SCH4U – S2018 Name [redacted]

Enthalpy and Energy Quiz 19 /20 Great!

For full marks, please provide complete solutions with all units and significant digits where appropriate. Good luck! ☺

c_{water} = **4.184J/g°C** d_{water} = **1.0g/mL**

1. Identify each of the following systems as open, closed or isolated: (1 mark K)

   a) An automobile with all doors, vents and windows closed. closed

   b) The ocean. Open

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2. A sample of ethanol absorbs 32.5kJ of energy. The temperature of the sample increases from 3.5°C to 21.7°C. What is the mass of the ethanol sample? The specific heat capacity of ethanol is 2.46J/g°C. (3 marks = 2 marks T, 1 mark C)

$\Delta t = 21.7 - 3.5$

$\Delta T = 18.2°C$

$32500 = mc\Delta T$

$\frac{32500}{18.2(2.46)} = m$

$m = 725.9\,g$

$m = 7.3 \times 10^2\,g$

put in units (-0.5)

2.5

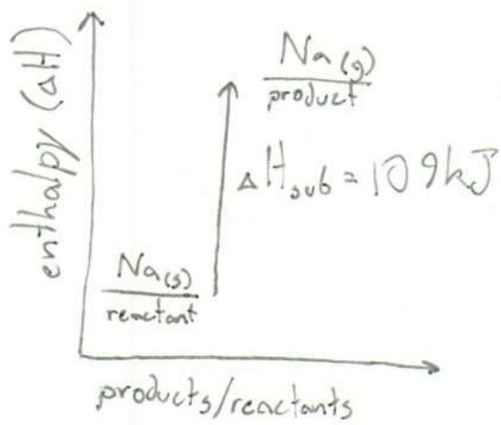
3. Solid sodium metal undergoes sublimation according to the equation below:

$$Na(s) + 109kJ \rightarrow Na(g)$$

   a) State whether the change is endothermic or exothermic. (1 mark C)

endothermic

   b) Draw a labelled enthalpy diagram of the reaction. (2 marks C)



3

   c) Calculate the enthalpy for this change 110g of solid sodium metal undergoes sublimation. (4 marks = 3 marks T, 1 mark C)

mm Na = 22.99 g/mol

molar ΔH: 1 mol Na yeilds 109kJ, so molar enthalpy is 109kJ/mol

$110\,g \times \frac{1\,mol}{22.99\,g} \times \frac{109\,kJ}{1\,mol} = 522\,kJ$ of energy must be added.

$\Delta H = 522\,kJ$

4

10.5

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4. Use Hess' law to find the enthalpy of the following reaction

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O \quad \Delta H = ?$

given the following reactions:

(1)	$H_2 + \frac{1}{2} O_2$	$\rightarrow H_2O$	$\Delta H = -241.8$ kJ
(2)	$C + O_2$	$\rightarrow CO_2$	$\Delta H = -393.5$ kJ
(3)	$C + 2H_2$	$\rightarrow CH_4$	$\Delta H = -74.6$ kJ

Remember to show all work to receive full marks. (4 marks = 3 marks T, 1 mark C)

① $2H_2 + O_2 \rightarrow 2H_2O \quad \Delta H = -483.6kJ$

② $C + O_2 \rightarrow CO_2 \quad \Delta H = -393.5kJ$

③ $CH_4 \rightarrow C + 2H_2 \quad \Delta H = 74.6kJ$

1+2+3 $2H_2 + O_2 + O_2 + C + CH_4 \rightarrow 2H_2O + CO_2 + C + 2H_2 \quad \Delta H = -802.$

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O \quad \Delta H = -802.5kJ$

$\Delta H = -802.5kJ$

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5. A 60.0mL sample of 0.50mol/L hydrochloric acid, HCl(aq), was mixed with 70.0mL of a 1.0mol/L solution of potassium hydroxide, KOH(aq) in a coffee cup calorimeter. If both solutions had an initial temperature of 22.4°C, and after mixing the temperature was recorded as 34.7°C, what was the molar enthalpy of hydrochloric acid for the reaction? (5 marks = 4 marks T, 1 mark C)

kJ/mol

$Q = mc\Delta T$

$Q = 130(4.184)(34.7 - 22.4)$

$Q = 6690.2J$

HCL

$0.060L \times \frac{0.5mol}{L} = 0.03mol_{HCL}$

This is Q surroundings, since

$Q_{sur} = -Q_{sys}$,

$Q_{sys} = -6690.2J$

$\text{molar enthalpy} = \frac{-6690.2J}{0.03mol}$

$= -223006.6\overline{6} \text{ J/mol}$

$= -223 \text{ kJ/mol}$

SD 0.3

4.5

∴ the molar enthalpy of hydrochloric acid in this reaction is -223kJ/mol.