

Midterm Test #1 – September 2007**Lab Section** _____ **Bench #** _____**Out of 60****Useful constants & conversion factors:** Avogadro's number = $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$

Do all of your calculations on the quiz paper, use the back of the sheet if required. Be sure to **PRINT** your name and enter your student number on the top of this paper. This paper has 4 pages plus a periodic table.

Watch your significant figures!!!

1. Find the oxidation state of the underlined atom in each molecule (5 marks)

(a) $\underline{\text{P}}_2\text{O}_5$	OS(P) = +5	$2x\text{OS(P)} + 5(-2) = 0$
(b) $\text{Na}\underline{\text{H}}$	OS(H) = -1	$1 + \text{OS(H)} = 0$
(c) $\underline{\text{Sn}}\text{Br}_4$	OS(Sn) = +4	$\text{OS(Sn)} + 4(-1) = 0$
(d) $\underline{\text{Cr}}_2\text{O}_7^{2-}$	OS(Cr) = +6	$7(-2) + 2x\text{OS(Cr)} = -2$
(e) $\text{Ba}\underline{\text{O}}_2$	OS(O) = -1	$2x\text{OS(O)} + 2 = 0$

2. Name the following compounds (6 marks)

a) KOH	Potassium hydroxide
b) $\text{Ca}_3(\text{PO}_4)_2$	Calcium phosphate
c) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$	Copper (II) sulfate pentahydrate
d) Hg_2O	Mercury (I) oxide
e) N_2O_4	Dinitrogen tetroxide
f) SF_6	Sulfur hexafluoride

3. Write down the formula for the following compounds (5 marks)

(a) Iron (III) carbonate	$\text{Fe}_2(\text{CO}_3)_3$
(b) Aluminum hydroxide	Al(OH)_3
(c) Tetraphosphorous hexasulfide	P_4S_6
(d) Magnesium hydrogen carbonate	$\text{Mg(HCO}_3)_2$
(e) Cesium cyanide	CsCN

4. a) The formula for the selenate ion is SeO_4^{2-} . Write the formula for the selenite ion? (2 marks)



- b) The formula for the bromate ion is BrO_3^- . Write the formula for the hypobromite ion. (2 marks)



5. (4 marks) In the ^{184}W ion what are :

(a) The number of neutrons	184 - 74 = 110
(b) The number of protons	74
(c) The number of electrons	74
(d) The name of the element	Tungsten

6. Chlorine-35 (atomic mass 35.006 u) and chlorine-37 (atomic mass 36.711 u) are the two natural isotopes of chlorine. The average atomic mass of chlorine is 35.423 u. What are the relative percentage abundances of ^{35}Cl and ^{37}Cl (4 marks)?

*Fractional abundance $^{35}\text{Cl} = x$ so fractional abundance $^{37}\text{Cl} = 1-x$,
Average atomic mass = (atomic mass each isotope \times abundance)_n*

n = number of isotopes

$$\text{so } 35.423 = 35.006x + 36.711(1-x)$$

$$(35.006-36.711)x = 35.423 - 36.711$$

$$-1.705x = -1.288$$

$$x = 0.7554 \quad 1-x = 0.2446$$

% abundances: $^{35}\text{Cl} = 75.54\%$, $^{37}\text{Cl} = 24.46\%$

7. a) A 1.05 g sample of a compound containing only C, H, and O was burned completely. The only combustion products were 2.43 g CO₂ and 0.500 g H₂O. What is the empirical formula of the compound? (8 marks)

$$\underline{\text{Carbon}} \quad 2.43\text{g}/44.009\text{g mol}^{-1} \times 1\text{C}/1\text{CO}_2 = \mathbf{0.0552 \text{ mol C}}$$

$$\underline{\text{Hydrogen}} \quad 0.500\text{ g}/18.015\text{g mol}^{-1} \times 2\text{H}/1\text{H}_2\text{O} = \mathbf{0.0555 \text{ mol H}}$$

$$\underline{\text{Carbon}} \quad 0.05521 \times 12.011\text{g mol}^{-1} = 0.663\text{ g C}$$

$$\underline{\text{Hydrogen}} \quad 0.05551 \times 1.008\text{g mol}^{-1} = 0.0560\text{ g H}$$

$$\underline{\text{Oxygen}} = \text{Total mass} - \text{g C} - \text{g H} = 1.05\text{ g} - 0.663 - 0.0560 = 0.33\text{ g O}$$

$$\underline{\text{Oxygen}} \quad 0.33\text{ g} / 15.999\text{g mol}^{-1} = \mathbf{0.021 \text{ mol O}}$$

$$\text{so compound} = \text{C}_{0.0552}\text{H}_{0.0555}\text{O}_{0.021}$$

divide by smallest subscript empirical formula = C_{2.66}H_{2.66}O (only if O stored to 3 decimal places in calculator)



b) Write a balanced equation for the combustion of this compound. (2 marks)



8. At least 25 μg (2.5×10^{-5} g) of the compound tetrahydrocannabinol (THC) is required to produce intoxication. The molecular formula for THC is $\text{C}_{21}\text{H}_{30}\text{O}_2$. (mol. wt. = 314.47 g/mol) (4 marks)

a) How many moles of THC are present in this 25 μg sample.

$$\# \text{ moles} = 2.5 \times 10^{-5} \text{ g} / 314.47 \text{ g/mol} = \mathbf{7.9 \times 10^{-8} \text{ mol}}$$

b) How many molecules?

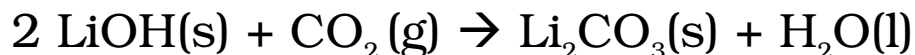
$$\# \text{ molecules} = 7.9 \times 10^{-8} \text{ mol} \times 6.022 \times 10^{23} \text{ molecule/mol} = \mathbf{4.8 \times 10^{16} \text{ molecules}}$$

c) How many atoms of H are present? (4 marks)

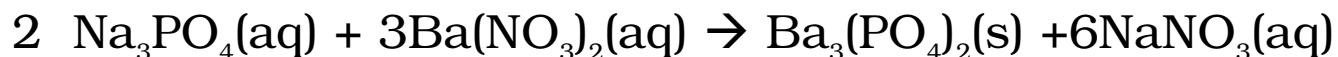
$$4.7 \times 10^{16} \times 30 = \mathbf{1.4 \times 10^{18} \text{ atoms of H}}$$

910. Write balanced chemical reactions to match the following descriptions. Make sure to include the physical state of the compound.

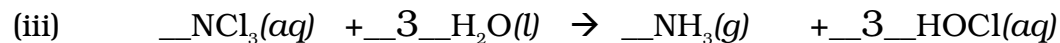
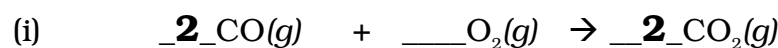
(a) Solid lithium hydroxide reacts with carbon dioxide gas to form solid lithium carbonate and liquid water. (3 marks)



(b) Sodium phosphate reacts with barium nitrate in a double replacement reaction to form barium phosphate and sodium nitrate. This reaction occurs in aqueous solution. Barium phosphate is the only precipitate. (5 marks)



11. Balance the following chemical reactions (2 marks each)



The End...have a good weekend!