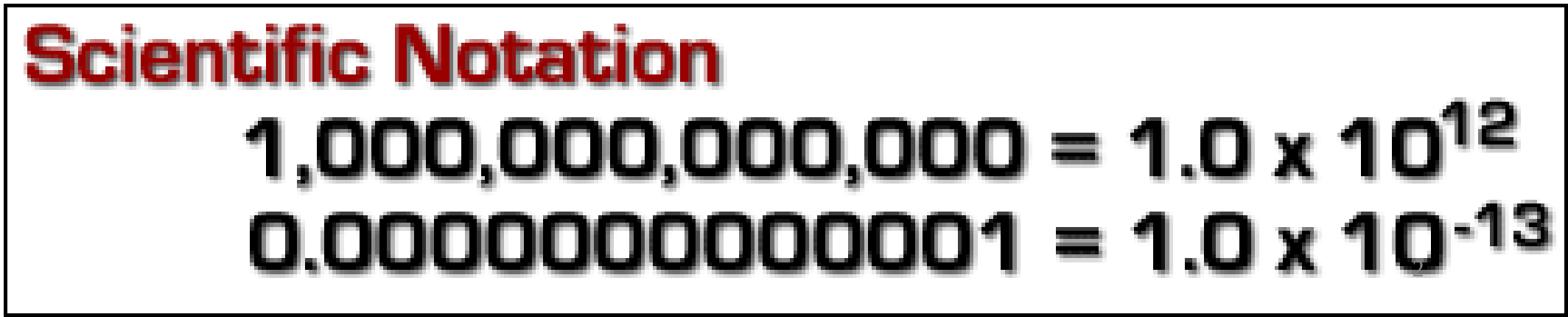
[5.1]: SI Units and Unit Conversions

Scientific (Exponential) Notation

- Used to express **very large** and **very small** numbers, scientists express numbers in terms of powers or exponents.
- The first term consists of a number between 1 to 10
- The second part is an exponent.

E.g. 5.8×10^{-5} **NOT** 0.89×10^{-5} **NOT** 20×10^{9}

- Scientists do this so that it is **EASIER** to write big and small numbers



Practice Problem #1

Convert the following numbers to ordinary expanded form:

1. 5×10^{12}
2. 4.21×10^{-3}
3. 9.0×10^{5}

Convert the following numbers to scientific notation:

1. 0.0000000041
2. 1200000000
3. 0.0000000321

Practice Problem #1

Convert the following numbers to ordinary expanded form:

1. 5×10^{12} 2. 4.21×10^{-3} 3. 9.0×10^{5}

5,000,000,000,000 **0.00421** **900000**

Convert the following numbers to scientific notation:

1. 0.0000000041 2. 1200000000 3. 0.0000000321

Practice Problem #1

Convert the following numbers to ordinary expanded form:

1. 5×10^{12} **5,000,000,000,000**
2. 4.21×10^{-3} **0.00421**
3. 9.0×10^{5} **900000**

Convert the following numbers to scientific notation:

1. 0.0000000041 **4.1×10^{-9}**
2. 1200000000 **1.2×10^{9}**
3. 0.0000000321 **3.21×10^{-8}**

SI Units

"SI units" stands for "Systeme Internationale", which means the International System (or known as metric units) in French. This system uses several "**base units**" and **prefixes** to describe quantities.

1 centimeter = 10^{-2} meter

$$\frac{1\text{cm}}{10^{-2}\text{ meter}} \quad \text{OR} \quad \frac{1\text{ meter}}{100\text{ cm}}$$

SI Prefixes

Multiple	Prefix	Symbol
10^{15}	peta	P
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10	deka	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f

SI Units

The Prefixes Used with SI Units

Prefix	Symbol	Meaning	Scientific Notation
exa-	E	1,000,000,000,000,000,000	10^{18}
peta-	P	1,000,000,000,000,000	10^{15}
tera-	T	1,000,000,000,000	10^{12}
giga-	G	1,000,000,000	10^{9}
mega-	M	1,000,000	10^{6}
kilo-	k	1,000	10^{3}
hecto-	h	100	10^{2}
deka-	da	10	10^{1}
—	—	1	10^{0}
deci-	d	0.1	10^{-1}
centi-	c	0.01	10^{-2}
milli-	m	0.001	10^{-3}
micro-	μ	0.000 001	10^{-6}
nano-	n	0.000 000 001	10^{-9}
pico-	p	0.000 000 000 001	10^{-12}
femto-	f	0.000 000 000 000 001	10^{-15}
atto-	a	0.000 000 000 000 000 001	10^{-18}

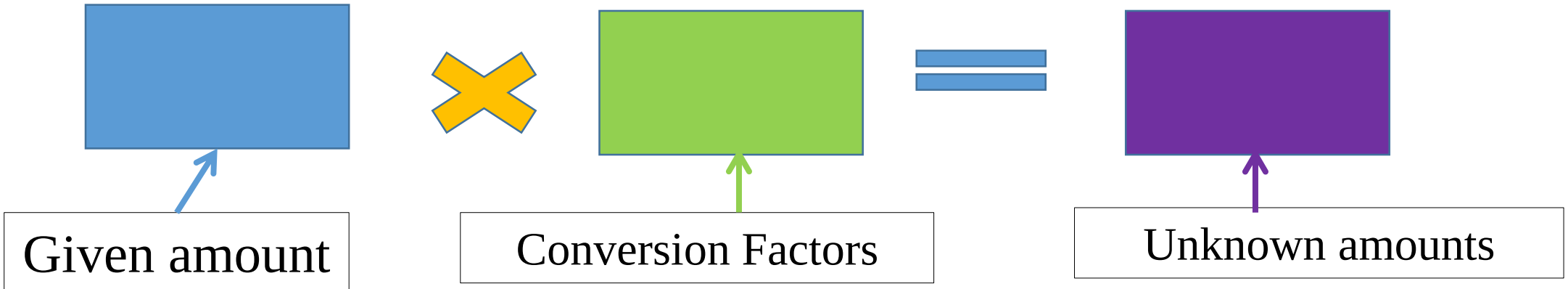
Memorize

The 3 Steps of Unit Conversion

- The method of unit conversions uses conversion factors to change the units associated with an expression into a different set of units

The Steps of Unit Conversion:

1. Identify the **given** (initial amount) & its **units**
2. Identify the **unknown** amount and its **units**
3. Use a **conversion factor** which relates the different units
4. Cancel out units as you would with numbers



Practice Problem #1

How many milliseconds are there in one hour?

Practice Problem #1

How many milliseconds are there in one hour?

$$1\text{ hour} \times \frac{60\text{ minutes}}{1\text{ hour}} \times \frac{60\text{ seconds}}{1\text{ minute}} \times \frac{1000\text{ milliseconds}}{1\text{ second}} = 3,600,000\text{ milliseconds}$$

$$= 3.6 \times 10^6\text{ ms}$$

Practice Problem #2

Convert the following using a conversion factor.

1. 10 mL = _____ L

2. 42000 mg = _____ g

3. 0.55 mm = _____ m

4. 5.5 kg = _____ mg

Practice Problem #2

Convert the following using a conversion factor.

1. 10 mL = **0.01**L
2. 42000 mg = **42** g
3. 0.55 mm = **5.5×10^{-4}** m
4. 5.5 kg = **5.5×10^{6}** mg

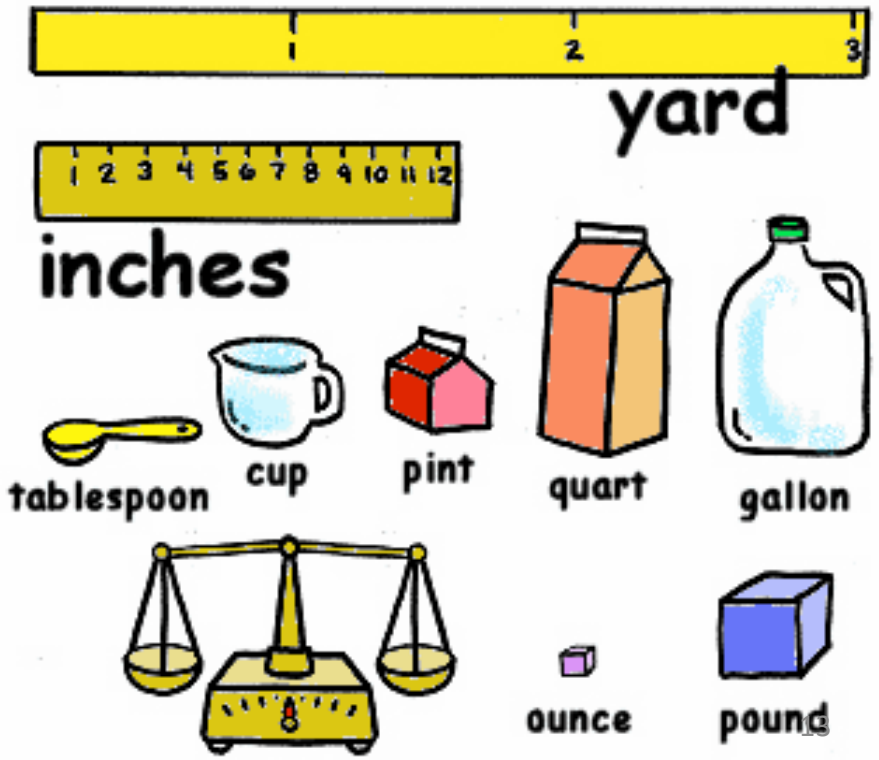
Unit Conversions

- A **quantity** is a property that can be described by a **number** and a **unit**. In everyday life, units are often omitted because the context is clear.
- **What unit is implied by each of the following quantity?**
- How old are you?

  Eighteen. _____
- How tall are you?

  One-ninety-three. _____
- How much do you weigh?

  Seventy-five. _____



Examples of Conversion Factors

1 hour = 60 min

1 min = 60 second

1 mile = 5280 feet

1 pound = 454 g

1 inch = 2.54 cm

1 feet = 12 inch

Conversion Factors

- When you write the conversion factor, write it **vertically** to cross out units easily. **You may turn factors upside down.**

Example: 1 min = 60 s or $\frac{1\text{min}}{60s}$ or $\frac{60s}{1\text{min}}$

The unit that you want goes on top

Practice Problem #1

How many minutes are there in 3480 seconds?

Practice Problem #1

How many minutes are there in 3480 seconds?

$$3480 \text{ seconds} \times \frac{1 \text{ minute}}{60 \text{ seconds}} = 58 \text{ minutes}$$

Practice Problem #2

A car travels 60 km in 1 hour, how far does it travel in 8.5 hours?

Practice Problem #2

A car travels 60 km in 1 hour, how far does it travel in 8.5 hours?

$$8.5 \text{ hours} \times \frac{60 \text{ km}}{1 \text{ hour}} = 510 \text{ km}$$

Practice Problem #3

Sugar costs $0.980/kg. Given 1 t = 1000 kg. How many tonnes (“t”) of sugar can you buy for $350?

Practice Problem #3

Sugar costs $0.980/kg. Given 1 t = 1000 kg. How many tonnes (“t”) of sugar can you buy for $350?

$$\$350 \times \frac{1\ \text{kg}}{\$0.980} \times \frac{1\ \text{t}}{1000\text{kg}} = 0.357\ \text{t}$$

HOMEWORK

Hebden Textbook

- pg. 11 - #1 (a-c)
- pg. 14 - #2 (a-c), #3
- pg. 21 - #16 (a-c), #17 (a-c)