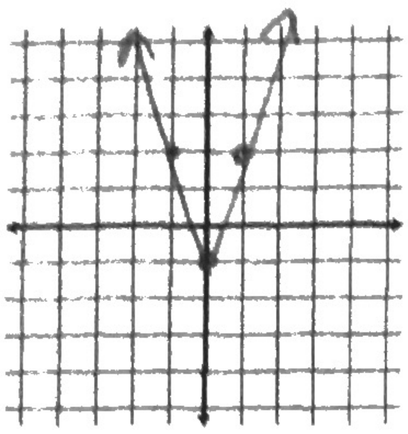
*As the number gets further from zero →* vertical stretch

* make x negative $y = 3|(-x)+2|$ $y = 2|(-x)|-1$

give x a coefficient $y = |3x+2|$

**Let's put it all together! Graph the following. State the domain and range of each.**

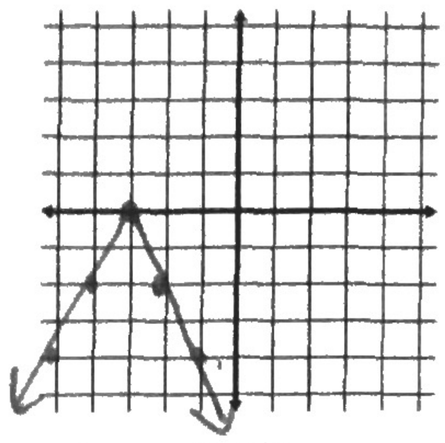
13. $f(x) = 3|x| - 1$



D: $x \in \mathbb{R}$

R: $y \geq -1$

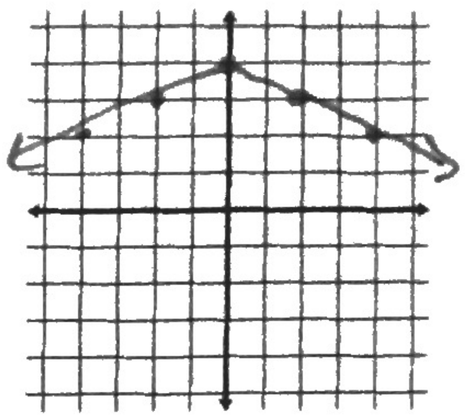
14. $f(x) = -2|x + 3|$



D: $x \in \mathbb{R}$

R: $y \leq 0$

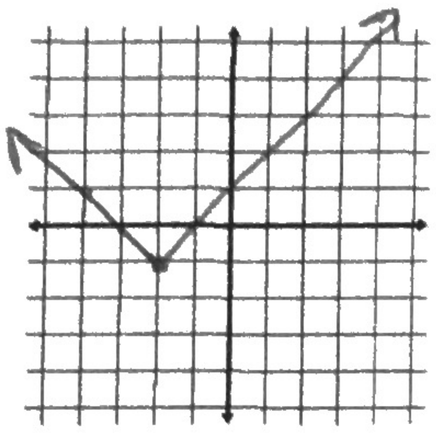
15. $f(x) = -1/2|x| + 4$



D: $x \in \mathbb{R}$

R: $y \leq 4$

16. $f(x) = |x + 2| - 1$

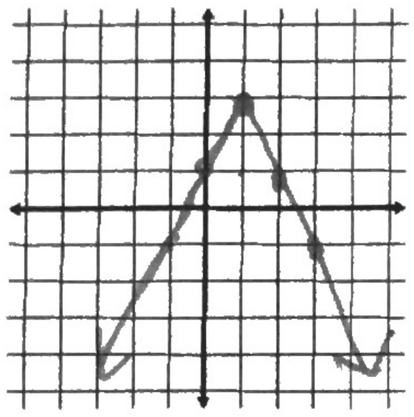


D: $x \in \mathbb{R}$

R $y \geq -1$

17. $f(x) = -2|x - 1| + 3$

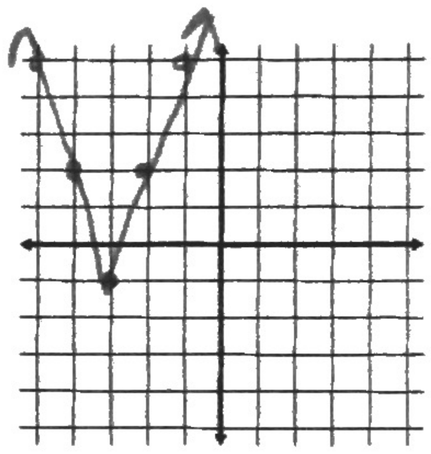
(1, 3)



D: $x \in \mathbb{R}$

R: $y \leq 3$

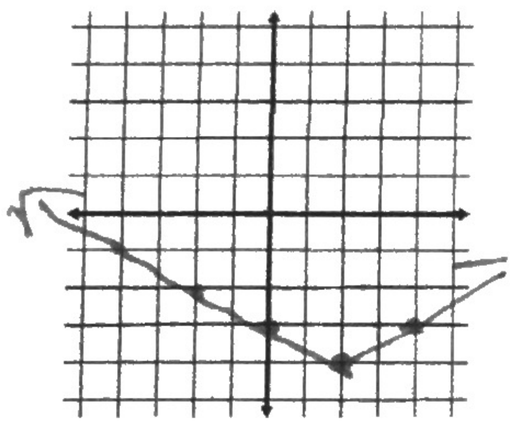
18. $f(x) = 3|x + 3| - 1$



D: $x \in \mathbb{R}$

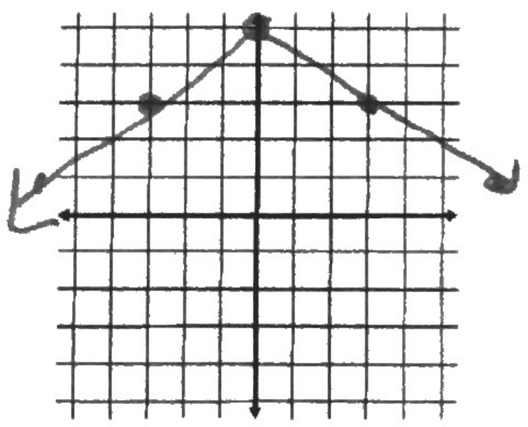
R: $y \geq -1$

19. $f(x) = 1/2|x - 2| - 4$



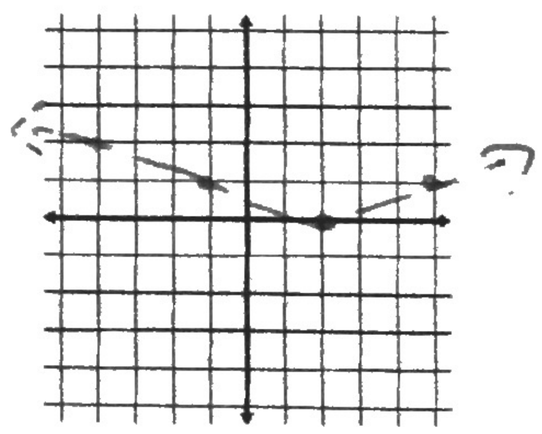
$x \in \mathbb{R}$ $y \geq -4$

20. $f(x) = -2/3|x| + 5$



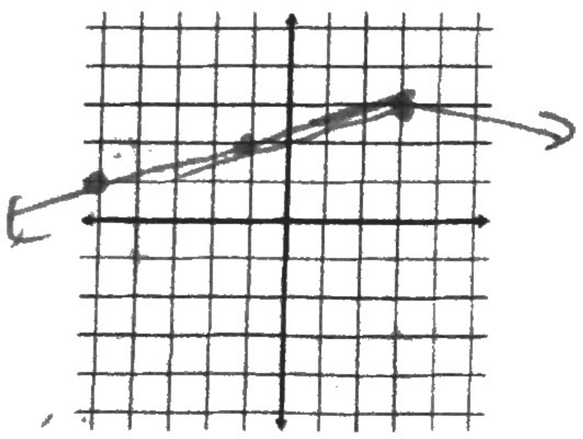
$x \in \mathbb{R}$ $y \leq -5$

21. $f(x) = 1/3|x - 2|$



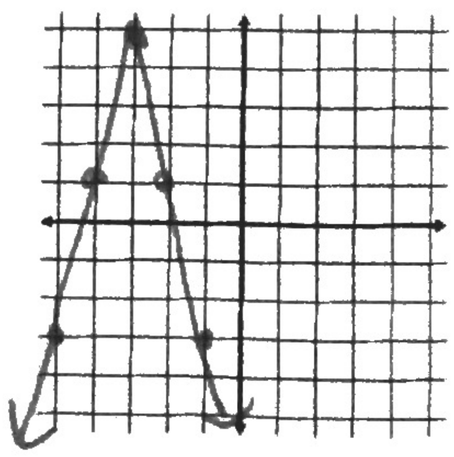
$x \in \mathbb{R}$ $y \geq 0$

22. $f(x) = -1/4|x - 3| + 3$



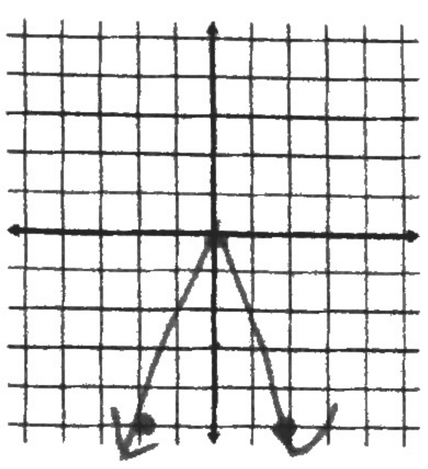
$x \in \mathbb{R}$ $y \leq 3$

23. $f(x) = -4|x + 3| + 5$



$x \in \mathbb{R}$ $y \leq 5$

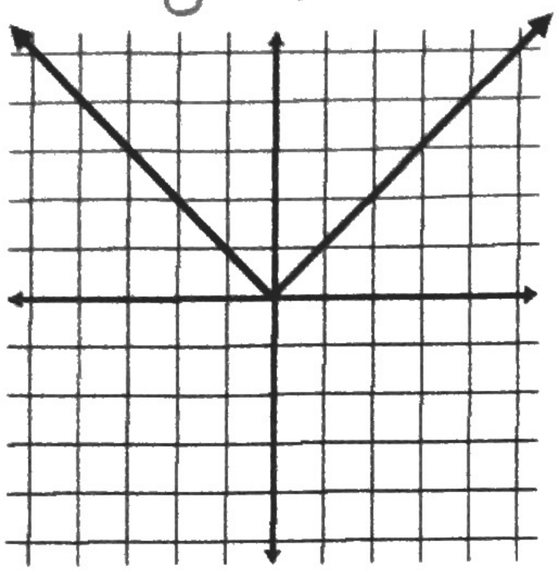
24. $f(x) = -5/2|x|$



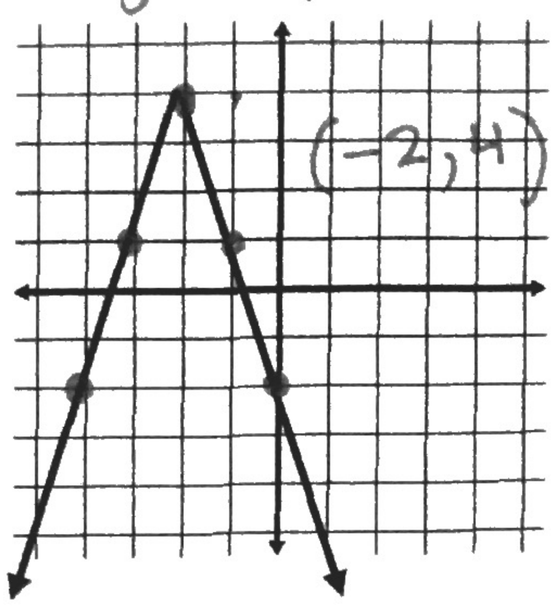
$x \in \mathbb{R}$ $y \leq 0$

**Write the functions of the following graphs.** (*Hint: first, write the vertex & slope)*

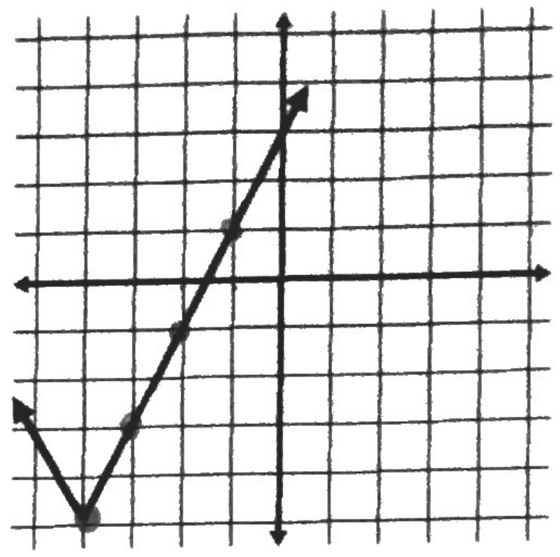
25. $y = |x|$



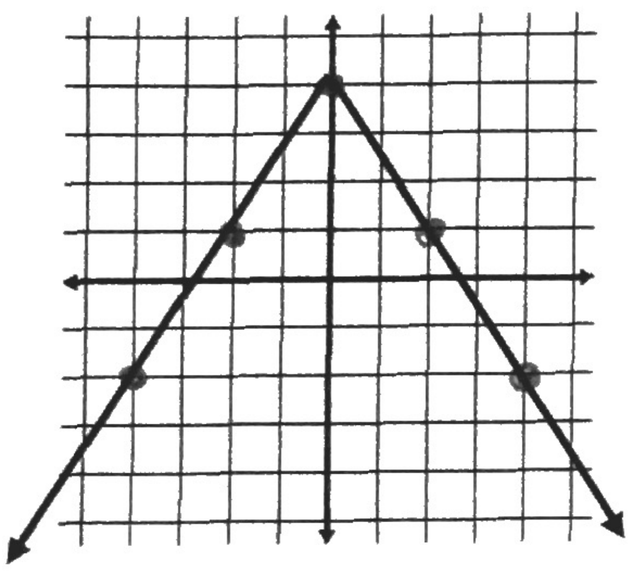
26. $y = -3|x+2|+4$



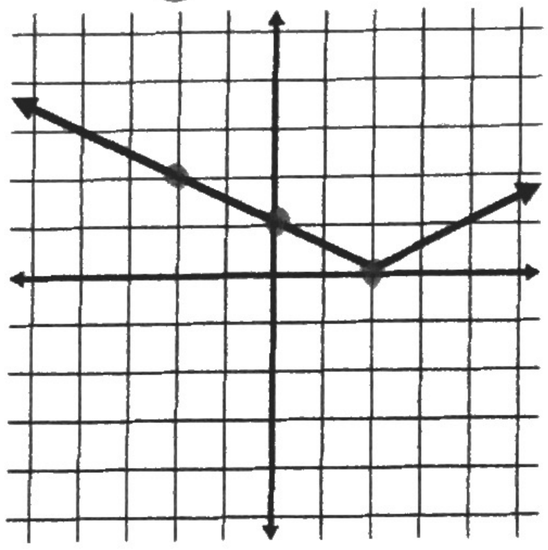

27. $y = 2|x+4|-5$



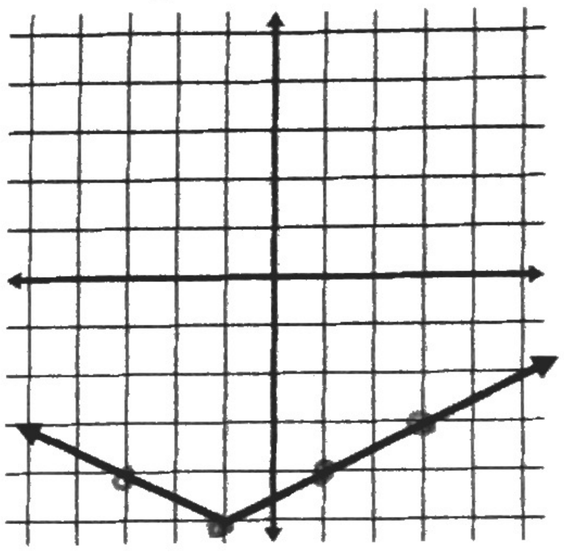
28. $y = -\frac{3}{2}|x|+4$



29. $y = \frac{1}{2}|x-2|$



30. $y = \frac{1}{2}|x+1|-5$



31. Write the equation of an absolute value graph that has:

a) a vertex at (–1, 3) and contains the point (–3, 7)

h k  x y

$y = a|x+1|+3$

$7 = a|-3+1|+3$

$-3 \quad -3$

$4 = a|-2|$

$\frac{4}{2} = \frac{2a}{2}$  $a = 2$

$\boxed{y = 2|x+1|+3}$

b) a vertex at (1, –2) and contains the point (–5, –8)

$y = a|x-1|-2$

$-8 = a|-5-1|-2$

$+2 \quad +2$

$-6 = a|-6|$

$\frac{-6}{6} = \frac{6a}{6}$

$\boxed{y = -|x-1|-2}$

c) a vertex at (1, 29) and contains (19, 82)

$y = a|x-1|+29$

$82 = a|19-1|+29$

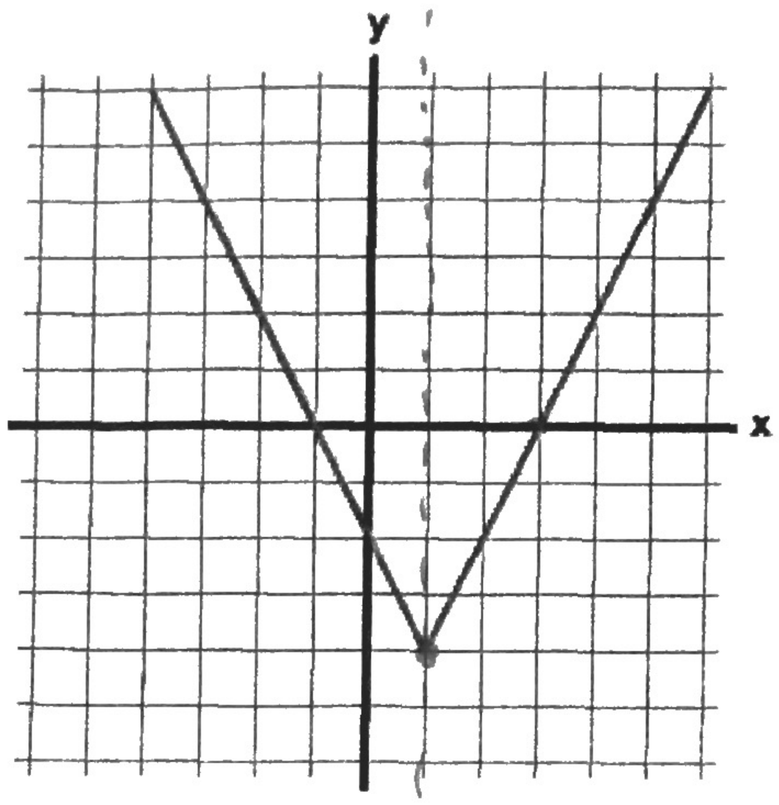
$53 = a|18|$

$a = \frac{53}{18}$

$\boxed{y = \frac{53}{18}|x-1|+29}$

## Analyzing the Graphs of an Absolute Value Function

35.




a. What is the equation of this function?

$y = 2|x-1|-4$

b. Domain? $x \in \mathbb{R}$ Range? $y \geq -4$

c. Axis of symmetry: $x = 1$

d. Maximum or Minimum value? $y = -4$

e. What is/are the x–intercept(s)? $(-1,0)(3,0)$ What is the y–intercept? $(-2,0)$

f. $f(-2.6) = 3.2$ g. $f(52.43) = 98.86$ h. $f(-34) = 66$

---

i. $f(x) = 4$

$2|x-1|-4=4$
$2|x-1|=8$
$|x-1|=4$
$x-1=4$ or $x-1=-4$
$x=5$ or $x=-3$

j. $f(x) = -4$

$2|x-1|-4=-4$
$2|x-1|=0$
$|x-1|=0$
$x=1$

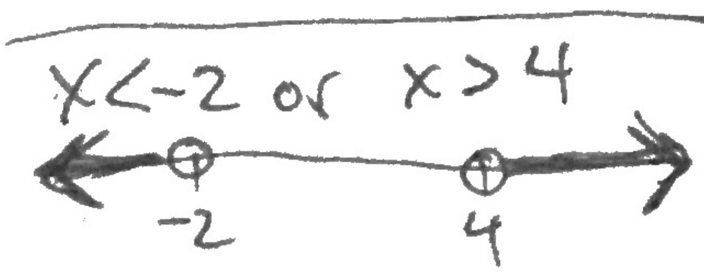
k. $f(x) = -6$

$2|x-1|-4=-6$
$\frac{2}{2}|x-1| = -\frac{2}{2}$
$|x-1| = -1$ ?
new!
no solution

l. $f(x) > 2$

$2|x-1|-4 > 2$
$+4 \quad +4$
$\frac{2}{2}|x-1| > \frac{6}{2}$
$|x-1| > 3$
$x-1 > 3 \quad x-1 < -3$
$x > 4 \quad x < -2$

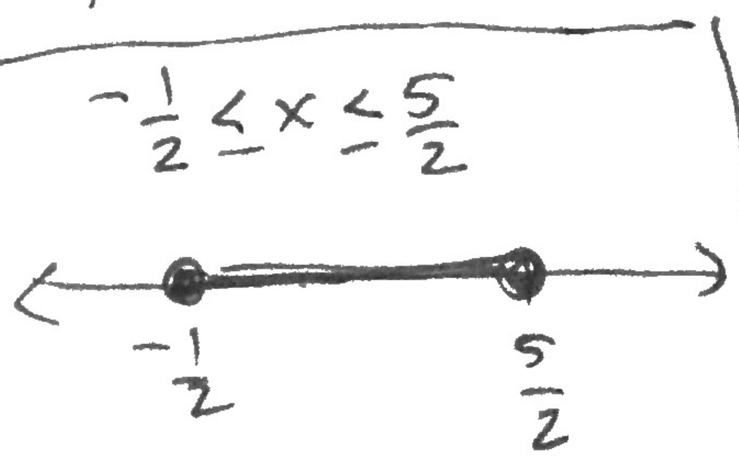
$x < -2$ or $x > 4$




m. $f(x) \leq -1$

$2|x-1|-4 \leq -1$
$+4 \quad +4$
$\frac{2}{2}|x-1| \leq \frac{3}{2}$
$-\frac{3}{2} \leq x-1 \leq \frac{3}{2}$
$+1 \quad +1 \quad +1$

$-\frac{1}{2} \leq x \leq \frac{5}{2}$




n. $f(x) \leq -4$

$2|x-1|-4 \leq -4$
$2|x-1| \leq 0$
$|x-1| \leq 0$
$x = 1$

**Complete by writing the equation of the transformed function:**

$f(x) = 2|x + 3| - 5 \quad \rightarrow \quad g(x) = 2f(-x) =$ $4|-x+3|-10$ → $4|-(x-3)|-10$

$f(x) = 3|x - 2| - 2 \quad \rightarrow \quad g(x) = -3f(x) =$ $-9|x-2|+6$

$f(x) = \frac{1}{2}|x| - 4 \quad \rightarrow \quad g(x) = f(x+4) + 3 =$ $\frac{1}{2}|x+4|-1$
$+3$

$f(x) = |x| + 3 \quad \rightarrow \quad g(x) = f(x - 3) - 5 =$ $|x-3|-2$

$f(x) = |x| \quad \rightarrow \quad -2f(x) - 4 =$ $-2|x|-4$

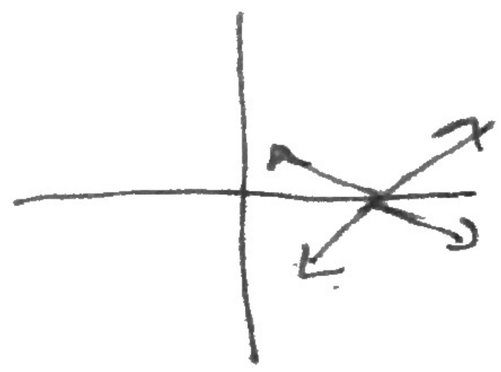
$f(x) = x \quad \rightarrow \quad -f(x - 2) =$ $-(x-2)$

$f(x) = 2x - 4 \quad \rightarrow \quad f(-x) + 6 =$ $2(-x)+2$

} lines!

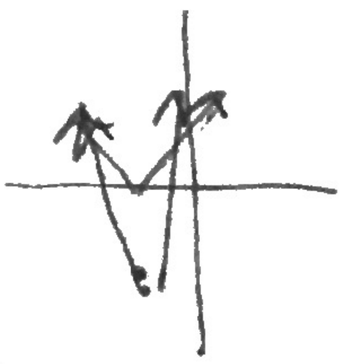
If $f(x) = -\frac{1}{2}|x - 5|$, write the equation of and sketch $k(x) = -f(x)$

$k(x) = \frac{1}{2}|x-5|$



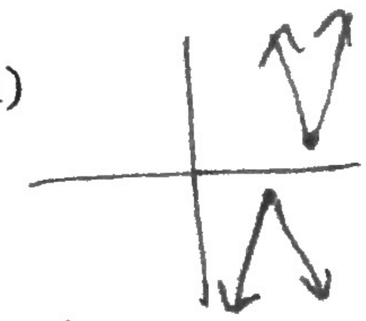
If $f(x) = |x + 3|$, write the equation of and sketch $g(x) = 2f(x) - 4$

$k(x) = 2|x+3|-4$



If $f(x) = 4|x - 5| + 1$, write the equation of and sketch $h(x) = -\frac{1}{2}f(x + 1)$

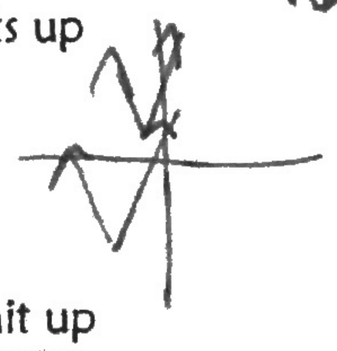
$h(x) = -2|x-4|-\frac{1}{2}$



$f(x) = 2|x + 2| - 3 \quad \rightarrow$ reflect over y axis, shift 3 units left, 5 units up

$2|-x+2|-3$
$-(x+2)+5$
$+3$

$g(x) = 2|-x+1|+2$



$f(x) = \frac{1}{2}|x + 1| + 4 \quad \rightarrow$ reflect over x axis, shift 6 units right, 2 unit up

$-\frac{1}{2}|x+1|-4$
$-6 \quad +2$

$g(x) = -\frac{1}{2}|x-5|-2$