

# Quiz I: Thermodynamics

SCH4U\_2018 - 2019\_V1

NAME: \_\_\_\_\_  
(Total Score: / 30)

## Multiple Choice (12)

1. When some solid ammonium nitrate was dissolved in water the temperature decreased from 22 °C to 3 °C. What can be deduced from this observation?

- A. The dissolving is endothermic and  $\Delta H$  is positive.
- B. The dissolving is endothermic and  $\Delta H$  is negative.
- C. The dissolving is exothermic and  $\Delta H$  is positive.
- D. The dissolving is exothermic and  $\Delta H$  is negative.

2. Which of the following conditions normally apply to the standard enthalpy change for a reaction,  $\Delta H^\circ$  ?

- I. A pressure of 101.3 kPa
- II. A temperature of 25 °C
- III. One mol of all reactants and all products

- A. I and II only      B. I and III only      C. II and III only      D. I, II and III

3. Which statements are correct for all exothermic reactions?

- I. The products are more stable than the reactants.
- II. The bonds in the products are stronger than the bonds in the reactants.
- III. The enthalpy of the products is less than the enthalpy of the reactants.

- A. I and II only      B. I and III only      C. II and III only      D. I, II and III

4. The heat capacities ( in  $\text{J g}^{-1} \text{ }^\circ\text{C}^{-1}$ ) of four elements are:

carbon	0.709
copper	0.385
gold	0.129
iron	0.449

Which element will show the greatest increase in temperature if 5 kJ of heat is supplied to 0.100 g samples of each element at the same initial temperature?

- A. Carbon      B. Copper      C. Gold      D. Iron

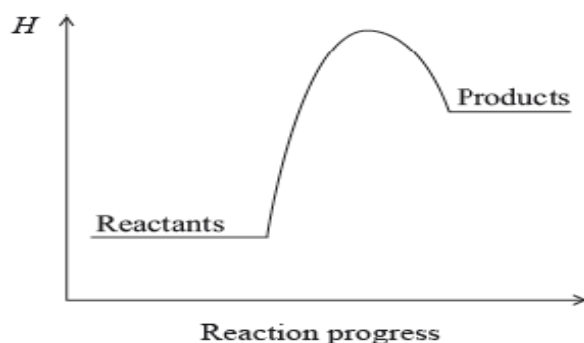
5. 40.0 g of a solution has its temperature raised from 25 °C to 50.0 °C by the addition of 4067 J of heat. Its specific heat in J g<sup>-1</sup>°C<sup>-1</sup> is:

- A. 4.31                      B. 4.07                      C. 4.18                      D. 2.03

6. Which of the following process is endothermic?

- A.  $\text{NaOH}_{(\text{aq})} + \text{HCl}_{(\text{aq})} \longrightarrow \text{NaCl}_{(\text{aq})} + \text{H}_2\text{O}_{(\text{l})}$   
B.  $\text{H}_2\text{O}_{(\text{g})} \longrightarrow \text{H}_2\text{O}_{(\text{l})}$   
C.  $\text{CH}_4_{(\text{g})} + 2\text{O}_2_{(\text{g})} \longrightarrow \text{CO}_2_{(\text{g})} + 2\text{H}_2\text{O}_{(\text{l})}$   
D.  $\text{H}_2\text{O}_{(\text{s})} \longrightarrow \text{H}_2\text{O}_{(\text{l})}$

7. Which statement is correct with the following enthalpy level diagram:



- A. Heat energy is released during the reaction and the reactants are more stable than the products.  
B. Heat energy is absorbed during the reaction and the reactants are more stable than the products.  
C. Heat energy is released during the reaction and the products are more stable than the reactants.  
D. Heat energy is absorbed during the reaction and the products are more stable than the reactants.

8. What is the temperature rise when 2100 J of energy is supplied to 100 g water? (specific heat capacity of water = 4.2 J g<sup>-1</sup>°C<sup>-1</sup>)

- A. 5 °C                      B. 278 K                      C. 0.2 °C                      D. 20 °C

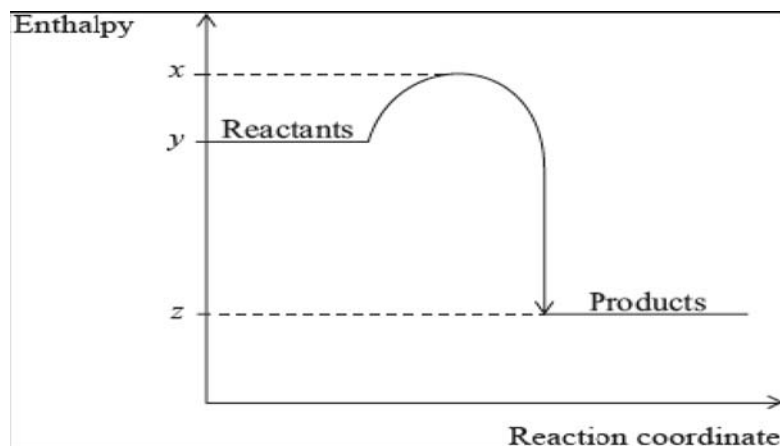
9. Consider the following reaction:



The activation energy of the forward reaction is 134 kJ. What is the activation energy, in kJ, for the reverse reaction?

- A. -134                      B. -100                      C. 234                      D. 368

10. What is the value of  $\Delta H$  for the enthalpy level diagram represented by the following diagram?



- A.  $y - z$                       B.  $z - y$                       C.  $x - z$                       D.  $z - x$

11. Which statement about bonding is correct?

- A. Bond breaking is endothermic and requires energy.
- B. Bond breaking is endothermic and releases energy.
- C. Bond making is exothermic and requires energy.
- D. Bond making is endothermic and releases energy.

12. What observation could you make regarding a neutralisation reaction?

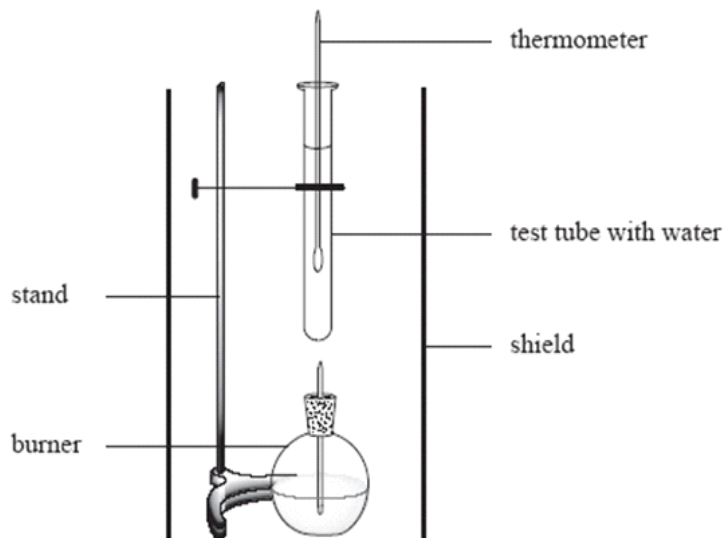
- A. a fall in temperature is recorded
- B. no temperature change
- C. fluctuating temperature with time
- D. a rise in temperature is recorded

**Multiple Choice Answers**

1	2	3	4	5	6	7	8	9	10	11	12

## Problems (18)

1. The enthalpy of combustion of methanol,  $\text{CH}_3\text{OH}_{(l)}$ , can be determined experimentally in a school laboratory. A burner containing methanol was weighed and used to heat water in a test tube as illustrated below.



The following data

were collected.

Initial mass of burner and methanol / g	80.557
Final mass of burner and methanol / g	80.034
Mass of water in test tube / g	20.000
Initial temperature of water / °C	21.5
Final temperature of water / °C	26.4

(i) Calculate the amount, in mol, of methanol,  $\text{CH}_3\text{OH}_{(l)}$ , burned.

2

mol: \_\_\_\_\_

(ii) Calculate the heat absorbed, in kJ, by the water.

3

heat absorbed by the water: \_\_\_\_\_

iii. Determine the enthalpy change, in  $\text{kJ mol}^{-1}$ , for the combustion of 1 mole of methanol. 2

enthalpy change: \_\_\_\_\_

iv. The literature value for the enthalpy of combustion of methanol is  $-726 \text{ kJ mol}^{-1}$ . Suggest one reason why the literature value differs from the experimental value calculated in part (iii) above. 1

Reason : \_\_\_\_\_

v. Write a thermochemical equation for the complete combustion of methanol,  $\text{CH}_3\text{OH}_{(l)}$ . 2

Thermochemical equation:

2. A  $100.0 \text{ mL}$  of  $0.500 \text{ mol L}^{-1}$  potassium iodide was mixed with  $100.0 \text{ mL}$  solution of  $0.300 \text{ mol L}^{-1}$  solution of lead (II) nitrate in an insulated calorimeter. A temperature increase of  $19.7^\circ\text{C}$  was measured.

i. Write a balanced chemical equation for the reaction. 2

Balanced equation:

ii. Calculate the limiting reactant. 2

limiting reactant: \_\_\_\_\_

iii. Determine the molar enthalpy,  $\text{kJ mol}^{-1}$ , for the above reaction.  
(State clearly any assumptions you have made in your calculation.)

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molar enthalpy of reaction: \_\_\_\_\_