Dougherty Valley HS Chemistry - AP
Thermochemistry – FRQs

Worksheet #6

Name: **Period:** **Seat#:**

Directions: Show all work in a way that would earn you credit on the AP Test! This is always the rule! Grading rubrics posted in the Google Answer Key Drive. Check your work, correct in green pen after you try them yourself in an honest way! Don't peek at rubrics while you work! **USE BINDER PAPER, STAPLE TO YOUR WORKSHEET**. Clearly label work.

SET A 27 MINUTE TIMER AND SEE IF YOU FINISH ON TIME!

2003

7. Answer the following questions that relate to the chemistry of nitrogen.

(a) Two nitrogen atoms combine to form a nitrogen molecule, as represented by the following equation.

$$2\ N(g) \rightarrow N_2(g)$$

Using the table of average bond energies below, determine the enthalpy change, ΔH, for the reaction.

Bond	Average Bond Energy ($kJ\ mol^{-1}$)
N – N	160
N = N	420
N ≡ N	950

2003B

3. In another experiment, liquid heptane, $C_7H_{16}(l)$, is completely combusted to produce $CO_2(g)$ and $H_2O(l)$, as represented by the following equation.

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

The heat of combustion $\Delta H°_{comb}$, for one mole of $C_7H_{16}(l)$ is -4.85×10^3 kJ.

(c) Using the information in the table below, calculate the vale of $\Delta H°_f$ for $C_7H_{16}(l)$ in $kJ\ mol^{-1}$

Compound	$\Delta H°_f$ ($kJ\ mol^{-1}$)
$CO_2(g)$	-393.5
$H_2O(l)$	-285.8

(d) A 0.0108 mol sample of $C_7H_{16}(l)$ is combusted in a bomb calorimeter.

(i) Calculate the amount of heat released to the calorimeter.

(ii) Given that the total heat capacity of the calorimeter is 9.273 kJ $°C^{-1}$, calculate the tempertature change of the calorimeter.

2006

$$CO(g) + ½\ O_2(g) \rightarrow CO_2(g)$$

2. The combustion of carbon monoxide is represented by the equation above.

(a) Determine the value of the standard enthalpy change, $\Delta H°rxn$, for the combustion of CO(g) at 298 K using the following information.

$$C(s) + ½\ O_2(g) \rightarrow CO(g) \qquad \Delta H°_{298} = -110.5\ kJ\ mol^{-1}$$

$$C(s) + O_2(g) \rightarrow CO_2(g) \qquad \Delta H°_{298} = -393.5\ kJ\ mol^{-1}$$

2005B

7. Answer the following questions about thermodynamics.

Substance	Combustion Reaction	Enthalpy of Combustion, $\Delta H°_{comb}$, at 298 K (kJ mol^{-1})
$H_2(g)$	$H_2(g) + ½\ O_2(g) \rightarrow H_2O(l)$	-290
$C(s)$	$C(s) + O_2(g) \rightarrow CO_2(g)$	-390
$CH_3OH(l)$		-730

(a) In the empty box in the table above, write a balanced chemical equation for the complete combustion of one mole of $CH_3OH(l)$. Assume products are in their standard states at 298 K. Coefficients do not need to be whole numbers.

(b) On the basis of your answer to part (a) and the information in the table, determine the enthalpy change for the reaction $C(s) + H_2(g) + H_2O(l) \rightarrow CH_3OH(l)$

(c) Write the balanced chemical equation that shows the reaction that is used to determine the enthalpy of formation for one mole of $CH_3OH(l)$

(d) Predict the sign of the standard entropy change, $\Delta S°$ for the combustion of $H_2(g)$. Explain your reasoning.
****NOTE*** We haven't learned about entropy yet, you can skip this part.*
BUT I bet you could give it a try anyway! ☺

(e) On the basis of bond energies, explain why the combustion of $H_2(g)$ is exothermic.

Reflection: Use this area to jot down notes about the types of mistakes you made, things you need to restudy, things that tricked you, etc. One of the most important skills to develop in AP Chem is self reflection and not making the same mistakes. The joke is – you should always make NEW mistakes, not the SAME mistakes ☺