1. Each set of axes shows the graph of $y=f(x)$. Sketch the graph of the given transformed equation.

2. The axes show the graph of $y=f(x)$. Draw the graph of the transformation indicated

3. Shown is the graph of $y=f(x)$. On the same axes, sketch the graph of the transformed equation in color.

a) $y=2 f(x)$

b) $y=-f(x)$

c) $y=-2 f(x)$
4. Fill in the table. The first is an example.

| transform | $y=\|x\|$ | $y=\frac{1}{x}$ | $y=f(x)$ |
| :---: | :---: | :---: | :---: |
| EXAMPLE: <br> left 2 | $y=\|x+2\|$ | $y=\frac{1}{x+2}$ | $y=f(x+2)$ |
| stretch 3 <br> vertically |  | $y=\frac{1}{5 x}$ |  |
|  | $y=\|x+2\|-7$ |  |  |
| up 4 |  |  |  |
| down 2, <br> stretch <br> $3 \times$ vertically |  |  |  |

5. The equation $y=f(x)$ is a solid curve, and some transformation of it is dashed. Write the transformed equation. Do not try to guess the actual equation (the curves are not parabolas).

a)

d)

b)

e)

c)

f)

|  |  <br> h) |  |
| :---: | :---: | :---: |
|  <br> j) |  <br> k) |  <br> 1) |

## 6. Sketching Graphs from Transformed Equations

We've already sketched parent graphs whose function rule has been modified, for example $y=2|x+4|-1$. We expect you to know what the basic parent graphs look like, and we expect you to know how the graphs will shift and stretch. You should not have to plot individual points.
We will want to generalize our results, so we'll use $a b s$ for absolute value, the way the calculator does. For example, we'll write
$y=2 a b s(x+4)-1$ instead of $y=2|x+4|-1$. Draw the graph on the grid to the right. Then describe the movement of the parent graph $y=$ $a b s(x)$ geometrically (see part (a) for an example). The last two are more challenging. No calculator allowed.
a. $y=-2 a b s(x)$

Reflect over the $x$-axis and stretch vertically with factor 2.

b. $y=a b s(x+2)-1$

c. $y=-a b s\left(\frac{x}{2}\right)$

d. $y=a b s(2 x+4)+1$

e. $y=-a b s\left(\frac{x-1}{2}\right)+3$


## 7. Negative Stretch Factors

Unfortunately, $y=a b s(x)$ is symmetric across the $y$-axis, so it's not convenient for the study of negative stretch factors. We'll use $f(x)=a b s(x-2)$ instead.
Given the graph of $f(x)$ shown, sketch and label each of the following graphs on the grid given to the right. Then describe the geometric transformation in words. You can write the equation and plot points to check.
a. $-f(x)$



(continued in next column)
b. $-2 f(x)$
c. $f(-x)$


## 8 Composite Transformations

a. Now we will consider multiple transformations, and do them geometrically first. Each original graph (left column) will undergo two transformations in the specified order. As before, start with $y=a b s(x)$ Write an equation for each graph, and use two key points to check.


The transformations in this table duplicate those on the last page. Complete the table for the composite transformations (Sketch graphs in the provided space below).

| Geometric <br> transformation <br> in words |  |
| :--- | :--- |
| 1. Vertical stretch with <br> factor 2, then vertical <br> shift up 2. |  |
| 2. Vertical shift up 2, <br> then vertical stretch with <br> factor 2. |  |
| 3. Horizontal stretch with $y=$ form <br> factor 2, then horizontal <br> shift 2 to the right. |  |
| 4. Horizontal shift 2 to <br> the right, then horizontal <br> stretch with factor 2. |  |


2.




