

Some Questions that Challenge. Grades six and above

## Definition of **Angstrom** Å

An **Angstrom** Å is a unit of length equal to  $10^{-10}$  meters

1. Which is bigger a nanometer or an Angstrom? Answer: \_\_\_\_\_

Answer: nanometer

2. Which is bigger a picometer or femtometer? Answer: \_\_\_\_\_

Answer: picometer

3. Which is bigger a zeptometer or attometer? Answer \_\_\_\_\_

Answer: attometer

4. Which is bigger a exameter or petameter? Answer: \_\_\_\_\_

Answer: exameter

5. True or False Å = 100 picometres Answer: \_\_\_\_\_

Answer: True

**Order of Magnitude:** The number of times we would have to multiple or divide by 10 to convert one size to the other. Comparing numbers of widely different size we use **Ratios!**

Examples: Determine the order of magnitude difference in the sizes of the radii for:

(a) The solar system ( $10^{12}$  meter) compared with Earth ( $10^7$  meter)

(b) Protons ( $10^{-15}$  meter) compared with Milky Way ( $10^{21}$  meter)

(c) Atoms ( $10^{-10}$  meter) compared with neutrons ( $10^{-15}$  meter)

Answer:

(a)  $10^{12}$  meter/ $10^7$  meter =  $10^5$  **Order 5** larger Solar system than Earth (b)  $10^{21}$  meter/ $10^{-15}$  meter =  $10^{36}$  **Order 36** larger Milky Way than Protons

(c)  $10^{-10}$  meter/ $10^{-15}$  meter =  $10^5$  **Order 5** larger Atoms than neutrons

For each of the following pairs, determine the order of magnitude difference:

6. The radius of the sun ( $10^9$  meters) and the radius of the Milky Way ( $10^{21}$  meters)

Ans: \_\_\_\_\_

Answers (a) order 12

7. The radius of a hydrogen atom ( $10^{-11}$  meter) and the radius of a proton ( $10^{-15}$  meter)

Ans: \_\_\_\_\_

Answer order 4

8. How many orders of magnitude greater is a kilometer than a meter? Than a millimeter?

Ans: \_\_\_\_\_

Answer: Kilometer to meter order 3 and kilometer to millimeter order 6

9. An ant is roughly  $10^{-3}$  meter in length and the average human roughly one meter.

How many times longer is a human than an ant?

Ans: \_\_\_\_\_

Answer:  $10^0$  meter/ $10^{-3}$  meter =  $10^3$  **Order 3** A human is of order 3 larger than an ant.

10. A millimeter and a gigameter

Ans: \_\_\_\_\_

Answers: A millimeter and a gigameter  $10^9/10^{-3} = 10^{12}$  **Order 12**

See page SI METRIC PREFIXES No 13 for definitions of exa, peta, nano, pico, femto, atto, zept etc.