Week 4 Lab Questions (START HERE):

1. Calculate the dH° for the combustion of Methane (CH4). (2 points)

   $CH_4(g) + O_2(g) \rightarrow CO_2(g) + H_2O(g)$ *(don't forget to balance the equation before you start the calculations). Show your work.*

   $CH_4(g) + \mathbf{2}O_2(g) \rightarrow CO_2(g) + \mathbf{2}H_2O(g)$

ΔH° for Product = -393.5+(-285.8)2=-965.1kj/mol

ΔH for reactant =-74.81+0=-74.81kj/mol

ΔH= ΔH° for Product - ΔH for reactant

ΔH = -965.1+74.81=- 890.3kj/mol

a. Did CH4 get **oxidized** or reduced? Circle the correct answer. (1 point)

b. Did O2 get oxidized or **reduced**? Circle the correct answer. (1 point)

c. Is CH4 an oxidizing or **reducing agent**? Circle the correct answer. (1 point)

d. Is O2 an **oxidizing** or reducing agent? Circle the correct answer. (1 point)

2. Calculate the dHo of the decomposition reaction of HI using the values from the table in Appendix 2 (2 points)

   $\mathbf{2}HI(g) \rightarrow \mathbf{1}\ H_2(g) + \mathbf{1}\ I_2(g)$ dHo = **___10.45kJ**

   _____

   (don't forget to balance the equation before you start the calculations). Show your work.

ΔH= ΔH° for Product - ΔH for reactant

(0+62.25)-2(-25.9)=

10.45kJ

a. Calculate the dHo for 1 mole of decomposition of HI (without using the tables). Show your work. (1 point)

FOR 1 mol =**10.45/2 = 5.225Kj/mol**

b. Calculate the dHo for 6 moles of decomposition of HI (without using the tables). Show your work (1 point)

1 mol = **= 5.225Kj/mol**

For 6 moles = 5.225×6 = 31.35kJ

3. Consider this reaction:

2$H_2(g)$ + **1**O_2 (g) → **2** H_2O (g) dHo = **__483.6kJ** ____

1. Balance the equation and put the correct number of moles in the equation above. *(1 point)*

2. Classify the forward reaction as (1) Combustion, (2) Decomposition, (3) Single replacement, (4) Double replacement, (5) Neutralization, (6) **Synthesis**. Circle the correct answer. (1 point)

3. In this reaction did Hydrogen get **oxidized** or reduced? Circle the correct answer. *(1 point)*

4. Based on your answer above is Hydrogen an oxidizing or **reducing reactant**? Circle the correct answer. *(1 point)*

5. In this reaction did Oxygen get oxidized or **reduced**? Circle the correct answer. *(1 point)*

6. Based on the answer above, is Oxygen **an oxidizing** or reducing agent? Circle the correct *(1 point)*

7. Calculate the dHo of the Synthesis reaction **<u>using the values from the table in Appendix 2.</u>** Show your work. *(2 points)*

(2×241.8)-(2(0)+0)= -483.6kJ

8. If 4 moles of H2 is used in a balanced equation for the synthesis reaction, how many moles of water will be produced (without using the tables). Show your work. *(1 point)*

Mole ratio of H_2:H_20 IS 1:1 HENCE 4 moles of hydrogen will produce 4 moles of water .

9. If 4 moles of H2 is used for the Synthesis reaction, calculate the enthalpy of the reaction without using the tables. Show your work. *(1 point)*

(483.6 kj ÷2)×4=967.2kJ

10. If 4 moles of H_2O is required to be produced, how many moles of H_2 and how many moles of O_2 will be required (without using tables). Show your work. *(1 point).*

Mole ratio of H_2:H_20 IS 1:1 HENCE 4 moles of water will need 4 moles of hydrogen .

Mole ratio of O_2:H_20 IS 1:2 HENCE 4 moles of water will need 2moles of Oxygen .

11. If 1 mole of water is required to be produced, how many moles of H_2 and O_2 will be required (without using tables)? Show your work. *(1 point)*

Mole ratio of H_2:H_20 IS 1:1 HENCE 1 moles of water will need 1 moles of hydrogen .

Mole ratio of O_2:H_20 IS 1:2 HENCE 1 moles of water will need 0.5 moles of Oxygen

12. If 6 moles of water is decomposed, how many moles of H_2 and O_2 will be formed? *(1 point)*

Mole ratio of H_2:H_20 IS 1:1 HENCE 6 moles of water will need 6 moles of hydrogen .

Mole ratio of O_2:H_20 IS 1:2 HENCE 6moles of water will need 3 moles of Oxygen

13. If 6 moles of water is decomposed, calculate the enthalpy of the reaction without using the values from the table available in Appendix 2 of your textbook. *(2 points)*

2 H2O = 483.6 Hence 1 H20 =483.6/2 =241.8kJ/mol

241.8 ×6=1450.8kJ

Solve the following problems from your textbook. (10 points each).

14. Practice Exercise on Page 186 (First solve Example 6.1 and then attempt the practice exercise).

a) against vacuum p= 0

W=-PΔv

0×(971-264)

w =0

b) W=-PΔv

-4 ×(971-264)=2828

2828/1000= 2.828L.atm

To conver t into joules
2.828L.atm ×101.325 =286.547J

c) Practice Exercise on Page 187 (First solve Example 6.2 and then attempt the practice exercise).

ΔU =q + w
The reaction is endothermic hence q is +279
W=387

ΔU = 387+ 279 =

666J

d) Practice Exercise on Page 191 (First solve Example 6.3 and then attempt the practice exercise).
MOLES = 266 /120 = 2.167 Moles

2.167 ×3013 =6529.171kJ

e) Practice Exercise on Page 194 (First solve Example 6.5 and then attempt the practice exercise).

$q=m\times c\times \Delta T$

$0.869\times 450\times (5-94)$

= -34803.5J Or -34.8035kJ

f) Practice Exercise on Page 196 (First solve Example 6.6 and then attempt the practice exercise).

q= 10.4 ×(4.20)=43.68kJ

The heat released is =-43.68Kj

Moles =1.922/32=0.06moles

Molar heat = 43.68/0.06

Answer =-728kJ/mol

g) Practice Exercise on Page 203 First solve Example 6.10 and then attempt the practice exercise).

$$2C_6H_6+90_2 \longrightarrow 12CO_2+6H_2O$$

(12 ×-393.5) +(-285.8×6)-(2×49.04+ 0×9)= -6338.72

For 1 mole of benzene =-6338.72/2 =- 3169.36kJ

Molar mass of benzene = (12 ×6)+(1×6)=78

-3169.36/78= -40.633Kj/g

Answer =**-40.633KJ/g**

Solve example 6.9 and then attempt the Hess' law questions below.

h) Show how the equations listed below with dHo values can be manipulated to calculate the dHo of the following equation (5 points)

$2KCl(s) + H_2SO_4 (l) \rightarrow 2HCl (g) + K_2SO_4 (s)$ dHo = ?

a. $HCl (g) + KOH (s) \rightarrow KCl (s) + H_2O (l)$ dHo = - 200.0 kJ
b. $H_2SO_4 (l) + 2KOH (s) \rightarrow K_2SO_4 (s) + 2 H_2O (l)$ dHo = -340.0 kJ

Answer

$KCl (s) + H_2O (l) \rightarrow HCl (g) + KOH (s)$ dHo = +200.0 kJ

Reversing the equation results to change of -200 to +200Kj to balance equation a AND equation multiply revised equation($KCl (s) + H_2O (l) \rightarrow HCl (g) + KOH (s)$ dHo = +200.0 kJ) by 2 changing the equation to

$2 KCl (s) + 2 H_2O (l) \rightarrow 2HCl (g) + 2KOH (s)$ ΔH = +400.0 kJ

Adding the ΔH for both equation

ΔH = 400-340 = 60kJ

i) Use the following two equations

a. $½ N_2 (g) + O_2 (g) \rightarrow NO_2 (g)$ dHo = +35 kJ
b. $½ N2 (g) + ½ O_2 (g) \rightarrow NO (g)$ dHo = +90.4 kJ

to calculate the dHo of

$NO (g) + ½ O_2 (g) \rightarrow NO_2 (g)$ dHo =

REVERSING equation 2

$NO (g) \rightarrow NO (g) + ½ O_2 (g)$ -90.4 kJ

$½ N_2 (g) + O_2 (g) \rightarrow NO_2 (g)$ = +35 kJ

Enthalpy is given by (-90.4 +35)= -55.4KJ

j) Use the following equations: (5 points)

a. Fe_2O_3 (s) + 3CO (g) → 2Fe (s) + 3 CO_2 (g) dHo = -27 kJ

b. CO (g) + ½ O_2 (g) → CO_2 (g) dHo = -283 kJ

To calculate the dHo of

2Fe (s) + 3/2 O_2 (g) → Fe_2O_3 (s)

Reversing equation a…… ΔH=(+ 27kJ)

The enthalpy is given by (27+-283)=-256kJ