Quiz I: Thermodynamics
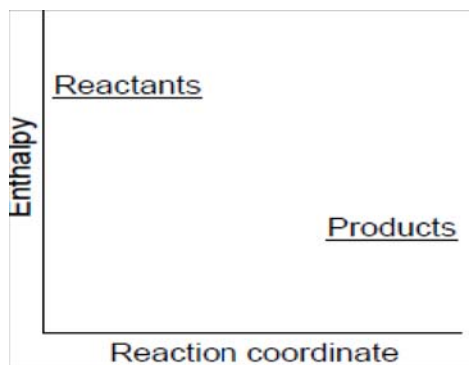
NAME: _____

(Total Score: / 30)

Multiple Choice (12)

1. What can be deduced from the following reaction profile?

A. The reactants are less stable than the products and the reaction is exothermic.
B. The reactants are less stable than the products and the reaction is endothermic.
C. The reactants are more stable than the products and the reaction is exothermic.
D. The reactants are more stable than the products and the reaction is endothermic.

2. The specific heat capacities of two substances are given in the table below:

Substance	specific heat capacity $(J \ g^{-1} \ K^{-1})$
Ethanol	2.43
Water	4.18

Which statement is correct?

A. More heat is needed to increase the temperature of 50 g of water by 50 ^{O}C than 50 g of ethanol by 50 ^{O}C.
B. If the same heat is supplied to equal masses of ethanol and water, the temperature of the water increases more.
C. If equal masses of water at 20 ^{O}C and ethanol at 50 ^{O}C are mixed, the final temperature of the mixture is 35 ^{O}C.
D. If equal masses of water and ethanol at 50 ^{O}C cool down to room temperature , ethanol liberates more heat.

3. Which combination is correct for the standard enthalpy change of neutralization?

	Process	Sign of ΔH^0
A	exothermic	negative
B	exothermic	positive
C	endothermic	negative
D	endothermic	positive

4. The enthalpy change for the dissolution of ammonium nitrate , NH_4NO_3, is + 26 kJ mol^{-1} at 25 $^\circ$C. Which statement about this reaction is correct?

A. The reaction is exothermic and the reaction mixture gets hot.
B. The reaction is exothermic and the reaction mixture gets cold.
C. The reaction is endothermic and the reaction mixture gets hot.
D. The reaction is endothermic and the reaction mixture gets cold.

5. What is the value of ΔH for the enthalpy level diagram represented by the following diagram?
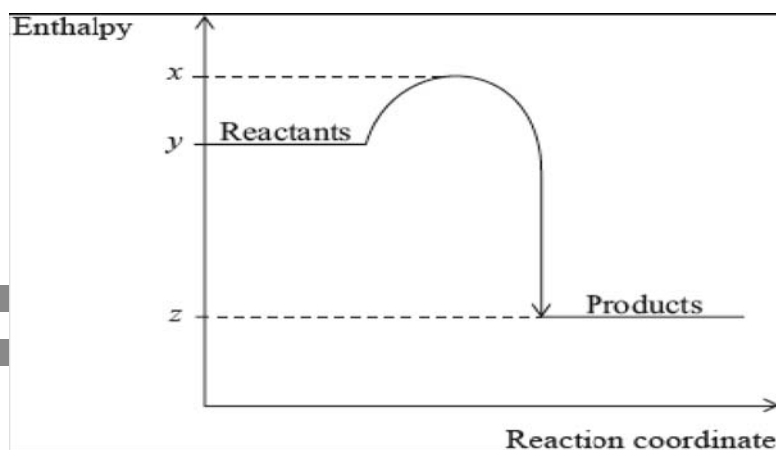
A. $y - z$ `   B. $z - y$ C. $x - z$ D. $z - x$

6. A 5.00 g sample of a substance was heated from 25.0 $^\circ$C to 35.0 $^\circ$C using 2.00 x 10^2 J of energy. What is the specific heat capacity of the substance in J g^{-1} $^\circ$C^{-1}?

A. 4.00 x 10^{-3} B. 2.50 x 10^{-1} C. 2.00   D. 4.00
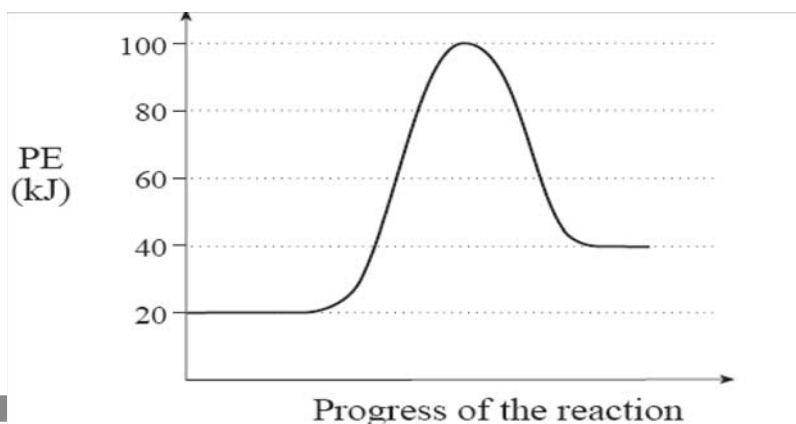
7. Which element is not in standard state ?

A. $H_{2(g)}$ B. $Na_{(s)}$ C. $Ne_{(g)}$ D. $Cl_{(g)}$

8. The specific heat capacity of nickel is 0.264 J g^{-1} $^{\circ}$C^{-1}. What would be the rise in temperature of a 100.0 g block of nickel if 528 J of of heat energy is supplied to it?

A. 200 $^{\circ}$C   B. 1.42 $^{\circ}$C   C. 20.0 $^{\circ}$C   D. 1.39 $^{\circ}$C

9. Consider the following potential energy diagram:

The forward reaction can be described as:

	ΔH (kJ)	Activation Energy (kJ)	Type of Reaction
A	+ 20	80	endothermic
B	+ 20	60	exothermic
C	– 20	80	exothermic
D	– 20	100	endothermic

10. If a reaction is endothermic:

A. More energy is needed to form bonds than is gained from breaking them.
B. More energy is needed to break bonds than is gained from forming them.
C. Less energy is needed to break bonds than is gained from forming them.
D. Less energy is needed to form bonds than is gained from breaking them.

11. The heat capacity of a calorimeter is 2.22 kJ/$^{\circ}$C. What is the temperature change if 997 J of energy is absorbed by a reaction in that calorimeter?

A. 2.21 $^{\circ}$C higher
B. 2.21 $^{\circ}$C lower
C. 0.449 $^{\circ}$C higher
D. 0.449 $^{\circ}$C lower

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12. The enthalpy change for the reaction between zinc metal and copper(II) sulphate solution is -217 kJ mol^{-1}. Which statement about this reaction is correct?

A. The reaction is endothermic and the temperature of the reaction mixture initially rises.
B. The reaction is endothermic and the temperature of the reaction mixture initially drops.
C. The reaction is exothermic and the temperature of the reaction mixture initially rises.
D. The reaction is exothermic and the temperature of the reaction mixture initially drops.

Multiple Choice Answers

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

Problems (18)

1. A 1.922 g sample of methanol, $CH_3OH_{(l)}$, was used to heat 200 mL of water in a copper calorimeter with a mass of 125 g, (specific heat capacity of copper = 0.385 J/ g. $^{\circ}$C). The temperature of the water rose from 19.7 $^{\circ}$C to 24.2 $^{\circ}$C.

i. Calculate the amount, in mol, of methanol, $CH_3OH_{(l)}$, burned.   1

mol: _____

(ii)   Calculate the heat absorbed, in kJ, by the copper calorimeter.   2

heat absorbed by the calorimeter: _____

(ii)   Calculate the heat absorbed, in kJ, by the water.   2

heat absorbed by the water: _____

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

4

molar enthalpy of methanol: _____

2. 100.0 cm^3 of 0.750 mol L^{-1} of sodium hydroxide was reacted with 150.0 cm^3 of 0.500 mol L^{-1} hydrochloric acid. The temperature rise was 3.55 ^{O}C.

a. Calculate the molar heat of neutralization. Assume that the specific heat capacity of the solution is the same as that of water.   3

molar heat of neutralization: _____

b. Write a thermochemical equation for the above neutralisation reaction.   1

Thermochemical equation:

_____

c. Write a net ionic equation for the above neutralisation reaction.   1

net-ionic equation:

_____

d. In light of your answer to (c) above, explain if the temperature rise observed in this reaction

is justified, and hence justify the expected sign of the ΔH for this reaction.   2

Justification for observed temperature rise:

_____

_____

Justification for sign of ΔH:

_____

_____

e. The literature value for the enthalpy of neutralisation is   — 56.8 kJ mol^{-1}.
Suggest one reasons why the literature value differs from the experimental value calculated in
part (a) above.   1

Reason :_____

_____

f. Sketch a potential energy diagram to illustrate the neutralization reaction of sodium hydroxide
with hydrochloric acid. (Label all the relevant details!!!)   3