AST121

Mathematics review questions., Form: A

Name: _____

Date: _____

1. What is $\frac{10^8}{10^{-7}}$? This is the number of times that the electric field at a point in space oscillates in one second due to a light wave.

2. The distance from the Earth to the Sun is 1.5×10^{11} meters and light travels 3×10^8 meters in one second. What is $\frac{10^{11}}{10^8}$?

3. There are approximately 10^{23} atoms in 1 gram of hydrogen atoms. If the sun has a mass of 10^{33} grams and is mostly made of hydrogen, approximately how many hydrogen atoms are in the Sun?

4. What is $(\frac{1}{2})^2$? What about $(\frac{1}{3})^2$? What about $(\frac{1}{4})^2$

5. The diameter of the Earth is about 10^7 m. The Earth is about 10^{11} m from the Sun. How many Earths lined up next to each other could fit between here and the Sun?

6. What is "a million million" written as a power of 10?

7. What is a thousand?

8. What is a hundredth?

9. What is a hundredth of a million?

10. The speed of light is 300 million meters per second. Express this answer as 300 times a power of ten and alternatively as 3 times a power of ten.

11. The Earth is 150 million kilometers from the Sun. Express this as 1.5 times a power of ten.

12. How many Earth diameters is the diameter of Jupiter? In other words, if you lined up a bunch of Earths in a line, how many would fit across the diameter of Jupiter?

13. The Earth's diameter is 1.3×10^4 km. The Moon's diameter is 2.4×10^3 km. How many moons would fit across the Earth's diameter?

14. Suppose you set up a laser at one end of the hallway and point it at a sensor 30 m away. A circuit is used to measure the time interval between when you turn on the laser and when the light hits the sensor. What do we expect it to measure for the time interval?

15. The energy radiated from a star depends on its temperature to the fourth power. We write that like

$$E \sim T^4$$

If you multiply T by a factor of 2, then the energy radiated from the star increases by a factor of 2^4. what is this factor?

16. The energy radiated from a star depends on its radius squared. We write that like

$$E \sim R^4$$

If you multiply R by a factor of 2, then the energy radiated from the star increases by a factor of 2^2. what is this factor?

17. Suppose that star A has 4 times the radius of star B; however, it has only half the temperature of star B. How much more energy does star A radiate compared to star B?

Answer Key for Exam A

1.

$$\frac{10^8}{10^{-7}} = 10^{8--7} = 10^{15}$$

2.

$$\frac{10^{11}}{10^8} = 10^{11-8} = 10^3$$

3.

$$10^{23} \times 10^{33} = 10^{23+33} = 10^{56}$$

4.

$$(\frac{1}{2})^2 = \frac{1}{4}$$

$$(\frac{1}{3})^2 = \frac{1}{9}$$

$$(\frac{1}{4})^2 = \frac{1}{16}$$

5.

$$10^{11} \times 10^7 = 10^{11-7} = 10^4$$

6.

$$10^6 \times 10^6 = 10^{6+6} = 10^{12}$$

7.

$$10^3$$

8.

$$10^{-2}$$

9.

$$10^{-2} \times 10^6 = 10^{-2+6} = 10^4$$

10.

$$300 \times 10^6$$

and

$$3 \times 10^8$$

11.

$$150 \times 10^6 = 1.5 \times 10^8$$

12.

$$\frac{7.149 \times 10^4}{6.378 \times 10^3}$$

13.

$$\frac{1.3 \times 10^4}{2.4 \times 10^3}$$

14.

$$\frac{3 \times 10^1}{3 \times 10^8} = 1 \times 10^{-7}$$

15.

$$2^4 = 16$$

16.

$$2^2 = 8$$

17. The larger radius means that star A radiates $4^2 = 16$ times more energy as a result of its larger radius. However, it has half the temperature which means that it radiates $(1/2)^4 = 1/16$ times less energy as a result of its cooler temperature. These effects essentially cancel each other out so that star A radiates the same amount of energy as star B.