Group #: _____ Name: _____

1. (70 points) Let $f(x) = x^2$. Let $g(x)$ be the function whose graph is obtained by taking the following steps:

Step 1. shifting the graph of $f(x)$ to the right 3 units (call the result of this function $g_1(x)$),

Step 2. shifting $g_1(x)$ down 4 units (call the result of this function $g_2(x)$),

Step 3. reflecting $g_2(x)$ across the y-axis (call the result of this function $g_3(x)$),

Step 4. reflecting $g_3(x)$ across the x-axis (this is the desired $g(x)$).

   (a) (20 points) Find the **equation** obtained at each step in terms of $f(x)$. For example, $g_1(x) = f(x-3)$ which turns into $g_1(x) = (x-3)^2$ when we use the definition of $f(x)$. Do the same for $g_2(x)$, $g_3(x)$, and $g(x)$.

   (b) (20 points) Graph $f(x)$, $g_1(x)$, $g_2(x)$, $g_3(x)$, and $g(x)$ on the same figure. (At the end, you should be very confident that each figure matches with its respective equation.)

   (c) (30 points) Do you think the equation of the graph obtained by following the sequence of steps: reflect across x-axis $\to$ shift to the right 3 units $\to$ shift down 4 units $\to$ reflect across the y-axis will be the same as $g(x)$? Confirm your guess by actually finding the new equation and drawing the figure. Do you think the order at which we apply the transformations matters? That is, do we expect to get the same equation/figure if we apply the same set of transformations but in different order?

2. (30 points, 10 points each) Sketch the graph of the following functions, **not by plotting points**, but by starting with the graph of a standard function and applying transformations. Feel free to include the sketch of the graph at each step of the transformation.

   (a) $g(x) = 2 - |x-3|$

   (b) $h(x) = \sqrt{-x+4} - 3$

   (c) $k(x) = -(x+2)^3$