CHM 1025
Exam 1 Review

Academic Resources

Welcome!

- Drop-In Tutoring: Schedule
  - Monday and Tuesday: 1pm-5pm
    - Zoom Link
  - Friday: 1pm-3pm
    - Zoom Link
- Private Appointments: Scheduling Link

Ionic vs. Molecular Compounds

Magnesium Chloride $MgCl_2$

Mg^{2+} Cl^{1-}

Ionic Compounds

cation (+) ← metal

anion (−) ← nonmetal

- Ionic compounds consists of multiple elements connected by ionic bond(s)- electrostatic attraction of opposite charges
- Ionic bond= metal + nonmetal
- Naming rules (+) (−)
    - State cation first, then anion
    - Roman numerals can be used for ions that have multiple forms
        - This happens for cations with multiple possible oxidation states, like copper
    - Change anion ending to -ide

NaCl ← Na^+ Cl^-

Sodium chloride

transition metals → NOT group 1A or 2A (+1) (2+)

Cu(I): Cu^+ ①

Cu(II): Cu^{2+} ②

A^{4-} B^{2+}

~~B_4A_2~~

B_2A

N_2O_2 dinitrogen dioxide

$\theta = +4 \; -4$

Covalent Compounds

- ~~Ionic~~ Covalent compounds consists of multiple elements connected by covalent bond(s)- sharing of electron pair(s) between atoms
- ~~Ionic~~ Covalent bond= metalloid + nonmetal or nonmetal + nonmetal\ CO_2
- Naming rules
  - Name the non-metal furthest to the left on the periodic table by its elemental name
  - Name the other non-metal by its elemental name and an -ide ending
  - Use the prefixes mono- (1), di- (→ 2), tri- (3).... to indicate the number of that element in the molecule
    - Note: if mono- is the first prefix, it is understood and not written

mono, di, tri, tetra, penta, hexa, hepta, octo

carbon → oxygen → CO_2

carbon dioxide

Prefixes for Covalent Compounds

- 1: mono-
- 2: di-
- 3: tri-
- 4: tetra-
- 5: penta-
- 6: hexa-
- 7: hepta-
- 8: octa-
- 9: nona-
- 10: deca-

How many atoms of phosphorus are in 7.9 g of P_4S_{10}?

↳ Avogadro's Number: 6.022×10^{23} atoms/mol (change → P, P)

$$7.9\,g\ P_4S_{10} \cdot \frac{1\ mol\ P_4S_{10}}{444.546\ g\ P_4S_{10}} \cdot \frac{4\ mol\ P}{1\ mol\ P_4S_{10}} \cdot \frac{6.022 \times 10^{23}\ atoms\ P}{1\ mol\ P} = 4.28 \times 10^{22}$$

4.3×10^{22} atoms P

$$(30.974\,g/mol)(4) + (32.065\,g/mol)(10) = 444.546\,g/mol$$

Compound X has three isotopes: X–28, X–29, and X–30. X–28 has a mass of 27.9769 amu and is 92.2% abundant. X–29 has a mass of 28.9765 amu and is 4.67% abundant. X–30 has a mass of 29.9737 amu is 3.10% abundant. Calculate the atomic mass of compound X.

^{28}X : 27.9769 g/mol 92.2%

^{29}X : 28.9765 g/mol 4.67%

^{30}X : 29.9737 g/mol 3.10%

$= (27.9769)(0.922) + (28.9765)(0.0467) + (29.9737)(0.0310)$

$= \boxed{28.0771 \text{ amu}}$

P : 30.974 g/mol = $^{31}P \cdot \%$ + $^{30}P \cdot \%$ . . . . .

↑ Periodic Table

Polyatomic Ions

Polyatomic Ions Recap

- NOT made of multiple ions
  - Covalently-bonded set of two or more atoms that holds an overall charge
- Great resource: Symbols and Names for Common Polyatomic Ions
- Understanding polyatomics differing in oxygen number
  - Most Os: per[base name]ate
  - [base name]ate
  - [base name]ite
  - Least Os: Hypo[base name]ite
  - Just remember the [base name]ate version (usually most common), and figuring other ones out will be much easier

ClO_3 : Chlorine trioxide (covalent) ClO_3^- : Chlorate (ion)

Cl, Br, I (1−)

[Base Name]ate: Chlorate (ClO_3^-)

- One more O: ClO_4^-: perchlorate
- One less O: ClO_2^-: chlorite
- One less O than chlorite: ClO^-: hypochlorite

Contain O: less Oxygens – ite
more oxygens – ate

Cl:
- ClO^- hypochlorite
- ClO_2^- chlorite
- ClO_3^- chlorate
- ClO_4^- perchlorate

Br:
- BrO^- hypobromite
- BrO_2^- bromite
- BrO_3^- bromate
- BrO_4^- perbromate

I:
- IO^- hypoiodite
- IO_2^- iodite
- IO_3^- iodate
- IO_4^- periodate

NO_2^- Nitrite
NO_3^- Nitrate
(1−)

SO_3^{2-} Sulfite
SO_4^{2-} Sulfate
(2−)

PO_3^{3-} Phosphite
PO_4^{3-} Phosphate
(3−)

AsO_3^{3-} arsenite
AsO_4^{3-} arsenate
(3−)

SeO_3^{2-} selenite
SeO_4^{2-} selenate (2-)
TeO_3^{2-} Tellurite
TeO_4^{2-} Tellurate

[Base Name]ate: Sulfate (SO_4^{2-})

- One less O: SO_3^{2-}: sulfite
- Note: know how many variations of the base name exist for each polyatomic with multiple Os!

Borate: BO_3^{3-}

Significant Figures

Which Figures are Significant?

- All non-zero numbers
- Zeroes between two non-zero digits
- Trailing zeroes in a number with a decimal
  - To the RIGHT of the decimal
- In scientific notation, only the coefficient (the part that comes before “x10”) has significant figures

305 ← sig fig

350 ← not significant

3.50 ← sig fig

3.5×10^2 2 sig figs

3.50×10^2 3 sig figs

not correct scientific notation → 30×10^2 1 sig fig

300050 — sig figs; not sig fig

350. 3 sig figs

350.0 4 sig figs

0.0035 2 sig figs

3.5×10^{-3} 2 sig figs

Which Figures are NOT Significant?

- Leading zeroes
  - To the LEFT of the decimal
- Trailing zeroes in numbers without decimals

Average: 3.75, 3.5, 3.22080

$$\frac{3.75 + 3.\underline{5} + 3.22080}{3} = \frac{10.4708}{3} = \frac{10.5}{3} = 3.5$$

4

3 ← sig figs not important

Significant Figures: Rules

- Non-zero digits are always significant
- Any zeros between two significant digits are significant
- A final zero or trailing zeros in the decimal portion ONLY are significant
- Addition and Subtraction: — Decimals
  - Count the number of significant figures in the decimal portion ONLY of each number in the problem
  - Add or subtract in the normal fashion
  - Your final answer may have no more significant figures **to the right of the decimal** than the LEAST number of significant figures in any number in the problem.
- Multiplication and Division: — ALL Sig Figs
  - The LEAST number of significant figures in any number of the problem determines the number of significant figures in the answer
    - (You are now looking at **the entire number**, not just the decimal portion)

5 → 3.5000 / 0.125 = 28 = 28.0

3.50 ← 2
+0.125 ← 3
= 3.625 → **3.63**

3.50 — 2 sig figs after the decimal

0.0035 — 2 sig figs

3.5000 ← 5
×0.125 ← 3
= 0.4375 → **0.438**

3 → 0.125

2 3

How many significant figures are present in the value 5.04 x 10^3?

middle

3

How many significant figures are present in the value 302,000?

sig fig

trailing no decimal point insignificant

3

How many Significant figures are present in the value 0.040?

0.040 → significant

insignificant

2

Perform the following calculation to the correct number of significant figures.

$$[(1.7 \times 10^6) \div (2.63 \times 10^5)] + 7.33$$

$6.46387 8 \ldots$

$$2 \rightarrow \left(\frac{1.7 \times 10^6}{2.63 \times 10^5}\right) + 7.33 \qquad (3.0 \times 10^2)\left(\frac{1.7 \times 10^6}{2.63 \times 10^5}\right) + 7.33$$

$3 \rightarrow$

$\rightarrow$ ① ②

$6.5 + 7.33$

13.83

13.8

① round + 7.33

Mult./Div. rules

② round

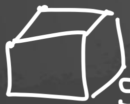
+/−

Density

Density Recap

- A physical property that describes how much mass is present in a given space
- Density= mass/volume
- Example: If a cube has a side length of 5 cm and has a mass of 40g, what is its density, in g/cm^3?

$40.\ g$



5 cm

$d = \frac{m}{V}$

$d = \frac{40g}{125cm^3} = 0.32g/cm^3$

$= 0.3g/cm^3$

$= 3 \times 10^{-1} g/cm^3$

$V_{cube} = s^3 = (5cm)^3 = 125\ cm^3$

Diamonds are measured in carats and one carat equals 0.200 grams. The density of diamond is 3.51 g/cm^3. What is the volume in cm^3 of a 5.0 carat diamond?

mass (carats)

1 carat = 0.200 g

$$d = \frac{m}{V} \Rightarrow V = \frac{m}{d}$$

m ← 5.0 carats → g

d ← 3.51 g/cm^3

$$5.0 \text{ carats} \cdot \frac{0.200 \text{ g}}{1 \text{ carat}} = 1 \text{ g}$$

(2) (3)

$$V = \frac{1 \text{ g}}{3.51 \text{ g/cm}^3} = 0.2849002\ldots \text{ cm}^3$$

(3)

$$= 0.28 \text{ cm}^3$$

lowest ↓

$$\frac{(5.0)(0.200)}{3.51}$$

(2) (3) (3)

$$\frac{1}{10^{-2}} = \frac{10^2}{1} \qquad \frac{10^3\,g}{1\,Kg} = \frac{1\,g}{10^{-3}\,Kg}$$

A proton has a radius of approximately 1.0 x 10^{-6} nm and a mass of 1.7 x 10^{-27} kg. Determine the density of a proton. For a sphere, $V = (4/3)\pi r^3$.

(g/cm³)

$$d = \frac{m}{V} \checkmark \qquad V = \frac{4}{3}\pi r^3$$

(2) ↓

$$1.0 \times 10^{-6}\,nm \cdot \frac{10^{-9}\,m}{1\,nm} \cdot \frac{10^{2}\,cm}{1\,m} = 1.0 \times 10^{-13}\,cm \leftarrow \text{radius (r)}$$

$$1.7 \times 10^{-27}\,Kg \cdot \frac{10^3\,g}{1\,Kg} = 1.7 \times 10^{-24}\,g = m$$

↑ (2)

$$d = \frac{m}{\frac{4}{3}\pi r^3}$$

$$d = \frac{1.7 \times 10^{-24}\,g}{\left(\frac{4}{3}\right)(\pi)\left(1.0 \times 10^{-13}\,cm\right)^3}$$

$$d = 4.05845\ldots \times 10^{14}\,g/cm^3$$

$$\boxed{d = 4.1 \times 10^{14}\,g/cm^3}$$

A pure titanium cube has an edge length of 2.78 in. ~~How many titanium atoms does it contain?~~ (D_{Ti} = 4.50 g/cm^3). What is the mass of the titanium cube in Kg?

2.78 in

$d = 4.50\ g/cm^3$

$1\ in = 2.54\ cm$

$d = \frac{m}{V}$

$2.78\ in \cdot \frac{2.54\ cm}{1\ in} = 7.0612\ cm$

(3)

$m = d \cdot V$

$10^3\ g = 1\ Kg$

$V = s^3$

$1\ g = 10^{-3}\ Kg$

(3)

$m = d \cdot s^3 = (4.50\ g/cm^3)(7.0612\ cm)^3$

$m = 1584.3388....\ g \cdot \frac{1\ Kg}{10^3\ g} = 1.5843388...\ Kg$

1.58 Kg