Quiz 4:

- **Hand me your ZipGrade Scantron at the beginning of the class on Wednesday, 12/1.**
- **Upload your solutions in BbLearn.**
- **I will not grade any quiz without solutions. Solution means I should see how you have solved the problems.**

1) Which of the following does not involve a chemical reaction?
   a. The formation of a solid in a previously clear solution
   b. Bubbles forming when a soda can is opened → Not a chemical reaction
   c. The formation of a gas when we add a substance to a solution
   d. All of the above are chemical reactions

2) Is the following statement True or False:

   "We are allowed to change coefficients and subscripts while balancing chemical equations to make sure the number of atoms in the left equals the number of atoms in the right side of the chemical equation."

   Not subscripts

   a. True
   b. False

3) Balance the following chemical equation by substituting A, B, C, and D with suitable numbers:
   A $Pb(C_2H_3O_2)_2(aq)$ + **B** $Na_2SO_4(aq)$ → **C** $PbSO_4(s)$ + **D** $NaC_2H_3O_2(aq)$
   a. A=1 , B=1 , C=1 , D=1
   b. A=1 , B=2 , C= 1 , D=2
   c. A=1 , B=1 , C= 1 , D=2
   d. A=1 , B=2 , C=1 , D=1

   Do not balance individual atoms in polyatomic ions. Consider and balance polyatomic ions as a unit.

4) Which of the following is not a gas evolution reaction?
   a. $2HCl + K_2S \rightarrow H_2S + 2KCl$
   b. $NH_4Cl + KOH \rightarrow H_2O + NH_3 + KCl$
   c. $HCl + K_2SO_3 \rightarrow H_2O + SO_2 + 2KCl$
   d. $H_2SO_4 + 2KOH \rightarrow 2H_2O + K_2SO_4$ → Not a gas evolution reaction.

   Acid Base

   Remember Table 7.4 (Types of Compounds that undergo gas evolution reactions).

5) Which of the following compounds is insoluble in water?
   a. $Pb(NO_3)_2$ → Always soluble
   b. CaS : Soluble
   c. $BaBr_2$ → Br^- Mostly Soluble (Ba^{2+} is not an exception)
   d. PbI_2 → I^- mostly soluble (Pb^{2+} is an exception)

   PbI_2: insoluble

   S^{2-}: mostly insoluble → Ca^{2+} exception

   Table 7.2: Solubility Rules

Compounds containing Na^+, K^+, NO_3^- are ALWAYS soluble in water. They would be aqueous (aq). So you won't see any reaction for a, b, c.

6) Which of the following reactions is correct?
   a. KI (aq) + NaCl (aq) → NaI (aq) + KCl (aq)
   b. $2NaNO_3$ (aq) + CaS (aq) → Na_2S (aq) + $Ca(NO_3)_2$
   c. KI (aq) + NaCl (aq) → NaI (s) + KCl (aq)
   d. 2 KI (aq) + Pb $(NO_3)_2$ (aq) → PbI_2 (s) + 2 KNO_3 (aq)

Precipitation reaction ← d. ; PbI_2 = Insoluble

7) Which of the following statements is NOT correct?
   a. Compounds containing Cl^-, Br^-, and I^- are soluble unless they pair with Ag^+, Hg_2^{2+}, or Pb^{2+} which makes them insoluble.
   b. Compounds containing NO_3^- and $C_2H_3O_2^-$ are always insoluble. ✗
   c. When SO_4^{2-} pairs with Ca^{2+}, Sr^{2+}, Ba^{2+}, or Pb^{2+}, the compound is insoluble.
   d. When either of OH^- or S^{2-} ions pairs with Li^+ or NH_4^+, the compound is soluble.

Table 7.2 ←

8) Which of the following statements is NOT correct?
   a. Combustion reactions are a subcategory of oxidation-reduction reactions. ✓
   b. All gas evolution reactions are also acid-base reactions. ✗
   c. Some gas evolution reactions form an intermediate product that then decomposes into a gas. ✓
   d. The key to predicting precipitation reactions is understanding that only insoluble compounds form precipitates. ✓

9) Define the following effect: "Certain gases in Earth's atmosphere allow visible-light energy to enter the atmosphere but prevent heat energy from escaping."
   a. Theoretical yield
   b. Stoichiometry
   c. Greenhouse effect
   d. The Bohr effect

10) Which of these are NOT redox reactions?
   a. 2 Mg (s) + O_2 (g) → 2 MgO (s) → A metal reacts with a nonmetal → redox
   b. 2 HBr (aq) + $Ca(OH)_2$(aq) → 2 H_2O (l) + $CaBr_2$(aq) (acid, Base)
   c. Zn (s) + Fe^{2+} (aq) → Zn^{2+}(aq) + Fe(s) → Transfer of electrons → redox
   d. Ca (s) + Cl_2(g) → $CaCl_2$ (s) → A metal reacts with a nonmetal → redox

11) Which of the following is NOT a double-displacement reaction?
   a. 2 HCl (aq) + Na_2CO_3 (aq) → H_2CO_3 (aq) + 2 NaCl (aq)
   b. Zn (s) + $CuCl_2$ (aq) → $ZnCl_2$ (aq) + Cu (s) → This is single-displacement
   c. $AgNO_3$ (aq) + NaCl (aq) → AgCl (s) + $NaNO_3$ (aq)
   d. All of the above are double-displacement reactions

Balance free elements last. (O_2, H_2, Mg, Al, ...)

12) What is the coefficient of water in the balanced chemical equation for combustion of heptane (C_7H_{16})?

a. 8
b. 15
c. 14
d. 16

$C_7H_{16} + O_2 \rightarrow CO_2 + H_2O$

$C_7H_{16} + 11O_2 \rightarrow 7CO_2 + 8H_2O$ (22)

$(7\times2) + (8\times1) = 22 : 0$ (14, 8)

13) Ammonia, NH_3, can be synthesized by this reaction (please be advised this chemical equation is not balanced):

$2 \times (NO(g) + H_2(g) \rightarrow NH_3(g) + H_2O(g))$ $\quad 3+2=5$ H

$2NO + 5H_2 \rightarrow 2NH_3 + 2H_2O$ (10 g, 20 g)

H 1.01 | N 14.01 | O 16.00

What maximum amount of ammonia in grams can be synthesized from 10 g of NO and 20 g of H_2?

Theoretical yield — limiting reactant — Smaller number — Theoretical yield

a. 26.00
b. 67.48
c. 41.80
d. 5.68

$?\ g\ NH_3 = 10\ g\ NO \times \frac{1\ mol\ NO}{30.01\ g\ NO} \times \frac{2\ mol\ NH_3}{2\ mol\ NO} \times \frac{17.04\ g\ NH_3}{1\ mol\ NH_3} = 5.68\ g\ NH_3$

$?\ g\ NH_3 = 20\ g\ H_2 \times \frac{1\ mol\ H_2}{2.02\ g\ H_2} \times \frac{2\ mol\ NH_3}{5\ mol\ H_2} \times \frac{17.04\ g\ NH_3}{1\ mol\ NH_3} = 67.485\ g\ NH_3$

$N_2 = 14.01\times2 = 28.02$ g/mol $\quad HNO_3 = 1.01 + 14.01 + 16\times3 = 63.02$ g/mol

$NO = 14.01 + 16.00 = 30.01$ g/mol

$NH_3 = (1\times N) + (3\times H) = 17.04$ g/mol

$H_2 = 2\times1.01 = 2.02$ g/mol

$O_2 = 16\times2 = 32$ g/mol

14) Consider the unbalanced chemical equation:

$N_2(g) + O_2(g) + H_2O(g) \rightarrow HNO_3(g)$ (2, 10, 2, 2×3=6)

This should be 5 oxygen. Remember balance that last

If a reaction mixture contains 28 g of N_2, 150 g of O_2, and 36 g of H_2O, what is the limiting reactant?

a. N_2
b. O_2
c. H_2O
d. HNO_3

$2N_2 + 5O_2 + 2H_2O \rightarrow 4HNO_3$ (28 g, 150, 36)

$N_2 \rightarrow 125.95$ g HNO_3

$O_2 \rightarrow 236.33$ g HNO_3

$H_2O \rightarrow 251.80$ g HNO_3

$?\ g\ HNO_3 = 28\ g\ N_2 \times \frac{1\ mol\ N_2}{28.02\ g\ N_2} \times \frac{4\ mol\ HNO_3}{2\ mol\ N_2} \times \frac{63.02\ g\ HNO_3}{1\ mol\ HNO_3}$

$?\ g\ HNO_3 = 150\ g\ O_2 \times \frac{1\ mol\ O_2}{32\ g\ O_2} \times \frac{4\ mol\ HNO_3}{5\ mol\ O_2} \times \frac{63.02\ g\ HNO_3}{1\ mol\ HNO_3}$

$?\ g\ HNO_3 = 36\ g\ H_2O \times \frac{1\ mol\ H_2O}{18.02\ g\ H_2O} \times \frac{4\ mol\ HNO_3}{2\ mol\ H_2O} \times \frac{63.02\ g\ HNO_3}{1\ mol\ HNO_3}$

15) Consider this unbalanced chemical equation:

$Cu_2O(s) + C(s) \rightarrow Cu(s) + CO(g)$ (2)

When 20 g of C are allowed to react with 200 g of Cu_2O, 160 g of Cu are obtained. Determine the percent yield:

Actual yield

a. 177.64 %
b. 211.66 %
c. 90 %
d. 84 %

$?\ g\ Cu = 20\ g\ C \times \frac{1\ mol\ C}{12.01\ g\ C} \times \frac{2\ mol\ Cu}{1\ mol\ C} \times \frac{63.55\ g\ Cu}{1\ mol\ Cu} = 211.66\ g\ Cu$

$?\ g\ Cu = 200\ g\ Cu_2O \times \frac{1\ mol\ Cu_2O}{143.1\ g\ Cu_2O} \times \frac{2\ mol\ Cu}{1\ mol\ Cu_2O} \times \frac{63.55\ g\ Cu}{1\ mol\ Cu} = 177.64\ g\ Cu$

Theoretical yield

$Cu_2O = (63.55\times2) + 16.00 = 143.1$ g/mol

$\text{percent yield} = \frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100\%$

$= \frac{160\ g\ Cu}{177.64\ g\ Cu} \times 100\% = 90\%$

First find limiting reactant

$? \text{ mol C} = 5 \text{ mol A} \times \frac{2 \text{ mol C}}{3 \text{ mol A}} = 3.33 \text{ mol C}$

$? \text{ mol C} = 6 \text{ mol B} \times \frac{2 \text{ mol C}}{5 \text{ mol B}} = 2.40 \text{ mol C}$

limiting reactant

Theoretical yield

16) Consider the generic reaction:

$3\,A + 5\,B \rightarrow 2\,C \qquad \Delta H_{rxn} = -200 \text{ kJ}$

3 mol A, 5 mol B

If a reaction mixture initially contains 5 mol of A and 6 mol of B, how much heat (in kJ) will have evolved once the reaction has occurred to the greatest extent possible?

use limiting reactant to find heat.

$? \text{ kJ} = 6 \text{ mol B} \times \frac{-200 \text{ kJ}}{5 \text{ mol B}} = -240 \text{ kJ}$

a. -100 kJ
b. -240 kJ
c. -480 kJ
d. -330 kJ

17) Which of the following is a component of white light?

a. Red
b. Infrared
c. Ultraviolet
d. Gamma

$1s\,2s\,2p\,3s\,3p\,4s\,3d\,4p$: This is the order we fill orbitals with electrons.

18) Write the electron configuration of bromine?

35 Br

a. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$
b. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$
c. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$
d. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4p^5$

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$

2+2+6+2+6 = 18 electrons ; 30 electrons ; 35

19) Which atom has the biggest size?

a. F
b. Cl
c. Br
d. I

7A

F
Cl
Br
I

atomic size increases

They are all in a family (group)

20) What is the orbital?

a. Orbits
b. Electrons around the nucleus in exact locations
c. Circular path around the protons
d. Probability maps indicating where electron is likely to be found

21) What is the limiting reactant for the following chemical equation and initial quantities of reactants?

$2\,Li\,(s) + F_2\,(g) \rightarrow 2\,LiF\,(s)$

We need to have moles or grams of reactants to determine limiting reactant, and initial quantities of reactants.

a. Li
b. F_2
c. LiF
d. Cannot be determined based on the information provided

22) Which electromagnetic radiation is most dangerous to human beings?

a. Radio waves
b. Gamma rays → highest energy is the most dangerous
c. Ultraviolet radiation
d. X-rays

23) Which wavelength of light has the highest energy?

shortest wavelength

a. 200 nm
b. 500 nm
c. 700 nm
d. 100 nm

24) After balancing the following equation, what is the sum of all the coefficients? (Consider all the reactants and products)

$2HI(aq) + Ba(OH)_2 \rightarrow H_2O(l) + BaI_2(aq)$

a. 3
b. 4
c. 6
d. 5

$2HI + 1Ba(OH)_2 \rightarrow 2H_2O + 1BaI_2$

$2+1+2+1 = 6$

25) Is the following statement True or False:

NO

The Pauli exclusion principle states that orbitals may hold more than two electrons with opposing spins.

a. True
b. False