Name:_____ November 18, 2013

Algebra II: Scientific Notation

1 Big Stuff

The **supermassive black hole** in the center of the Milky Way Galaxy has a mass of $M = 7.559 \times 10^{36}$ kilograms! It's so large that it warps time around it, making time pass slower near it.

The formula for how slow time passes is

$$T^2_{\text{BlackHole}} = \left(1 - \frac{2 \cdot G \cdot M}{c^2 \cdot D}\right) \cdot T^2_{\text{Earth}}$$

where

- Newton's Constant: $G = 6.67 \times 10^{-11} \ \frac{\text{meters}^3}{\text{kilogram} \ \ \text{seconds}^2}$
- The Speed of Light: $c = 3 \times 10^8 \ \frac{\text{meters}}{\text{second}}$
- T_{Earth} is the time on Earth, and $T_{\text{BlackHole}}$ is the time measured by a spaceship D meters from the black hole.

1.1 Time Dilation

1. Say you're 12 billion meters away from the black hole. What is D in scientific notation?

$$D =$$

2. Using the numbers above, solve for

$$\left(1 - \frac{2 \cdot G \cdot M}{c^2 \cdot D}\right) =$$

3. If one second passes on Earth, how long will pass for someone next to the black hole?
4. **Bonus Question:** How close do I have to be to the black hole for time to stand still? That is,

$$\text{if } \left(1 - \frac{2 \cdot G \cdot M}{c^2 \cdot D}\right) = 0, \text{ then } D = ?$$