

Topic 1A: Mathematical Reasoning

Skill One: Standard, Scientific Notation, Metric Prefixes and Operations

Scientific Notation rules- Coefficient equal to or greater than 1 but less than 10

9.4×10^3
Coefficient Base Exponent

- positive exponent means multiply by 10 (greater than 1)
- negative exponent means divide by 10 (less than 1)
- Coefficient only includes significant figures (rounded #)

- Multiply 2 numbers in SN by adding exponents
- Divide 2 numbers in SN by subtracting exponents

On calculator use EE button to replace $\times 10^n$
 $5 \times 10^2 \rightarrow 5E^2$

Metric prefixes are interchangeable with powers of 10 (See PRT page 1)

ex: Kilo means 10^3 so $9.4 \times 10^3 \text{ m}$ is also 9.4 km

Any change in decimal location must be balanced by opposite change in exponent. If coefficient gets larger, exp gets smaller & vice versa

$$350 \times 10^{-6} = 3.5 \times 10^{-4}$$

2 smaller 2 bigger

$$.0046 = 4.6 \times 10^{-3}$$

3 bigger 3 smaller

Skill Two: Estimating Metric Values

Metric prefixes are listed on front of Physics Reference Table

Translating between prefixes involves moving powers of 10

$$350 \text{ nm} = 350 \times 10^{-9} \text{ m} = 3.5 \times 10^{-7} \text{ m}$$

$$\text{or } 350 \text{ nm} = 350 \times 10^{-9} \text{ m} = 3.5 \times 10^2 \times 10^{-9} \text{ m} = 3.5 \times 10^{-7} \text{ m}$$

To estimate which answer is most reasonable, convert to most logical common unit.

Ex: Which of these is most likely the height of a door way

- A) $2 \times 10^2 \text{ m}$ B) $2.1 \times 10^4 \text{ cm}$ C) $2.1 \times 10^2 \text{ cm}$ D) $2.1 \times 10^{-3} \text{ m}$
- 210m 210m 2.1m .0021m

Values to know: $1 \text{ kg} = 2.2 \text{ lbs}$ $1 \text{ in} = 2.54 \text{ cm}$ $1 \text{ mile} = 1600 \text{ m} = 1.6 \text{ km}$ $1 \text{ N} = 1 \text{ kg}$

Skill Three: Factor Label Method and Dimensional Analysis

This skill is all about keeping track of units and setting them up to Simplify. (Cross off by setting unit up in opposite position of fraction)

Step 1: Identify the question: ie ? of a = b

Step 2: Write a list of conversion factors (equalities) that connect starting point and goal

Step 3: Solve by multiplying by series of fractions that progress toward goal by crossing out units.

Ex: The Earth is orbiting the Sun at 30 km/s. How many miles does it travel in 1 week

$$? \text{ miles} = 1 \text{ week} \times \frac{7 \text{ days}}{1 \text{ week}} \times \frac{24 \text{ hour}}{1 \text{ day}} \times \frac{3600 \text{ seconds}}{1 \text{ hour}} \times \frac{30 \text{ km}}{1 \text{ seconds}} \times \frac{1 \text{ mi}}{1.6 \text{ km}} = \frac{1 \times 7 \times 24 \times 3600 \times 30}{1.6} \text{ mi}$$

(weeks $\rightarrow$ days $\rightarrow$ hours $\rightarrow$ seconds $\rightarrow$ km $\rightarrow$ miles)
1 = 7 1 = 24 1 = 3600 1 = 30 1.6 = 1

$$= 1.13 \times 10^7 \text{ mi}$$