

CHEMISTRY 123-01

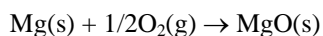
Practice exam #4

October 16, 2007

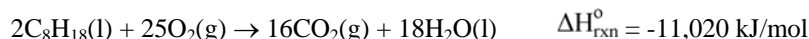
PART I: MULTIPLE CHOICE

- An endothermic reaction causes the surroundings to
 - warm up.
 - become acidic.
 - condense.
 - decrease in temperature.
 - release CO₂
- Which of the following is an example of potential energy?
 - Hitting a baseball
 - Running around bases
 - Pitching a baseball
 - A bat lying on the ground
 - Sliding into home plate
- The First Law of Thermodynamics states that:
 - Molecules move faster as temperature increases.
 - The total energy of the universe is constant.
 - Energy transfers from hotter objects to cooler objects.
 - Samples with different temperatures that come in contact with one another will reach thermal equilibrium.
 - All of the above.
- Which property can be used to distinguish one substance from another substance?
 - Temperature
 - Enthalpy
 - Internal energy
 - Specific heat capacity
 - Kinetic energy
- Which term refers to a quantity of heat transferred at constant pressure?
 - Entropy
 - Enthalpy
 - Work
 - Specific heat capacity
 - Expansion
- If a 10.0 g sample of each substance below has 250 J applied to it, which substance will have the greatest increase in temperature?
 - Iron (specific heat = 0.46 J/g·°C)
 - Water (specific heat = 4.184 J/g·°C)
 - Copper (specific heat = 0.39 J/g·°C)
 - Aluminum (specific heat = 0.92 J/g·°C)
 - Lead (specific heat = 0.13 J/g·°C)
- The temperature of a 15.5 g sample of a metal rises 35.0 °C when 125 J of energy is applied to it. What is the identity of the metal?
 - Silver (specific heat = 0.23 J/g·°C)
 - Copper (specific heat = 0.39 J/g·°C)
 - Iron (specific heat = 0.46 J/g·°C)
 - Lead (specific heat = 0.13 J/g·°C)
 - Aluminum (specific heat = 0.92 J/g·°C)
- Copper metal has a specific heat of 0.385 J/g·°C. Calculate the amount of heat required to raise the temperature of 22.8 g of Cu from 20.0°C to 875°C.
 - 1.97×10^{-5} J
 - 1.0×10^{-2} J
 - 329 J
 - 7.51 kJ
 - 10.5 kJ
- A glass containing 200. g of H₂O at 20°C was placed in a refrigerator. The water loses 11.7 kJ as it cools to a constant temperature. What is its new temperature? The specific heat of water is 4.184 J/g·°C.
 - 0.013°C
 - 4°C
 - 6°C
 - 14°C
 - 34°C

10. Suppose a 50.0 g block of silver (specific heat = 0.2350 J/g·°C) at 100°C is placed in contact with a 50.0 g block of iron (specific heat = 0.4494 J/g·°C) at 0°C, and the two blocks are insulated from the rest of the universe. The final temperature of the two blocks.
- will be higher than 50°C.
 - will be lower than 50°C.
 - will be exactly 50°C.
 - is unrelated to the composition of the blocks.
 - cannot be predicted.
11. A 0.1326 g sample of magnesium was burned in an oxygen bomb calorimeter. The total heat capacity of the calorimeter plus water was 5,760 J/°C. If the temperature rise of the calorimeter with water was 0.570°C, calculate the enthalpy of combustion of magnesium.

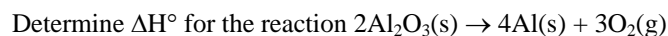


- 3280 kJ/mol
 - 24.8 kJ/mol
 - 435 kJ/mol
 - 106 kJ/mol
 - 602 kJ/mol
12. To which one of these reactions occurring at 25°C does the symbol $\Delta H_f^\circ [\text{H}_2\text{SO}_4(\text{l})]$ refer?
- $2\text{H}(\text{g}) + \text{S}(\text{g}) + 4\text{O}(\text{g}) \rightarrow \text{H}_2\text{SO}_4(\text{l})$
 - $\text{H}_2(\text{g}) + \text{S}(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{H}_2\text{SO}_4(\text{l})$
 - $\text{H}_2\text{SO}_4(\text{l}) \rightarrow \text{H}_2(\text{g}) + \text{S}(\text{s}) + 2\text{O}_2(\text{g})$
 - $\text{H}_2\text{SO}_4(\text{l}) \rightarrow 2\text{H}(\text{g}) + \text{S}(\text{s}) + 4\text{O}(\text{g})$
 - $\text{H}_2(\text{g}) + \text{S}(\text{s}) + 2\text{O}_2(\text{g}) \rightarrow \text{H}_2\text{SO}_4(\text{l})$
13. Octane (C_8H_{18}) undergoes combustion according to the following thermochemical equation:



- Given that $\Delta H_f^\circ [\text{CO}_2(\text{g})] = -393.5 \text{ kJ/mol}$ and $\Delta H_f^\circ [\text{H}_2\text{O}(\text{l})] = -285.8 \text{ kJ/mol}$, calculate the standard enthalpy of formation of octane.
- 210 kJ/mol
 - 11,230 kJ/mol
 - 22,040 kJ/mol
 - 420 kJ/mol
 - 420 kJ/mol

14. Given $2\text{Al}(\text{s}) + (3/2)\text{O}_2(\text{g}) \rightarrow \text{Al}_2\text{O}_3(\text{s})$, $\Delta H_f^\circ = -1,670 \text{ kJ/mol}$ for $\text{Al}_2\text{O}_3(\text{s})$.

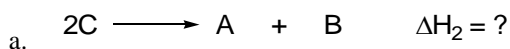
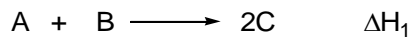


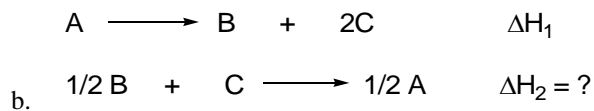
- 3,340 kJ/mol
 - 1,670 kJ/mol
 - 3,340 kJ/mol
 - 1,670 kJ/mol
 - 835 kJ/mol
15. Given the thermochemical equation $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$, $\Delta H_{\text{rxn}}^\circ = -198 \text{ kJ/mol}$, what is the standard enthalpy change for the decomposition of one mole of SO_3 ?
- 198 kJ/mol
 - 99 kJ/mol
 - 99 kJ/mol
 - 396 kJ/mol
 - 198 kJ/mol
16. For the reaction $\text{C}(\text{graphite}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$, $\Delta H^\circ = -393 \text{ kJ/mol}$. How many grams of C(graphite) must be burned to release 275 kJ of heat?
- 22.3 g
 - 0.70 g
 - 12.0 g
 - 17.1 g
 - 8.40 g

17. Find the heat absorbed from the surroundings when 15 g of O_2 reacts according to the equation $O + O_2 \rightarrow O_3$, $\Delta H_{\text{rxn}}^\circ = 103$ kJ/mol.
- 4.6×10^{-3} kJ
 - 48 kJ
 - 96 kJ
 - 32 kJ
 - 110 kJ
18. At 25°C , the standard enthalpy of formation of $KCl(s)$ is -435.87 kJ/mol. When one mole of $KCl(s)$ is formed by reacting potassium vapor and chlorine gas at 25°C , the standard enthalpy of reaction is -525.86 kJ/mol. Find ΔH° for the sublimation of potassium, $K(s) \rightarrow K(g)$, at 25°C .
- -345.88 kJ/mol
 - 45.00 kJ/mol
 - 345.88 kJ/mol
 - 89.99 kJ/mol
 - -525.86 kJ/mol
19. 10.1 g CaO is dropped into a styrofoam coffee cup containing 157 g H_2O at 18.0°C . If the following reaction occurs, then what temperature will the water reach, assuming that the cup is a perfect insulator and that the cup absorbs only a negligible amount of heat? [specific heat of water = 4.18 J/g $\cdot^\circ\text{C}$]
- $$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(s) \quad \Delta H_{\text{rxn}}^\circ = -64.8 \text{ kJ/mol}$$
- 18.02°C
 - 35.8°C
 - 311°C
 - 42.2°C
 - 117°C
20. A gas is compressed in a cylinder from a volume of 20 L to 2.0 L by a constant pressure of 10.0 atm. Calculate the amount of work done on the system.
- 1.01×10^4 J
 - 180 J
 - 1.81×10^4 J
 - -1.81×10^4 J
 - 180 J
21. Which of the following processes *always* results in an increase in the energy of a system?
- The system loses heat and does work on the surroundings.
 - The system gains heat and does work on the surroundings.
 - The system loses heat and has work done on it by the surroundings.
 - The system gains heat and has work done on it by the surroundings.
 - None of these is always true.
22. For which of these reactions will the difference between ΔH° and ΔE° be the smallest?
- $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
 - $4PH_3(g) \rightarrow P_4(g) + 6H_2(g)$
 - $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$
 - $CO_2(g) + 2H_2O(l) \rightarrow CH_4(g) + 2O_2(g)$
 - $P_4(s) + 10Cl_2(g) \rightarrow 4PCl_5(s)$

PART II: CONCEPTS

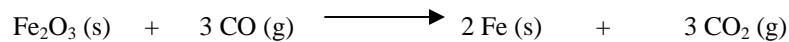
23. For each of the following, determine the value of ΔH_2 in terms of ΔH_1 .





PART III: HESS'S LAW

24. Calculate ΔH for the following reaction:

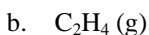


Use the following reactions:



PART IV: STANDARD MOLAR ENTHALPIES OF FORMATION

25. Write an equation for the formation of each of the following compounds from their constituent elements, in their standard states.



26. Use data on ΔH_f° (Table 6.4 and Appendix 2) to calculate ΔH for each of the following reactions.

