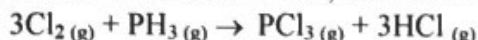## Unit 5 Quiz 2 Thermochemistry

Multiple Choice
Identify the choice that best completes the statement or answers the question.

✳ 1. Given the data in the table below, calculate $\Delta H°rxn$ for the reaction
$$3Cl_{2\,(g)} + PH_{3\,(g)} \rightarrow PCl_{3\,(g)} + 3HCl_{(g)}$$

| Compound	$\Delta H°_f$ (kJ/mol)
PCl_3 (g)	-288.07
HCl (g)	-92.30
PH_3 (g)	5.40

   a. -385 77 kJ
   b. 385.77 kJ
   c. -570.37 kJ
   d. 570.37 kJ
   e. missing necessary information

2. The reaction $A + 2B \rightarrow C$ has the following proposed mechanism:

    Step 1: $A + B \leftrightarrow D$ (fast, equilibrium)
    Step 2: $D + A \rightarrow E$ (slow)
    Step 3: $E + B \rightarrow C + A$ (fast)

If Step 2 is the rate-determining step, then the rate of formation of C should equal

   a. $k[A]$
   b. $k[A]^2[B]$
   c. $k[A]^2[B]^2$
   d. $k[A][B]$
   e. $k[A][B]^2$

✳ 3. When 2.00 grams of $N_aC_2H_3O_2$ is dissolved in 50.0 mL of water, the temperature decreases by 3.90 °C. What is the enthalpy of solution, ΔH_{soln} in kJ/mol?

   a. 44.6 kJ
   b. -44.6 kJ
   c. 4.29×10^4 kJ
   d. 42.9 kJ
   e. -42.9 kJ

$*$ 4. The value of $\Delta H°$ for the reaction below is -125 kJ. How much heat is released when 60.0 g of K_2O_2 reacts with excess water?

$$2K_2O_2 \text{ (s)} + 2H_2O \text{ (l)} \rightarrow 4KOH \text{ (s)} + O_2 \text{ (g)}$$
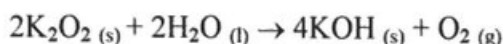
   a. 68.0 kJ
   b. 34.0 kJ
   c. 3.75 kJ
   d. 3750 kJ
   e. none of the above

$*$ 5. Calculate the work (kJ) done during a reaction in which the internal volume contracts from 107 L to 25 L when the outside pressure is 2204 mmHg.

   a. 2.4×10^4 kJ
   b. 2.4×10^2 kJ
   c. -24 kJ
   d. 24 kJ
   e. -2.4×10^2 kJ

6. Two substances of equal mass lose the same amount of heat. Which substance will experience the smallest temperature change?

   a. The substance with the highest heat capacity.
   b. The substance with the lowest heat capacity.
   c. Both substances will have the same temperature change.
   d. You must know the identity of the substances to answer this question.
   e. You need to know the initial temperatures of the substances to answer this question.

$*$ 7. A sample of iron absorbs 8.1 kJ of heat. This results in the temperature of the sample increasing from 13.6 °C to 42.1°C. If the specific heat of iron is 0.450 J/g-K, what is the mass (in grams) of the sample?

   a. 1.58×10^{-3} g
   b. 104 g
   c. 1.04×10^5 g
   d. 0.630 g
   e. 630 g

8. Which of the following has the least negative electrostatic potential energy (lattice energy)?
   a. CaO
   b. NaCl
   c. KI
   d. SrO
   e. MgBr

✳ 9. 50.0 mL of 0.100 M $AgNO_3$ and 50.0 mL of 0.100 M NaCl are mixed in a coffe cup calorimeter. The two solutions are initially 22.0 °C and the final temperature after mixing is 23.7 °C. Calculate the ΔHr in kJ/mol AgCl. The density of the solutions is 1.0 g/mL and the specific heat of the solutions is 4.184 J/g°C .

    a. 710 kJ
    b. 0.710 kJ
    c. 142 kJ
    d. 356 kJ
    e. none are correct.

✳ 10. Consider the following thermochemical equation:

$$NaOH\ (aq)\ +\ HCl\ (aq)\ \rightarrow\ NaCl\ (aq)\ +\ H_2O\ (l)\qquad \Delta H_{rxn} = -110\ kJ$$
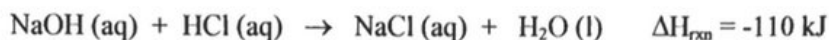
Calculate the heat released when 300.0 mL of 0.0750 M NaOH is mixed with 300.0 mL of 0.100 M HCl.

    a. 110 kJ
    b. 0.825 kJ
    c. 11.0 kJ
    d. 2.48 kJ
    e. none of the above is correct

✳ 11. A sample of water has a mass of 16.55 grams and is 20.0 °C. If 1.2 kJ of energy is removed from the water, then the water will be

    a. still a liquid.
    b. decomposed.
    c. frozen solid.
    d. completely vaporized.
    e. boiling

12. The internal energy of a system can be increased by _____.

    (a) transferring heat from the surroundings to the system
    (b) transferring heat from the system to the surroundings
    (c) system doing work on the surroundings
    (d) surroundings doing work on the system

    a. (a) only
    b. (a) and (c)
    c. (a) and (d)
    d. (b) and (c)
    e. (c) only

Reaction progress
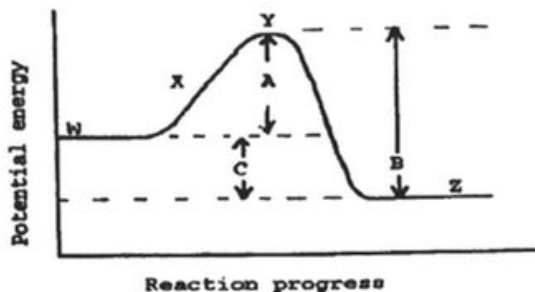
13.

Why is the reaction represented in the diagram above considered to be exothermic?

a. Because energy difference A and energy difference C are about the same
b. Because energy difference B is greater than energy difference C plus energy difference A
c. Because energy difference B is greater than energy difference C
d. Because energy difference A is greater than energy difference C
e. Because energy difference B is greater than energy difference A

✳ 14. Calculate the value of ΔE in joules for a system that loses 123 J of heat and has 151 J of work performed on it by the surroundings.

a. 28 J
b. 274 J
c. -28 J
d. -274 J
e. more information is needed

✳ 15. Use the following thermochemical equations to calculate the ΔH_f° of CuO.

$$Cu_2O(s) + \tfrac{1}{2} O_2(g) \rightarrow 2CuO(s) \quad \Delta H^\circ = -154 \text{ kJ}$$
$$Cu_2O(s) \rightarrow Cu(s) + CuO(s) \quad \Delta H^\circ = -13 \text{ kJ}$$

a. -141 kJ
b. -182 kJ
c. +182 kJ
d. -167 kJ
e. +167 kJ