

Unit 1 Review for Midterms

① a) $\text{C}_2\text{H}_6\text{O}_2$ C: $\frac{2 \cdot 12.01}{62.07} \cdot 100 = 38.70\%$ C

H: $\frac{6 \cdot 1.008}{62.07} \cdot 100 = 9.744\%$ H

O: $\frac{2 \cdot 16.00}{62.07} \cdot 100 = 51.56\%$ O

(Double check: $38.70 + 9.744 + 51.56 = 100.00$)

b) % \rightarrow g, g \rightarrow mol, divide by small, multiply to whole

$$\frac{40.92 \text{ g C}}{12.01 \text{ g C}} \left| \begin{array}{c} 1 \text{ mol} \\ \hline 12.01 \text{ g C} \end{array} \right. = \frac{3.407 \text{ mol C}}{3.406} = 1 \times 3 = 3$$

$$\frac{4.58 \text{ g H}}{1.008 \text{ g H}} \left| \begin{array}{c} 1 \text{ mol} \\ \hline 1.008 \text{ g H} \end{array} \right. = \frac{4.54 \text{ mol H}}{3.406} \rightarrow 1.33 \times 3 = 4 \quad \text{EF} = \text{C}_3\text{H}_4\text{O}_2$$

$$\frac{54.50 \text{ g O}}{16.00 \text{ g O}} \left| \begin{array}{c} 1 \text{ mol} \\ \hline 16.00 \text{ g O} \end{array} \right. = \frac{3.406 \text{ mol O}}{3.406} = 1 \times 3 = 3$$

$$\frac{\text{MF}}{\text{EF}} = \frac{176.12}{88.06} = 2 \quad \text{MF} = \text{C}_3\text{H}_4\text{O}_2 = \text{C}_6\text{H}_{12}\text{O}_6$$



$$2.78 \text{ g} \quad 6.32 \text{ g} \quad 2.58 \text{ g}$$

$$6.32 \text{ g CO}_2 \cdot \frac{12.01 \text{ g C}}{44.01 \text{ g CO}_2} = 1.72 \text{ g C}$$

$$(70\% \text{ comp of C in CO}_2) \quad 2.78 \text{ g E.B.} \\ - 1.72 \text{ g C}$$

$$2.58 \text{ g H}_2\text{O} \cdot \frac{2 \cdot 1.008 \text{ g H}}{18.02 \text{ g H}_2\text{O}} = .289 \text{ g H} \quad - .289 \text{ g H} \\ (.9\% \text{ comp of H in H}_2\text{O}) \quad ,77 \text{ g O}$$

$$\frac{1.72 \text{ g C}}{12.01 \text{ g C}} \left| \begin{array}{c} 1 \text{ mol} \\ \hline 12.01 \text{ g C} \end{array} \right. = \frac{.143 \text{ mol C}}{.048} = 3$$

$$\text{EF} = \text{C}_3\text{H}_6\text{O}$$

$$\frac{.289 \text{ g H}}{1.008 \text{ g H}} \left| \begin{array}{c} 1 \text{ mol} \\ \hline 1.008 \text{ g H} \end{array} \right. = \frac{.287 \text{ mol H}}{.048} = 6$$

$$\frac{.77 \text{ g O}}{16.00 \text{ g O}} \left| \begin{array}{c} 1 \text{ mol} \\ \hline 16.00 \text{ g O} \end{array} \right. = \frac{.048 \text{ mol O}}{.048} = 1$$



$$14.240\text{g CO}_2 \cdot \frac{12.01\text{g C}}{44.01\text{g CO}_2} = 3.886\text{g C}$$

$$4.083\text{g H}_2\text{O} \cdot \frac{2.1008\text{g H}}{18.02\text{g H}_2\text{O}} = .4568\text{g H}$$

5.250g nicotine

- 3.886g C

- .4568g H

.9073N

$$\frac{3.886\text{g C}}{12.01\text{g C}} \cdot \frac{1\text{mol}}{1\text{mol}} = \frac{3236\text{mol C}}{10647} = 5$$

$$\frac{.4568\text{g H}}{1.0085} \cdot \frac{1\text{mol}}{1\text{mol}} = \frac{4532\text{mol H}}{10647} = 7$$

EF = C₅H₇N

$$\frac{.9073\text{N}}{14.01\text{g}} \cdot \frac{1\text{mol}}{1\text{mol}} = \frac{647\text{mol N}}{10647} = 1$$

$$\frac{MF}{EF} = \frac{160}{81.12} \approx 2$$

MF = C₁₀H₁₄N₂

- ② a) Mass spectrum tells us relative abundance
+ mass of each isotope

b) slightly less than 80 amu, maybe 78. or 79, something

c) 74(.02) + 76(.10) + 77(.08) + 78(.25) + 80(.55) = 78.7 amu

d) Se

- ③ a) Radius increases - adding another e⁻ energy shell

b) Radius decreases - adding another proton to nucleus,
increasing nuclear charge, same # of core e⁻
so no difference in shielding;
greater attractive force b/w nucleus + e⁻ →
smaller radius

c) ↓ column, IE decreases. The farther from the nucleus
an e⁻ is, the less energy it takes to remove it

→ row, IE increases. The closer to the nucleus

an e⁻ is, the more energy it takes
to remove it. No change in shielding.

③ d) Electron affinity measures attraction of atom for e^-

↓ column ↓ E.A. Bigger atoms have more e^- shells, which shield outer shell. Also larger distance b/w outer shell + nucleus, decreasing attractive force
→ period ↑ E.A. No change in shielding, increasing nuclear charge increases attractive force to nucleus.

e) E.N. is attraction of e^- in bond to an atom.

Smaller atoms w/ less shielding have higher EN than larger atoms w/ more shielding.

f) i) gaining an e^- causes $e^- - e^-$ repulsion, increasing r
ii) losing an e^- means less $e^- - e^-$ repulsion, decrease r

iii) Ca^{2+} is largest ion - most e^- shells. Be^{2+} has fewest

g) 1st: $\text{Al(g)} \rightarrow \text{Al}^+(g) + e^-$ & requires least energy.
2nd: $\text{Al}^+(g) \rightarrow \text{Al}^{2+}(g) + e^-$ Al has largest radius
3rd: $\text{Al}^{2+}(g) \rightarrow \text{Al}^{3+}(g) + e^-$

h) 2 valence e^- . Huge jump b/w 2nd + 3rd IE, indicating that after removing 2 e^- , the 3rd e^- comes from a shell that is closer to nucleus

④ a) Be: $1s^2 2s^2$

Sc: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$

Fe: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$

b) F^- : $1s^2 2s^2 2p^6$

Ca^{2+} : $1s^2 2s^2 2p^6 3s^2 3p^6$

Zn^{2+} : $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$ (4s removed before 3d)

c) C: $\frac{1v}{1s} \quad \frac{1v}{2s} \quad \frac{1}{2p} \quad 1 \quad -$

Na: $\frac{1v}{1s} \quad \frac{1v}{2s} \quad \frac{1v}{2p} \frac{1v}{3s} \quad 1$

d) O: $\frac{1v}{1s} \quad \frac{1v}{2s} \quad \frac{1v}{2p} \frac{1v}{2p} \frac{1v}{2p}$ 2 e^- complete subshells

⑤	a)	Na	$1s^2 2s^2 2p^6 3s^1$	$\frac{1s}{1s}$	$\frac{1s}{1s}$	$\frac{1s}{1s} \frac{1s}{1s} \frac{1s}{1s}$	$\frac{1s}{1s}$	$\frac{1s}{1s}$
		Mg	$1s^2 2s^2 2p^6 3s^2$	$\frac{1s}{1s}$	$\frac{1s}{1s}$	$\frac{1s}{1s} \frac{1s}{1s} \frac{1s}{1s}$	$\frac{1s}{1s}$	$\frac{1s}{1s}$
		Al	$1s^2 2s^2 2p^6 3s^2 3p^1$	$\frac{1s}{1s}$	$\frac{1s}{1s}$	$\frac{1s}{1s} \frac{1s}{1s} \frac{1s}{1s}$	$\frac{1s}{1s}$	$\frac{1s}{1s}$
		Si	$1s^2 2s^2 2p^6 3s^2 3p^2$	$\frac{1s}{1s}$	$\frac{1s}{1s}$	$\frac{1s}{1s} \frac{1s}{1s} \frac{1s}{1s}$	$\frac{1s}{1s}$	$\frac{1s}{1s}$

b) Adding an extra proton in nucleus increases nuclear charge (w/ no change in core e^- shielding) which has stronger attractive force to e^-

AP

$$\text{i)} 2.241 \text{ g CO}_2 \cdot \frac{12.01 \text{ g C}}{44.01 \text{ g CO}_2} = .6116 \text{ g C}$$

Question

$$\text{ii)} .2884 \cdot 1.2359 \text{ g compd} = .3564 \text{ g N}$$

$$\text{iii)} 1.2359 \text{ g compd} - .6116 \text{ g C} - .3564 \text{ g N} = .2679 \text{ g O + H}$$

$$.2679 \text{ g} - .0648 \text{ g H} = .2031 \text{ g O}$$

$$\text{iv)} \frac{.3564 \text{ g N}}{14.01 \text{ g N}} \left| \begin{matrix} 1 \text{ mol} \\ 14.01 \text{ g N} \end{matrix} \right. = \frac{.02544 \text{ mol N}}{.01269} = 2$$

$$\frac{.2031 \text{ g O}}{16.00 \text{ g O}} \left| \begin{matrix} 1 \text{ mol} \\ 16.00 \text{ g O} \end{matrix} \right. = \frac{.01269 \text{ mol O}}{.01269} = 1 \quad \text{C}_4\text{H}_5\text{N}_2\text{O}$$

$$\frac{.0648 \text{ g H}}{1.008 \text{ g H}} \left| \begin{matrix} 1 \text{ mol} \\ 1.008 \text{ g H} \end{matrix} \right. = \frac{.0643 \text{ mol H}}{.01269} = 5$$

$$\frac{.6116 \text{ g C}}{12.01 \text{ g C}} \left| \begin{matrix} 1 \text{ mol} \\ 12.01 \text{ g C} \end{matrix} \right. = \frac{.05092 \text{ mol C}}{.01269} = 4$$

$$\text{vi)} d = 6.009 \text{ g/L}$$

$$T = 375 \text{ K}$$

$$P = .983 \text{ atm}$$

$$R = .08206 \frac{\text{Latm}}{\text{molK}}$$

$$\frac{?}{\text{mol}} = \frac{1}{M}$$

$$\text{mol} = \frac{g}{MM}$$

$$n = \frac{m}{MM}$$

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

$$\text{vii)} \frac{MF}{EF} = \frac{108}{93.93} = 1.2 \quad MF = \text{CH}_2\text{Br} \cdot 2 = \text{C}_2\text{H}_4\text{Br}_2$$

$$PV = nRT$$

$$PV = \frac{m}{MM} \cdot RT$$

$$MM = \frac{m \cdot RT}{PV} = \frac{M}{V} \cdot \frac{RT}{P} = \frac{d \cdot RT}{P}$$

$$= \frac{(6.009 \text{ g/L})(.08206 \frac{\text{Latm}}{\text{molK}})(375 \text{ K})}{.983 \text{ atm}}$$

$$= 188.9 \text{ g/mol}$$

AP

Questions

(2) a) compare LiI + LiF

I^- is a larger anion than F^-

Li^+ is a small cation

LiI has a lower melting point than LiF

