Make-up Quiz 4:

1) Which observation is consistent with a chemical reaction occurring?
   a. Propane forms a flame and emits heat as it burns. ✓
   b. Acetone feels cold as it evaporates form the skin.
   c. Heat is felt when a warm object is placed in your hand.
   d. Liquid ethyl alcohol turns into a solid when placed in a low-temperature freezer.

All physical changes

2) When water is boiled in a pot, it bubbles. Has a chemical reaction occurred?
   a. Yes
   b. No

physical change

3) Write a balanced chemical equation for the following chemical reaction:
"Solid copper reacts with solid sulfur to form solid copper (I) sulfide"
   a. $Cu\ (s) + S_2\ (g) \rightarrow CuS_2\ (s)$
   b. $Cu\ (s) + S\ (s) \rightarrow CuS\ (s)$
   c. $Cu\ (s) + S\ (s) \rightarrow CuS\ (s)$
   d. $2Cu\ (s) + S\ (s) \rightarrow Cu_2S\ (s)$

Cu^{+} S^{2-} $\Rightarrow Cu_2S$

4) What is the sum of all the coefficients after you balance the following chemical equation?

$3NO_2\ (g) + H_2O\ (l) \rightarrow 2HNO_3\ (aq) + NO\ (g)$

   a. 8
   b. 6
   c. 7
   d. 4

First balance hydrogen: You have 2 on the left, put 2 on the right (for HNO_3)
Second count nitrogen atoms: You have 2+1 = 3 on the right, so put 3 on the left (for NO_2)
Now oxygen atoms are automatically being taken care of. (3x2)+1 = 7 (on the left)
(2x3)+1 = 7 (on the right)

3 + 1 + 2 + 1 = 7

5) Which of the following groups are all soluble in water?
   a. $MgSO_4$, Ag_2SO_4, CaS
   b. $Mg(OH)_2$, $NaOH$, KNO_3
   c. BaS, $AgCl$, Hg_2Cl_2
   d. $MgCO_3$, $MnOH$, CaS

Soluble Soluble Soluble
insoluble
Soluble
Soluble
insoluble insoluble insoluble
AgCl: insoluble

Solubility Rules (Table 7.2)

6) A beaker of nitric acid is neutralized with calcium hydroxide. Write a net ionic equation for this reaction.

a. $HNO_3\ (aq) + CaOH\ (aq) \rightarrow Ca(NO_3)_2\ (aq) + H_2O\ (l)$
b. $H^+\ (aq) + NO_3^-\ (aq) \rightarrow HNO_3\ (aq)$
c. $Ca^{2+}\ (aq) + OH^-\ (aq) \rightarrow Ca(OH)_2\ (aq)$
d. $H^+\ (aq) + OH^-\ (aq) \rightarrow H_2O\ (l)$

Spectator ions

Molecular equation: $\leftarrow HNO_3(aq) + Ca(OH)_2(aq) \rightarrow Ca(NO_3)_2(aq) + H_2O(l)$

complete ionic equation: $\leftarrow H^+(aq) + NO_3^-(aq) + Ca^{2+}(aq) + OH^-(aq) \rightarrow Ca^{2+}(aq) + NO_3^-(aq) + H_2O(l)$

net ionic equation: $\leftarrow H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

7) What are the products of the following reaction?
$LiCl\ (aq) + AgNO_3\ (aq) \rightarrow$

First we write the potential compounds that may form. Then refer to the solubility table to see if they indeed form.

a. $LiNO_3$, $AgCl$
b. Li_2NO_3 , $AgCl_2$
c. There would be no reaction occurring between LiCl and $AgNO_3$
d. The products cannot be determined with the information provided

$LiNO_3(aq)$ and $AgCl(s) \Rightarrow$ precipitate will form

$N_2H_4 + \frac{1}{2}N_2O_4 \rightarrow \frac{3}{2}N_2 + 2H_2O$

balance N_2 last.

1) $4H \Rightarrow$ put coefficient of 2 for $H_2O \Rightarrow (2 \times 2) = 4\ H$
2) $4\ O \Rightarrow$ put coefficient of $\frac{1}{2}$ for $N_2O_4 \Rightarrow \frac{1}{2} \times 4 = 2$

8) Is the following chemical equation correctly balanced?
$2\ N_2H_4\ (g) + N_2O_4\ (g) \rightarrow 3N_2\ (g) + 4\ H_2O\ (g)$

a. Yes
b. No

3) Count number of nitrogen atoms on the left $2 + (\frac{1}{2} \times 2) = 2 + 1 = 3$ on the right 2

$\Rightarrow$ put coefficient of $\frac{3}{2}$ for N_2 and multiply the whole equation by 2

$2\ N_2H_4 + N_2O_4 \rightarrow 3\ N_2 + 4\ H_2O$

9) Consider the generic chemical reaction:
$2\ A + 3\ B \rightarrow 3\ C$
How many moles of B are required to completely react with 10 mol of A?

a. 15
b. 6.7
c. 0.6
d. This cannot be determined with the information provided.

$?\ mol\ B = 10^5\ mol\ A \times \frac{3\ mol\ B}{2\ mol\ A} = 15\ mol\ B$

10) For the following reaction calculate how many grams of oxygen form when 20.5 g HgO completely reacts.

$2\ HgO\ (s) \rightarrow 2\ Hg\ (l) + O_2\ (g)$

a. 1.51
b. 3.03
c. 3.27
d. 1.64

$$?\ g\ O_2 = 20.5\ g\ HgO \times \frac{1\ mol\ HgO}{(200.59+16)\ g\ HgO} \times \frac{1\ mol\ O_2}{2\ mol\ HgO} \times \frac{(16\times2)\ g\ O_2}{1\ mol\ O_2}$$

$$= 1.51\ g\ O_2$$

11) For the reaction shown, calculate theoretical yield of the product in moles when 2 mol Ti reacts with 2 mol Cl_2

$Ti\ (s) + 2\ Cl_2\ (g) \rightarrow TiCl_4\ (s)$

a. 2
b. 1
c. 0.2
d. 4

$$?\ mol\ TiCl_4 = 2\ mol\ Ti \times \frac{1\ mol\ TiCl_4}{1\ mol\ Ti} = 2\ mol\ TiCl_4$$

$$?\ mol\ TiCl_4 = 2\ mol\ Cl_2 \times \frac{1\ mol\ TiCl_4}{2\ mol\ Cl_2} = 1\ mol\ TiCl_4$$

Smaller number

Theoretical yield

12) The evaporation of water is endothermic:

$H_2O\ (l) \rightarrow H_2O\ (g) \quad \Delta H_{rxn} = +44.01\ kJ$

What minimum mass of water (in g) has to evaporate to absorb 175 kJ of heat?

a. 4.0
b. 71.7
c. 17.7
d. 2.5

$$?\ g\ H_2O(l) = 175\ kJ \times \frac{1\ mol\ H_2O(l)}{44.01\ kJ} \times \frac{(2\times1.01)+16\ g\ H_2O\ (l)}{1\ mol\ H_2O(l)}$$

$$= 71.65 \cong 71.7\ g\ H_2O(l)$$

13) Sodium and chlorine react to form sodium chloride.

$2\ Na\ (s) + Cl_2\ (g) \rightarrow 2\ NaCl\ (s)$

What is the theoretical yield of sodium chloride for the reaction of 55.0 g Na with 67.2 g Cl_2?

a. 111 g Na Cl
b. 1.40×10^2 g NaCl
c. 222 g NaCl
d. 55.4 g NaCl

$$?\ g\ NaCl = 55\ g\ Na \times \frac{1\ mol\ Na}{22.99\ g\ Na} \times \frac{2\ mol\ NaCl}{2\ mol\ Na} \times \frac{22.99+35.45\ g\ NaCl}{1\ mol\ NaCl} = 139.80\ g\ NaCl$$

$$?\ g\ NaCl = 67.2\ g\ Cl_2 \times \frac{1\ mol\ Cl_2}{(35.45\times2)\ g\ Cl_2} \times \frac{2\ mol\ NaCl}{1\ mol\ Cl_2} \times \frac{22.99+35.45\ g\ NaCl}{1\ mol\ NaCl} = 110.78\ g\ NaCl$$

Smaller number

14) Consider the generic chemical equation:

$A + 3\ B + 4\ C \rightarrow 3\ D$

If 5 mol A, 5 mol B, 5 mol C react with each other, identify the limiting reagent.

a. A
b. B
c. C
d. D

$$?\ mol\ D = 5\ mol\ A \times \frac{3\ mol\ D}{1\ mol\ A} = 15\ mol\ D$$

Theoretical yield

$$?\ mol\ D = 5\ mol\ B \times \frac{3\ mol\ D}{3\ mol\ B} = 5\ mol\ D$$

$$?\ mol\ D = 5\ mol\ C \times \frac{3\ mol\ D}{4\ mol\ C} = 3.75\ mol\ D$$

Smallest number

Theoretical yield

Write these ratios from the balanced chemical equation

15) Charcoal is primarily carbon. Determine the mass of CO_2 produced by burning enough carbon to produce 5.00×10^2 kJ of heat.

$C\ (s) + O_2\ (g) \rightarrow CO_2\ (g)\quad \Delta H_{rxn} = -393.5\ kJ$

a. 15 g
b. -15 g
c. 56 g
d. -56 g

$$?\ g\ CO_2 = 5\times10^2\ kJ \times \frac{1\ mol\ CO_2}{393.5\ kJ} \times \frac{12.01+(16\times2)\ g\ CO_2}{1\ mol\ CO_2}$$

$$= 55.92\ g \cong 56\ g$$

The reactant generating 3.75 mol D (C) is limiting reactant (limiting reagent)

In our daily life, we won't encounter negative mass.

16) Which type of electromagnetic radiation has the shortest wavelength?

highest energy

highest frequency

a. Radio waves
b. Infrared
c. Ultraviolet
d. Microwaves

17) List two types of electromagnetic radiation with frequencies lower than infrared light:

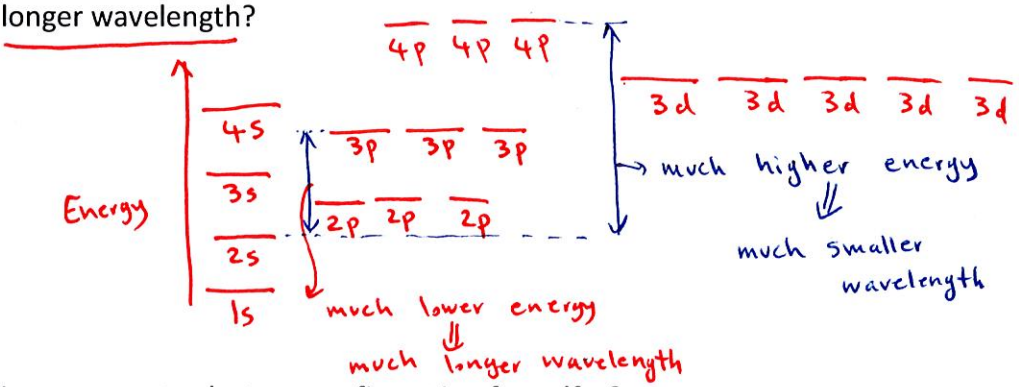
energies lower

wavelengths longer

a. Microwaves, ultraviolet
b. Microwaves, radio waves
c. Visible light, X-rays
d. Gamma rays, X-rays

18) According to the quantum-mechanical model for the hydrogen atom, which transition produces light with longer wavelength?

a. 3p to 2s
b. 4p to 2s



19) Which of the following represents electron configuration for sulfur?

a. $1s^2 2s^2 2p^6 3s^2 3p^6$
b. $1s^2 2s^2 2p^6 3s^2 3p^4$
c. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
d. $1s^2 2s^2 2p^6 3p^6$

16
S

$1s^2 2s^2 2p^6 3s^2 3p^4$

S is in group 6A ⇒ should have 6 valence electrons

S is in row (period) of 3 ⇒ should end with n = 3.

20) Use the periodic table to identify the element with the following electron configuration:

[Ne]$3s^1$ → Group 1A (since there is one valence electron)
n = 3

⇓

Na

a. Ne
b. F
c. Na
d. Mg

21) How many valence electrons Al has?

a. 13
b. 3
c. 10
d. 9

13 Al

Al is in group 3A and as a result has 3 valence electrons.

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$

22) How many 3d electrons are in an atom of potassium?

a. 6
b. 12
c. 1
d. 0

19 K

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$

23) Which of the following has the lowest ionization energy?

a. Nitrogen
b. Phosphorous
c. Arsenic
d. Bismuth

Most metallic character

⇒ All are in group 5A.

24) Which of the following has the largest atomic size?

a. Potassium
b. Calcium
c. Arsenic
d. Krypton

All are in row (period) of n = 4

Sizes of atoms tend to decrease across a period.

25) Arrange these elements in order of increasing metallic character: Sr, N, Si, P, Ga, Al.

a. Sr (lowest metallic character) → N → Si → P → Ga → Al
b. N (lowest metallic character) → P → Si → Al → Ga → Sr
c. P (lowest metallic character) → N → Si → Al → Ga → Sr
d. N (lowest metallic character) → P → Si → Ga → Sr → Al

Among these elements, Sr has the highest metallic character. And N has the lowest metallic character