CHEMISTRY CLASS NOTES
(Aims 3)

AIM 3a: What are the SI units?
AIM 3b: What is significant figures?
AIM 3c: What is scientific notation?
AIM 3d: What is dimensional analysis and how do we use it?

International System of Units (SI)
- standard system of measurements used in chemistry
- enable scientists to communicate with one another
- there are 7 base units
    - all other units are derived from these 7 base units

7 SI base units
- ampere (A) – measures electric current
- kilogram (kg) – measure mass
- meter (m) – measure length
- second (s) – measure time
- kelvin (K) – measure thermodynamic temperature
- mole (mol) – measure amount of substance
- candela (cd) – measure luminous intensity

SI prefixes (use to increase the size of the units)

Prefix	Abbreviation	Meaning	Exponential Notation	Number
tera	T	1 trillion	10^{12}	1,000,000,000,000
giga	G	1 billion	10^{9}	1,000,000,000
mega	M	1 million	10^{6}	1,000,000
kilo	k	1 thousand	10^{3}	1,000
hecto	h	1 hundred	10^{2}	100
deka	da	1 ten	10	10
deci	d	1 tenth	10^{-1}	0.1
centi	c	1 hundredth	10^{-2}	0.01
milli	m	1 thousandth	10^{-3}	0.001
micro	μ	1 millionth	10^{-6}	0.000001
nano	n	1 billionth	10^{-9}	0.000000001
pico	p	1 trillionth	10^{-12}	0.000000000001
femto	f	1 quadrillionth	10^{-15}	0.000000000000001

Significant Figures

- definition: a prescribed decimal place that determines the amount of rounding off to be done based on the precision of the measurement
- consist of all digits known with certainty and one uncertain digit.

Rules for determining significant figures

- nonzero digits are always significant
  - example: 46.3 m has 3 significant figures
  - example: 6.295 g has 4 significant figures
- Zeros between nonzero digits are significant
  - example: 40.7 m has 3 significant figures
  - example: 87,009 m has 5 significant figures
- Zeroes in front of nonzero digit are not significant
  - example: 0.009587 m has 4 significant figures
  - example: 0.0009 g has 1 significant figure
- Zeroes both at the end of a number and to the right of a decimal point are significant
  - example: 85.00 g has 4 significant figures
  - example: 9.0700 has 5 significant figures

Rules for using significant figures in calculation

- For multiplication and division
  - The number of significant figure for the answer can not have more significant figures than the measurement with the smallest significant figures
    - Example: 12.257 x 1.162 = 14.2426234
      - 12.257 = 5 significant figures
      - 1.162 = 4 significant figures
      - Answer = 14.24 (4 significant figures)
- For addition and subtraction
  - The number of significant figure for the answer can not have more significant number to the right of the decimal point
    - Example: 3.95 + 2.879 + 213.6 = 220.429
      - 3.95 = has 2 significant figures after the decimal points
      - 2.879 has 3 significant figures after the decimal points
      - 213.6 has 1 significant figures after the decimal points
      - Answer = 220.4 (1 significant figure)
- Remember the rounding rules
  - Below 5 – round down
  - 5 or above - roundup

Exact values

- has no uncertainty
  - example: Count value – number of items counted. There is no uncertainty
  - example: conversion value – relationship is defined. There is no uncertainty
- do not consider exact values when determining significant values in a calculated result

CALCULATOR does not account for significant figures!!!!

Scientific Notation

- Use to write very large number and very small number (more manageable)
- Parts:
  - Before the decimal point = 1 number
  - After the decimal points = more than 1 numbers (can be optional)
  - Exponential number = the number of places the decimal is moved
- Examples:
  - 1,234,400 = 1.234400 x 10^{6} = 1.234400 $_{E}$6
  - 0.1234400 = 1.234400 x 10^{-1} = 1.234400 $_{E}$-1
  - 0.0000123 = 1.23 x 10^{-5} = 1.234400 $_{E}$-5

Rules for Scientific Notation in calculation

- Exponents are count values
- For addition and subtraction, all values must have the same exponents before calculations
- For multiplication, the first factors of the numbers are multiplied and the exponents of 10 are added
- For division, the first factors of the numbers are divided and the exponent of 10 in the denominator is subtracted from the exponent of 10 in the numerator

<u>Addition Example:</u>
Problem: 6.2 x 10^{4} + 7.2 x 10^{3}
Step 1: 62 x 10^{3} + 7.2 x 10^{3}
Step 2: 69.2 x 10^{3}
Step 3: 6.92 x 10^{4}
Step 4: 6.9 x 10^{4} (Significant rule: can only have as many as the least significant figure to the right of the decimal)

<u>Multiplication Example:</u>
Problem: (3.1 x 10^{3})(5.01 x 10^{4})
Step 1: (3.1 x 5.01) x 10^{4+3}
Step 2: 16 x 10^{7}
Step 3: 1.6 x 10^{8} (Significant rule: can only have as many as the least significant figure)

<u>Division Example:</u>
Problem: (7.63 x 10^{3}) / (8.6203 x 10^{4})
Step 1: (7.63 / 8.6203) x 10^{3-4}
Step 2: 0.885 x 10^{-1}
Step 3: 8.85 x 10^{-2} (Significant rule: can only have as many as the least significant figure)

Dimensional Analysis

- Definition: Math system using conversion factors to move from one unit of measurement to a different unit of measurement.
- Why we use it: Make doing calculations easier when comparing measurements given in different units.
- Example: 1 day = how many seconds
    - Conversion factors
        - 1 day = 24 hours
        - 1 hour = 60 minutes
        - 1 minute = 60 seconds
    - Dimensional Analysis
        - Setup

1 day	24 hours	60 minutes	60 seconds
	1 day	1 hour	1 minute

        - Remove the common units

1 day	24 hours	60 minutes	60 seconds		
	1 day	1 hour	1 minute	=	86,400 seconds

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