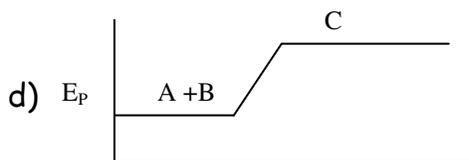


THERMOCHEMISTRY TEST REVIEW

Multiple Choice:

- 1) A substance increases in temperature by 255°C when a 983 g sample of it absorbs 83 200 J of heat. What is the specific heat capacity of the substance?
- a) $0.332 \text{ J/g}^{\circ}\text{C}$ b) $0.450 \text{ J/g}^{\circ}\text{C}$ c) $21.6 \text{ J/g}^{\circ}\text{C}$ d) $321 \text{ J/g}^{\circ}\text{C}$
- 2) What is the ΔH value for an exothermic change?
- a) always negative b) always positive
c) could be positive or negative d) depends on the potential energy of the reactants
- 3) Which of the following equations represents an **exothermic** process?
- a) $A + B + 200 \text{ kJ} \rightarrow C$
b) $A + B \rightarrow C + 200 \text{ kJ}$
c) $A + B \rightarrow C \quad \Delta H = 200 \text{ kJ}$



- 4) Which statement concerning these equations is correct?
- (1) $\text{K(s)} + \frac{1}{2} \text{Br}_2(\text{l}) \rightarrow \text{KBr(s)} \quad \Delta H = -394 \text{ kJ}$
(2) $\text{K(s)} + \frac{1}{2} \text{Br}_2(\text{g}) \rightarrow \text{KBr(s)} \quad \Delta H = -416 \text{ kJ}$
- a. Both reactions are endothermic.
b. For each mole of KBr(s) formed in reaction (2), 416 kJ of heat is absorbed.
c. If reaction (1) occurs in an insulated container, the temperature in the container will rise.
d. In both reactions, the heat content of the KBr(s) is more than that of the reactants.
- 5) Which statement about enthalpy is true?
- a. Heat is given off to the surroundings in endothermic reactions.
b. Some substances have a negative specific heat capacity.
c. Specific heat capacity is the same for all liquids.
d. The sign of ΔH is always negative in exothermic reactions.
- 6) What is the correct order, from highest to lowest molar heat value, for the three types of energy change?
- a) chemical, phase, nuclear c) nuclear, phase, chemical
b) nuclear, chemical, phase d) phase, chemical, nuclear

7) What is the energy required to evaporate two moles of liquid water given the following equations?



- a. 44.0 kJ b. 88.0 kJ c. 527.6 kJ d. 1055.2 kJ

Calculations and Explanations

8. a) Write a balanced equation for the combustion of propane (C_3H_8) (Water vapour is a product).

b) Rewrite the equation to show the heat of combustion of propane (2200 kJ/mole) using both methods of communicating enthalpy changes in chemical equations.

9) Water vapour has more potential energy than water.

a) It takes 40.6 kJ of energy to convert 1 mole of water to water vapour. Write an equation to represent this.

b) Explain why the conversion of water to water vapour would be considered an endothermic process.

c) How much energy would be required to convert 50.0 g of water to water vapour ?
(113 kJ)

d) What mass of water could be converted to water vapour with an input of 1000 kJ of energy? **(443 g)**

10) Lead (Pb) is a very harmful chemical to humans. It was used in the manufacture of water pipes and as an additive to paint but these uses have been banned. How much energy would be required to convert a 15.0 g sample of solid lead at room temperature (25.0°C) to liquid lead. The enthalpy of fusion for lead is 4.77 kJ/mol. **(1.07 kJ)**

11) How much energy would be released by freezing 500.0 g of water? **(167 kJ)**

12) What mass of ice could be melted by an input of 1000 kJ of energy? **(2.99 kg)**

13) a) A coffee cup calorimeter was used to determine the heat of fusion of a substance. When a 6.00 g sample of the substance was placed in 150.0 mL of water, the temp of the water was observed to go from 23.4°C to 6.8°C . If we assume that all the heat lost by the water was gained by the substance what is the molar heat of fusion of the substance? (molar mass = 78.7 g/mole) **(137 kJ/mol)**

b) Was the process in the calorimeter exothermic or endothermic ?

c) Why is it that a beverage gets cooler when you place ice in it ?

d) How many g of ice are necessary to cool 150.0 g of water by 10.0°C ? **(18.8 g)**

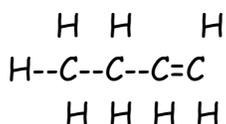
14) Compare exothermic processes and endothermic processes in terms of sign of ΔH , and the effect on environment (heat being given off or absorbed).

15) The heat capacity of a bomb calorimeter was calculated to be 45.1 kJ/°C. A 2.30 g chocolate sample was burned in a bomb calorimeter and the temp of the calorimeter was observed to increase by 12.3°C. What is the heat of combustion of the peanut in kJ/gram? **(241 kJ/g)**

16) a) 2.00 g of NaOH was dissolved in water in a coffee cup calorimeter and the temp of the 120.0 g of water was observed to go from 21.8°C to 27.6°C. What is the heat of solution of NaOH in kJ/mole ? **(-58.2 kJ/mol)**

b) Write an equation for the process and include the energy term with proper sign.

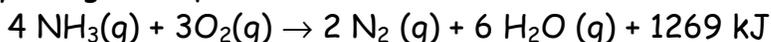
17) a) Write a balanced equation for the combustion of butene (C₄H₈)



b) Use your bond energy tables to determine the heat of combustion of butane. ()

c) From a bond energy point of view, explain why an exothermic reaction gives off heat and an endothermic reaction absorbs heat.

18. Study the given equation:

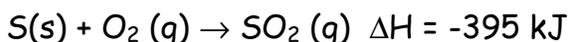


a) How many grams of NH₃ are reacted when 600 kJ of heat is released? ()

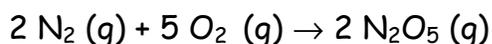
b) How much energy is released when 30.0 g of N₂ are formed? ()

19. What is the value of ΔH for the reaction $\text{S}(\text{s}) \rightarrow \text{S}(\text{g})$? **(223 kJ)**

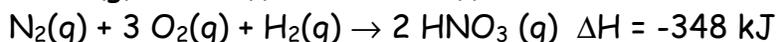
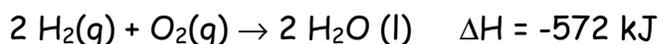
Given:



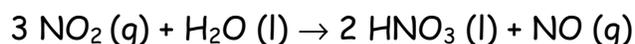
20. Use Hess' Law to determine the ΔH of the following reaction: **(60 kJ)**



Given:



21. Use heat of formation data to calculate the ΔH of the reaction shown below: ()



Draw a potential energy diagram for the above process.

22) A lab technician places a 5.00 g sample of lactose ($\text{C}_{12}\text{H}_{22}\text{O}_{11}$) into a bomb calorimeter that is calibrated at $9.23 \text{kJ}/^\circ\text{C}$. The initial temperature of the calorimeter is 21.0°C . After burning the lactose, the final temperature of the system is 32.0°C . What is the heat of combustion of this sample of lactose in kJ/mol ? (**6940 kJ/mol**)

23) A chemist wants to calibrate a new bomb calorimeter. She burns a mass of 0.930 g of carbon in the calorimeter. The temperature change of the calorimeter changes from 25.00°C to 28.15°C . If the molar enthalpy of combustion of carbon is $-394 \text{kJ}/\text{mol}$, what is the heat capacity of the new calorimeter? ()

Theory

22. a) Explain what happens to the heat that is transferred during a change of state.
b) Which process, melting or vaporization, requires more heat and why?
c) Water is said to have a high specific heat capacity. What does this mean?
d) Why do chemical reactions involve larger enthalpy changes than physical processes?

23) Explain why on a hot summer day the sand can be unbearably hot on bare feet yet the water is very cold. (Hint: Sand is made up of primarily Silicon. Check your data booklet and specific heat capacities to help form an answer.)

24) What would cause a more severe burn: 100 g of boiling water or 100 g of steam?

25) Fats have long hydrocarbon sections in their molecular structure. Therefore, they have many C-C bonds and C-H bonds. Sugars have fewer C-C bonds and C-H bonds but more C-O bonds. Explain why you can obtain more energy from burning a fat than from burning a sugar. To help explain this question, consult the table of bond energies found on P. 688 in your textbook.

For extra practice, complete the following questions in the textbook.