Name _____

1. Simplify the following exponential expressions.

   (a) $54^0 =$

   (b) $(14^{-1})^{-1} =$

   (c) $9^{-2} =$

   (d) $\dfrac{3^7 \cdot 5^2}{(3^2)^3 \cdot 5 \cdot 5^2} =$

   (e) $\dfrac{2^1 5 - 2^7}{(2^2)^3} =$

   (f) $\dfrac{2^8}{(2^{-3})^{-2}} =$

   (g) $(x^3 x^{-1})^{-2} =$

   (h) $\dfrac{xy^8}{(y^{-3})^{-2}} =$

2. Write the following in scientific notation:

   (a) $7.2 \cdot 10 \cdot 10 \cdot 10 \cdot 10$

   (b) $6 + 2 \cdot 10^2$

   (c) The number of grains of sand on earth is $7\,500\,000\,000\,000\,000\,000$.

   (d) The number of atoms in a grain of sand is 43 quintillion.

   (e) The number of atoms in *all* of the sand on earth.

   (f) $(2.5 \cdot 10^5) \cdot (8 \cdot 10^{-1})$

   (g) $\dfrac{3.6 \times 10^8 + 4 \times 10^7}{2 \times 10^3}$

3. In class last week, we estimated the weight of all of the water in Lake Superior. In this problem, we'll estimate the weight of the moon.

(a) Using telescopes, we can estimate that the diameter of the moon is about 2000 miles. Using the information that the radius is half of the diameter, and that the volume of a sphere is $\frac{4}{3}\pi r^3$, what is the *volume* of the moon in cubic miles and scientific notation? (Round to two decimal places.)

(b) Using the information that 1 mile is equal to 1600 meters, what is the volume of the moon in m^3 (and scientific notation)?

(Recall that if $1 = \dfrac{1600m}{1mi}$, then $1^3 = 1 = \left(\dfrac{1600m}{1mi}\right)^3 = \dfrac{1600^3m^3}{1mi^3}$.)

(c) Using that $1m^3$ weighs 2200 pounds, how much does the moon weigh in pounds?

(d) Using that $1m^3$ weighs 2200 pounds, how much does the moon weigh in pounds?

(e) The Pacific Ocean contains $1.5 \cdot 10^{21}$ pounds of water. The moon weighs how many more times than the Pacific Ocean?

4. Determine whether each of the functions are polynomials. If a function is a polynomial, find the degree.

(a) $f_1(x) = -3x^5 - \frac{2}{3}x^2 + \sqrt{71}$

(b) $f_2(x) = -x^{-5} - 7x^{-2} + 7$

(c) $f_3(x) = x^4 + 3^x - 7x^2 + x + 1$

(d) $f_4(x) = x(x+1)(x+2)(x+3)$ *(What are the roots?)*

(e) $f_5(x) = x^2 - 100$ *(What are the roots?)*

(f) $f_6(x) = x(x+1)(x+2)(x+3)(x^2 - 100)$ *(What are the roots?)*

5. Use a calculator or website that can graph functions, and draw a rough sketch (not to scale) of (a) $y = -\frac{1}{2}x^3 + 2x^2 - 1$ and (b) $y = -2x^4 + 10x^3 - 14x^2 + 6x$ including end behavior and all roots.