Hi everyone! Here are the solutions to the Math 110 Exam of Happiness B!!! Enjoy!

1. (a) \( f(-2) = \frac{(-2)^2 + 4}{2} = \frac{8}{2} = 4. \)
   
   (b) There are no \( y \)-intercepts, since 0 is not in the domain of the function.

   (c) The function is odd, since
   
   \[
   f(-x) = \frac{(-x)^2 + 4}{-x} = -\frac{x^2 + 4}{x} = -f(x).
   \]

2. (a) Shift the graph 3 units to the right.

   (b) Reflect the graph over the \( x \)-axis, and scale the graph away the \( x \)-axis by a factor of 3.

   (c) Scale horizontally towards the \( y \)-axis by a factor of 3, and then shift the graph down 6 units.

3. The midpoint between the points \( P \) and \( Q \) is

   \[
   \left( \frac{5 + (-1)}{2}, \frac{2 + (-6)}{2} \right) = (2, -2).
   \]

4. We complete the square on the \( x \)'s to see that

   \[
   x^2 + 4x = x^2 + 4x + 4 - 4 = (x + 2)^2 - 4.
   \]

   Completing the square with the \( y \)'s gives us

   \[
   y^2 - 12y = y^2 - 12y + 36 - 36 = (y - 6)^2 - 36.
   \]

   So finally we have

   \[
   9 = x^2 + 4x + y^2 - 12y = (x + 2)^2 - 4 + (y - 6)^2 - 36,
   \]

   So,

   \[
   49 = (x + 2)^2 + (y - 6)^2.
   \]

   Thus, the center of the circle is at \((-2, 6)\) and the radius is \( \sqrt{49} = 7 \).
5. This line has slope $-6$, and goes through $(5, 7)$, so the equation is
\[ y - 7 = -6(x - 5). \]

6. This line has slope $-\frac{1}{7}$, and goes through $(2, -1)$, so the equation is
\[ y + 1 = -\frac{1}{7}(x - 2). \]

7. (a) \((f - g)(1) = f(1) + g(1) = [(1) - (1)^2] - [(2(1) + 1) = -3.\)

(b) The rule would be
\[(f \cdot g)(x) = f(x)g(x) = (x - x^2)(2x + 1).\]

(c) The rule would be
\[(g \circ f)(x) = g(f(x)) = g(x - x^2) = 2(x - x^2) + 1.\]

8. (a) We notice that
\[-2x^2 - 16x = -2(x^2 + 8x) = -2(x^2 + 8x + 16 - 16) = -2[(x + 4)^2 - 16] = -2(x + 4)^2 + 32.\]
So \[-2x^2 - 16x - 30 = -2(x + 4)^2 + 32 - 30 = -2(x + 4)^2 + 2\]

(b) The vertex is at $(-4, 2)$, and the graph is pictured below.