CHEMISTRY | LEE

NAME ____

DATE ___________________________ BLOCK __________

UNIT EIGHT

PROBLEM SET

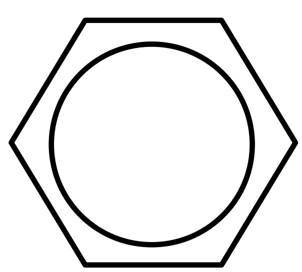
Score:

Do not cheat by copying the work of another person, or by allowing another person to copy your answers. Cheating results in a 0% grade for both parties involved.

Signature____________________________________ Date__________

In the event any or all of this Problem Set is assessed for a grade,
it <u>must be signed and dated</u> in order to receive a grade. The work shall be your own.

Problem Sets are generally not accepted late. Late assignments are 50% off.



HALF-LIFE PROBLEMS

Name____ Block _______

1. An isotope of cesium (cesium-137) has a half-life of 30 years. If 1.0 g of cesium-137 disintegrates over a period of 90 years, how many g of cesium-137 would remain?

2. Actinium-226 has a half-life of 29 hours. If 100 mg of actinium-226 disintegrates over a period of 58 hours, how many mg of actinium-226 will remain?

3. Sodium-25 was to be used in an experiment, but it took 3.0 minutes to get the sodium from the reactor to the laboratory. If 5.0 mg of sodium-25 was removed from the reactor, how many mg of sodium-25 were placed in the reaction vessel 3.0 minutes later if the half-life of sodium-25 is 60 seconds?

4. The half-life of isotope X is 2.0 years. How many years would it take for a 4.0 mg sample of X to decay and have only 0.50 mg of it remain?

5. Selenium-83 has a half-life of 25.0 minutes. How many minutes would it take for a 10.0 mg sample to decay and have only 1.25 mg of it remain?

6. The half-life of Po-218 is three minutes. How much of a 2.0 gram sample remains after 15 minutes? Suppose you wanted to buy some of this isotope, and it required half an hour for it reach you. How much should you order if you need to use 0.10 gram of this material?

Writing Nuclear Equations

Chem Worksheet 4-4

Name _______________

In the early 1900s scientists discovered that various isotopes will undergo nuclear decay. During this process the unstable nucleus of an atom gives off radiation. When scientists studied this radiation they discovered three types of particles: alpha, beta, and gamma. The **alpha particle** is composed of two protons and two neutrons, so it has a mass of 4 amu and a charge of 2+. A **beta particle** is a high energy electron emitted from the nucleus. A **gamma ray** often accompanies the other decay processes. Gamma radiation has no charge and no mass.

Radiation Type	Symbol	Mass (amu)	Charge
Alpha	${}^{4}_{2}He$ or ${}^{4}_{2}\alpha$	4	2+
Beta	${}^{0}_{-1}e$ or ${}^{0}_{-1}\beta$	$\frac{1}{1840}$	1–
Gamma	${}^{0}_{0}\gamma$	0	0

Equations can be written to show how a nucleus changes during a nuclear decay process. With these nuclear equations we track the atomic number and the mass number. For this reason it is important to correctly write the symbols for each particle involved. A nuclear equation is written for an alpha decay and a beta decay below. Notice that the sum of the atomic numbers is equal on both sides of the arrow. The sum of the mass numbers is also the same on both sides.

$${}^{206}_{84}Po \rightarrow {}^{202}_{82}Pb + {}^{4}_{2}\alpha \qquad \textbf{alpha decay}$$

$${}^{124}_{51}Sb \rightarrow {}^{124}_{52}Te + {}^{0}_{-1}\beta \qquad \textbf{beta decay}$$

Rewrite the following equations. Fill in all the missing information.

1. ${}^{129}_{53}I \rightarrow {}^{0}_{-1}e + \underline{\ ?\ }$
2. ${}^{216}_{86}Rn \rightarrow {}^{4}_{2}\alpha + \underline{\ ?\ }$
3. $\underline{\ ?\ } \rightarrow {}^{4}_{2}\alpha + {}^{239}_{97}Bk$
4. $\underline{\ ?\ } \rightarrow {}^{0}_{-1}e + {}^{52}_{23}V$
5. ${}^{255}_{?}Rf \rightarrow {}^{4}_{2}\alpha + \underline{\ ?\ }$
6. ${}^{85}_{?}Br \rightarrow \underline{\ ?\ } + {}^{85}_{?}Kr + {}^{0}_{0}\gamma$
7. $\underline{\ ?\ } \rightarrow {}^{0}_{-1}e + {}^{32}_{?}S + {}^{0}_{0}\gamma$
8. ${}^{257}_{101}Md \rightarrow {}^{4}_{2}\alpha + {}^{4}_{2}\alpha + \underline{\ ?\ }$

Write nuclear equations that describe the following processes.

9. Uranium-235 undergoes an alpha decay to produce thorium-231.
10. Lanthanum -144 becomes cerium-144 when it undergoes a beta decay.
11. Neptunium-233 is formed when americium-237 undergoes a nuclear decay process.
12. When protactinium-229 goes through two alpha decays, francium-221 is formed.
13. Uranium-238 undergoes an alpha decay and produces two gamma rays.
14. The neon-22 nucleus is formed when an element undergoes a beta decay.
15. Samarium-146 is produced when an element undergoes an alpha decay.
16. The beta decay of dysprosium-165 creates a new element.

Answer the following questions. Include the mass number when naming isotopes.

17. What atom produces scandium-47 when it goes through a beta decay?
18. What new element is formed when curium-244 emits two alpha particles and three gamma rays?

Le Châtelier's Principle
Chem Worksheet 18-6

Name ________________

A stress that is applied to a reaction that is at equilibrium conditions will shift the equilibrium position in a direction that tends to reduce this stress. This concept was first described by Le Châtelier. A reaction can be 'stressed' by changing the concentration of a reactant or product, changing the volume, and changing the temperature. Each stress tends to either favor the forward or reverse reaction until a new equilibrium position is established. If the forward reaction is increased we say equilibrium shifts to the right, and if the reverse reaction is increased equilibrium shifts to the left.

When the **concentration** of a gaseous or aqueous reactant or product is increased the equilibrium reaction shifts in the direction that decreases the concentration of that substance. If more product is added to a system at equilibrium, the reverse reaction increases in order to use the extra product, shifting equilibrium to the left. When the **volume** is reduced the equilibrium reaction shifts toward the side that contains the fewest gas particles. An increase in volume shifts to the side with the most gas particles. An increase in **temperature** will favor a reaction that is endothermic. A decrease in temperature will favor the reaction that is exothermic.

Concentration Changed	
$2A\ (g) + 3B\ (g) \leftrightarrows 2C\ (g) + D\ (g)$	
Action	**Effect**
Increase [A]	Shift to the right
Increase [C]	Shift to the left
Decrease [B]	Shift to the left
Decrease [C]	Shift to the right

Temp. Changed for Endothermic Rxn.	
$A\ (g) + B\ (g) + \text{heat} \leftrightarrows C\ (g) + D\ (g)$	
Action	**Effect**
Increase Temp.	Shifts to right (endothermic rxn.)
Decrease Temp.	Shifts to left (exothermic rxn.)

Volume Changed	
$2A\ (g) + 3B\ (g) \leftrightarrows 2C\ (g) + D\ (g)$	
Action	**Effect**
Volume decreased	Shifts to right (side with fewest gases)
Volume increased	Shifts to left (side with most gases)

Temp. Changed for Exothermic Rxn.	
$A\ (g) + B\ (g) \leftrightarrows C\ (g) + D\ (g) + \text{heat}$	
Action	**Effect**
Increase Temp.	Shifts to left (endothermic rxn.)
Decrease Temp	Shifts to right (exothermic rxn.)

Predict the direction equilibrium will shift when the following stresses occur. Explain your prediction. Assume each reaction occurs in a sealed container and has reached equilibrium.

$$2NO_2\ (g) \leftrightarrows N_2\ (g) + 2O_2\ (g) \quad \Delta H = +\ 33\ \text{kJ/mol (endothermic)}$$

1. NO_2 is added to the system.
2. N_2 is added to the system.
3. O_2 is removed from the system.
4. The temperature of the container is increased.
5. The volume of the container is increased.
6. N_2 is added and NO_2 is removed.

$$CaCO_3\ (s) \leftrightarrows CaO\ (s) + CO_2\ (g) \quad \Delta H = +\ 179\ \text{kJ/mol (endothermic)}$$

7. CO_2 is added to the system.
8. The volume of the container is decreased.
9. CaO is removed from the system.
10. The temperature of the container is decreased.
11. The volume of the container is increased.
12. $CaCO_3$ is added to the system.

$$H_2\ (g) + Cl_2\ (g) \leftrightarrows 2HCl\ (g) \quad \Delta H = -\ 185\ \text{kJ/mol (exothermic)}$$

13. H_2 is removed from the system.
14. HCl is removed from the system.
15. The volume of the container is increased.
16. The temperature of the container is increased.
17. The concentration is Cl_2 is decreased.
18. The volume of the container is decreased.

Chapter 19 Worksheet 1:

Name_________________________________ Date______________________

How is the equilibrium position of this reaction affected by the following changes? Determine whether the change shifts the reaction to the right → or to the left ←.

Heat + $NH_3(g) \leftrightarrows N_2(g) + 3H_2(g)$

Adding ammonia ___________________

Removing nitrogen _____________________

Adding hydrogen ___________________

Increasing the pressure in the vessel_______________________

Heating the reaction vessel ___________________________

$Xe(g) + 2F_2(g) \leftrightarrows XeF_4(g)$ + heat

Adding fluorine gas ______________________

Removing xenon gas __________________________

Removing Xenon tetrafluoride gas ______________________

Cooling the reaction vessel___________________________

$2C_2H_6(g) + 7O_2(g) \leftrightarrows 4CO_2(g) + 6H_2O(g)$ + heat

Adding C_2H_6 _______________

Removing carbon dioxide gas___________________

Removing oxygen gas_______________

Adding a catalyst_______________________

Increasing the pressure in the reaction vessel._________________________

Heating the reaction vessel.________________________

Circle the side of the reaction that has the most entropy

$2Al(s) + 3O_2(g) \leftrightarrows 2Al_2O_3(s)$

$NaCl(s) \leftrightarrows Na^+ + Cl^-$

$I_2(s) \leftrightarrows I_2(g)$

$2Mg(s) + O_2(g) \leftrightarrows 2MgO(s)$

Chapter 19 Worksheet 2:

Name__________________________________ Date_______________________

How is the equilibrium position of this reaction affected by the following changes? Determine whether the change shifts the reaction to the right → or to the left ←.

Heat + $2SO_2(g) + O_2(g) \leftrightarrows 2SO_3(g)$

Adding sulfur dioxide ____________________

Removing oxygen ______________________

Decreasing the pressure in the reaction vessel ____________________

Heating the reaction vessel ____________________________

$2NO(g) \leftrightarrows N_2(g) + O_2(g)$ + heat

Adding nitrogen gas _______________________

Removing oxygen gas ___________________________

Adding nitrogen monoxide gas _______________________

Adding a catalyst______________________________

Cooling the reaction vessel____________________________

$4H_2(g) + CS_2(g) \leftrightarrows CH_4(g) + 2H_2S(g)$ + heat

Adding carbon disulfide ________________

Removing H_2S____________________

Increasing the pressure in the reaction vessel.__________________________

Heating the reaction vessel._________________________

Circle the side of the reaction that has the most entropy

$4H_2(g) + CS_2(g) \leftrightarrows CH_4(g) + 2H_2S(g)$

$H_2O(s) \leftrightarrows H_2O(l)$ at zero Celsius

$NaHCO_3(s) + HCl(aq) \leftrightarrows H_2O(l) + CO_2(g) + NaCl(aq)$

Ch 19 WS 3: Determining if a reaction is spontaneous

Rules:

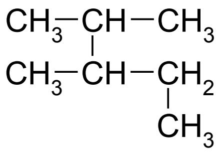
- An exothermic reaction favors spontaneity, -ΔH.
- A reaction with increasing entropy favors spontaneity, +ΔS.
- If a reaction is exothermic and has a positive ΔS, it will always be spontaneous
- If a reaction is endothermic and has a negative ΔS, it will never be spontaneous.
- The other cases are maybes

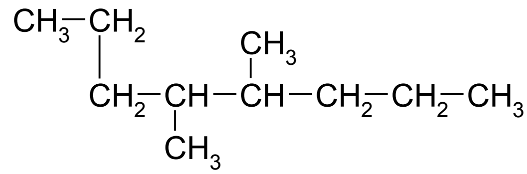
Evaluate the following reactions to determine if they are spontaneous

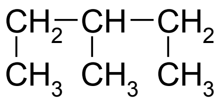
Reaction	Sign of ΔH	Sign of ΔS	Spontaneous (yes, no, maybe)
$400\ kJ + CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$			
$2Mg(s) + O_2(g) \rightarrow 2MgO(s) + 800\ kJ$			
$500\ kJ + 2NO(g) \rightarrow N_2O_2(g)$			
$2Na(s) + Cl_2(g) \rightarrow 2NaCl(s) + 800\ kJ$			
$2NI_3(s) \rightarrow N_2(g) + 3I_2(s) + 400\ kJ$			
$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4\ H_2O(l) + 420\ kJ$			
$MgSO_3(s) + 200\ kJ \rightarrow MgO(s) + SO_2(g)$			
$H_2O(l) + 250\ kJ \rightarrow 2H_2(g) + O_2(g)$			
$300\ kJ + O_2(g) + 2SO_2(g) \rightarrow 2SO_3(g)$			
$2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g) + 450\ kJ$			

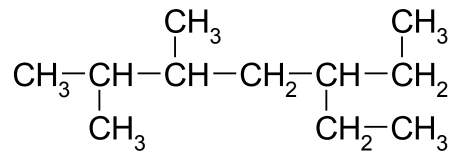
Naming Alkanes Practice

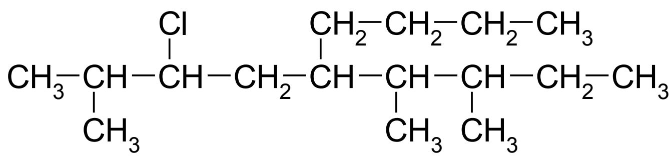
1. Give the correct IUPAC name for the following alkanes:

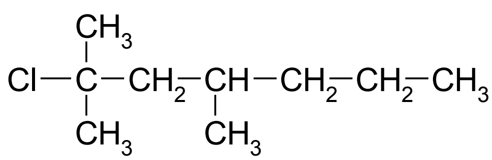
(a) 

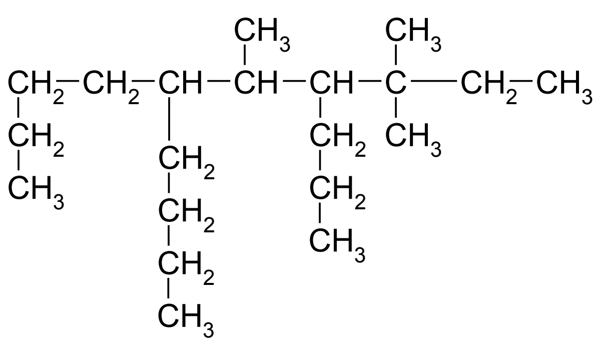
(b) 

(c) 

(d) 

(e) 

(f) 

(g) 

2. Draw the following alkanes:

(a) 2, 2, 4, 4 – tetramethylpentane

(b) 2-methyl-3-ethylpentane

(c) 3,5-diethyl-2,4-dimethyl-5-propyldecane

3. Draw the structures for all the alkanes with the molecular formula C_6H_{14}. Name each one.

1. Name the following simple branched-chain alkane

$CH_3 – CH - CH_2 – CH – CH - CH_3$
| | |
CH_3 CH_3 CH_3

____

2. Draw the condensed structural formula of each of the following molecules:
    a. 2,4-dimethylpentane

    b. 4-ethyl-3-methlyheptane

    c. methylpropane

3. Draw the condensed structural formula for 3,3,4-triethyl-4-methylhexane.

4. Draw the condensed structural formula for 3-ethyl-2,2-dimethlylpentane

5. Name the following molecules:
    a.
    $CH_3 –CH – CH_2 – CH_3$
    |
    CH_3

    ____

    b.
    CH_3
    |
    $CH_3 –CH_2 – CH – CH –CH_2 – CH_3$
    |
    $CH_2 – CH_3$

    ____

c.

$$CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3$$

d.

$$\begin{array}{ccccccccccc} & & CH_3 & & & & & & & & \\ & & | & & & & & & & & \\ CH_3 & - & C & - & CH_2 & - & CH & - & CH_2 & - & CH_3 \\ & & | & & & & | & & & & \\ & & CH_3 & & & & CH_3 & & & & \end{array}$$

e.

$$\begin{array}{ccccccccccccccccc} & & CH_3 & & & & & & CH_2 & - & CH_2 & - & CH_2 & - & CH_3 & & \\ & & | & & & & & & | & & & & & & & & \\ CH_3 & - & C & - & CH_2 & - & CH_2 & - & CH & - & CH_2 & - & CH_2 & - & CH_2 & - & CH_3 \\ & & | & & & & & & & & & & & & & & \\ & & CH_3 & & & & & & & & & & & & & & \end{array}$$

6. Give the complete, uncondensed, structural formula for each of the following alkanes:
   a. Decane

   b. 3,3-dimethylpentane

7. Give the condensed structural formula for the following:
   a. 2,2,4,4,-tetramethylpentane

   b. 4-ethyloctane

c. 2-methylnonane

d. 2-methyl-2-ethylbutane

e. 3-butylpentane

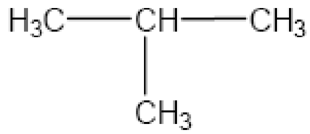
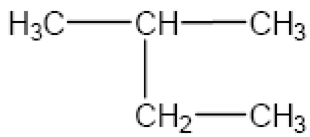
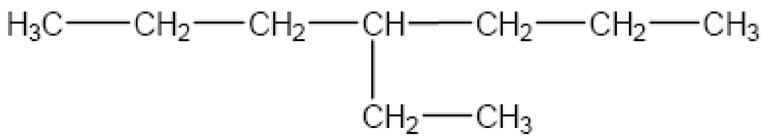
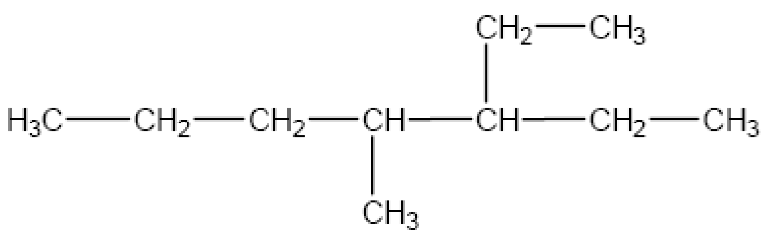
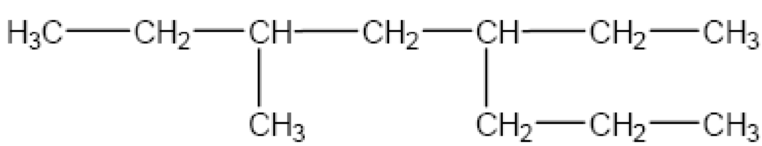
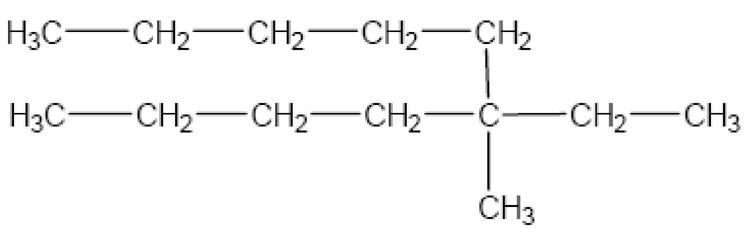
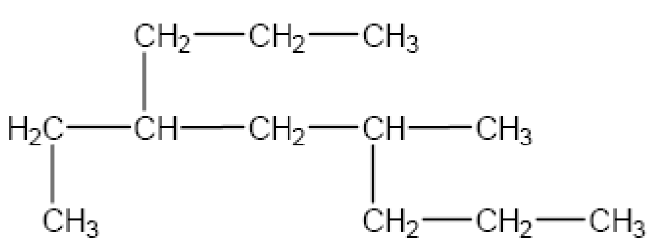
f. 2-ethyl-4-propylheptane

g. 2,2,3-trimethylbutane

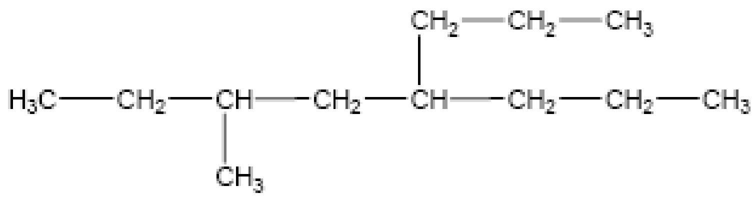
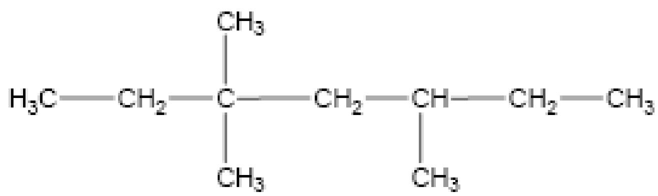
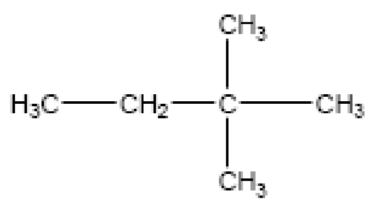
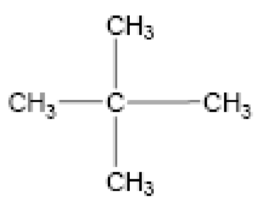
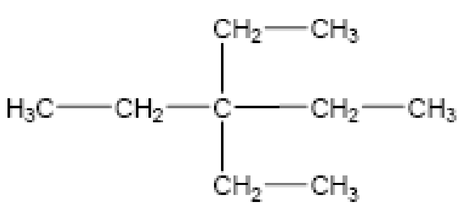
h. 3-ethyl-2,2-dimethylhexane

i. 2,3,4,5,6,7-hexamethyloctane

Name the following branched alkanes:

1.		
2.		
3.		
4.		
5.		
6.		
7.		

Name the following branched alkanes:

1.		
2.		
3.		
4.		
5.		

<u>**Chapter 22 WS 1: Oxidation Number Worksheet**</u>

In each of the following chemicals, determine the oxidation states of each element:

NBr_3	N=_____	Br=_____	
SiO_2	Si=_____	O=_____	
Fe_2O_3	Fe=_____	O=_____	
Li_3N	Li=_____	N=_____	
SO_3^{2-}	S= _____	O=_____	
Na_2CO_3	Na=_____	C=_____	O=_____
CO	C=_____	O=_____	
NH_3	N=_____	H=_____	
BF_3	B=_____	F=_____	
NO_2^-	N=_____	O=_____	
PO_3^{3-}	P=_____	O=_____	
MgF_2	Mg=____	F=_____	
$KBrO_3$	K=_____	Br=_____	O=______

sodium nitrate___________________________________

zinc oxide ______________________________________

water ______________________________________

calcium hydride ______________________________________

carbon dioxide ______________________________________

nitrogen ______________________________________

sodium sulfate ______________________________________

aluminum hydroxide ______________________________________

magnesium phosphate ______________________________________

sulfur dioxide ____

phosphorus pentachloride ______________________________________

Chapter 22 WS 2: Oxidation Number Worksheet

In each of the following chemicals, determine the oxidation states of each element:

P_2O_3	P=_____	O=______
CrO_3	Cr=_____	O=______
$PbCl_2$	Pb=_____	Cl=______
PH_3	P=_____	H=_____
NO_2	N=_____	O=_____
CH_4	C=_____	H=_____
N_2O	N=_____	O=_____
$NaNO_3$	Na=____	P=______

Write formulas for the following compounds

Iron(III) sulfide _______________

Nickel(II) carbonate_______________

Magnesiun hydroxide________________

Silver nitrate___________________

Zinc oxide____________________

Write names for the following formulas

$CaBr_2$____

$MgCO_3$____

$Cr(PO_4)_2$____

$FeCl_3$____

PCl_3____

$Ni(OH)_2$____

Chapter 22 WS 3:Oxidation and Reduction Practice

In each of the following equations, indicate the element that has been oxidized and the one that has been reduced. You should also label the oxidation state of each element before and after the process. Note that not all the reactions are redox reactions. Circle the reactions that are not redox reactions.

1) $4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$

2) $2NaOH(aq) + H_2SO_4(aq) \rightarrow 2H_2O(l) + Na_2SO_4(aq)$

3) $2N_2O(g) \rightarrow 2N_2(g) + O_2(g)$

4) $2C_6H_6(l) + 15O_2(g) \rightarrow 12CO_2(g) + 6H_2O(l)$

5) $Zn(s) + H_2SO_4(l) \rightarrow ZnSO_4(s) + H_2(g)$

6) $2H_2O \rightarrow 2H_2(g) + O_2(g)$

Ch 29 WS 1: Nuclear Chemistry Worksheet

Using your knowledge of nuclear chemistry, write the equations for the following processes:

1. The decay of radon-198

$$^{198}_{86}Rn \rightarrow ^{4}_{2}He + \_\_\_\_\_\_\_\_$$

2. The decay of Si-26.

$$^{26}_{14}Si \rightarrow \_\_\_\_\_\_\_ + ^{0}_{+1}e$$

3. The decay of uranium-237

$$^{237}_{92}U \rightarrow \_\_\_\_\_ + ^{237}_{93}Np$$

4. The decay of Uranium-235

$$^{235}_{92}U \rightarrow ^{231}_{90}Th + \_\_\_\_\_\_$$

5. The decay of Potassium-42

$$^{42}_{19}K \rightarrow ^{42}_{20}Ca + \_\_\_\_\_\_$$

Half Life Calculations

1) Thorium-234 has a half-life of 25 days. A 48 gram sample of Th-234 is stored for 50 days. How many grams of the sample is still Th-234 at the end of the storage period?

2) Polonium-218 has a half life of 4 days. A Russian journalist is fed 0.256 grams of Po-218. How many grams of Po-218 remain in his body after 16 days?

3) Polonium-210 has a half life of 5 days. How long can an 8 gram sample be stored until the Po-218 content falls to 1 gram?

4) Iodine-131 has a half-life of 8 days. If the Japanese Tsunami released 540 grams into the environment, how much Iodine-131 remains after 40 days?

Chapter 29 WS 3: Nuclear Decay

1) Radioactive Am-242 has a half-life of 16 hours. The amount of 400.0 grams of Am-242 sample left after 64 hours would be_____.(Ans = 25 grams)

2) Radioactive Ac-225 has a half-life of 10.0 days. The amount of a 256 gram sample left after 50 days would be _____. (Ans = 8 grams)

3) Carbon-14 is a radioactive isotope with a half-life of 6000 years. How many grams of a 12 gram sample would remain at the end of 12,000 years?(Ans = 3 grams)

4) Uranium-237 has a half-life of 7 days. How long will it take a 200 gram sample to decay until only 25 grams remain?(Ans = 21 days)

2. Complete the nuclear equation for the decay of Ac-228.

$$^{228}_{89}Ac \rightarrow \underline{\hspace{3cm}} + ^{0}_{-1}e$$

3. Complete the nuclear equation for the decay of Cf-252

$$^{252}_{98}Cf \rightarrow \underline{\hspace{2cm}} + ^{248}_{96}Cm$$