Revision of Chapter One

Chapter one

1. An exothermic reaction causes the surrounding to:

a) Become basic	b) Decrease in temperature
c) Increase in temperature	d) Decrease in pressure

2. How much heat is evolved when 320 g of SO_2 is burned according to the chemical equation shown below ?

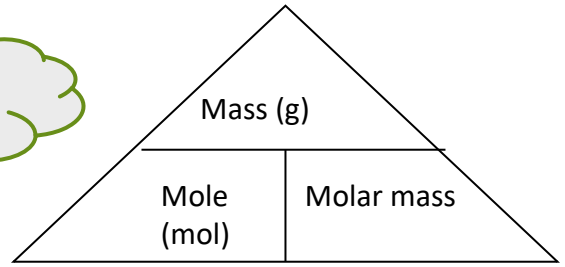
$2SO_2(g) + O_2(g) \longrightarrow 2SO_3(g)$ $\quad \Delta H^{\circ}_{rxn} = -198$ kJ

a) 5.04×10^{-2} kJ	b) 9.9×10^{2} kJ	c) 207 kJ	d) 5.0×10^{2} kJ

First convert SO_2 from g to mole

mole of SO_2 = $\frac{mass}{molar\ mass} = \frac{320}{64} = 5$ mol

Molar mass of SO_2 = 32 + 2x16 =64



Second compare

From equation :

2 mole of SO_2 → -198 kJ

5 mole of SO_2 → ? kJ

5 x -198 = ?kJ x 2

نحرك الفاصله جهت اليسار خانتين وبالتالي يزداد الاس 2

heat = $\frac{5\ x\ -198}{2}$ = -495 kJ

= -4.95 kJ x10^2kJ

≈ 5.00 x 10^2 kJ

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3. The specific heat of aluminum is 0.214 cal/g.°C. Determine the energy, in calories , necessary to raise the temperature of a 55.5 g piece of aluminum from 23.0 to 48.6°C ?

a) 109 cal	b) 273 cal	c) 304 cal	d) 577 cal

$q = m \times s \times \Delta t$

$= 55.5 \times 0.214 \times (48.6 - 23)$

$= 304.04$ cal

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4. A 60.0 g sample of an alloy was heated to 96°C and then dropped into a beaker containing 87 g of water at a temperature of 24.1°C. the temperature of the water rose to a final temperature of 27.63°C. The specific heat of water is 4.184 J/g.°C. what is the specific heat of the alloy?

a) 0.313 J/g.°C	b) 2.16 J/g.°C	c) 0.118 J/g.°C	d) 1.72 J/g.°C

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a) 0.313 J/g.°C	b) 2.16 J/g.°C	c) 0.118 J/g.°C	d) 1.72 J/g.°C

$q_{alloy} = m_{alloy} \times s_{alloy} \times \Delta t_{alloy}$

$q_{alloy} = -\, q_{water}$

$q_{water} = m_{water} \times s_{water} \times \Delta t_{water}$

$= 87 \times 4.184 \times (27.63-24.1)$

$= 1284.95$ J

$q_{alloy} = -\, q_{water}$

$= -\, 1284.95$ J

$q_{alloy} = m_{alloy} \times s_{alloy} \times \Delta t_{alloy}$

$$s_{alloy} = \frac{q_{alloy}}{m_{alloy}\, x\, \Delta t_{alloy}} = \frac{-1284.95}{60\, x\, (27.63 - 96)}$$

$$= 0.313 \text{ J/g.°C}$$

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5. When 1.535g of methanol (CH_3OH) was burned in a constant volume bomb calorimeter, the water temperature rose from 20.27°C to 26.87°C. if the mass of water surrounding the calorimeter was exactly 1000 g and the heat capacity of the bomb calorimeter was 1.75 kJ/°C, calculate the molar heat of combustion of CH_3OH. The specific heat of water is 4.184 J/g.°C?

a) -8.17 x 10^5 kJ/mol	b) - 817 kJ/mol	c) 1.88 kJ/mol	d) 817 kJ/mol

$q_{rxn} = -(q_{water} + q_{bomb})$

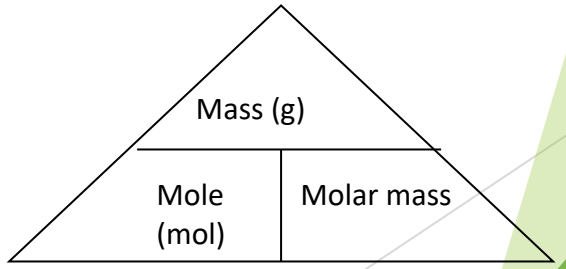
$q_{water} = m \times s \times \Delta t$
$= 4.184 \times 1000 \times (26.87-20.27)$
$= 27614.4$ J
$= 27.61$ kJ

To change from J to kJ dived on 1000

$q_{bomb} = C \times \Delta t$
$= 1.75 \times (26.87-20.27)$
$= 11.55$ kJ

$q_{rxn} = -(q_{water} + q_{bomb})$
$= -(27.61 + 11.55) = -39.16$ kJ

Molar mass of $CH_3OH = 12 + 4x1 + 16 = 32$



mole of $CH_3OH = \frac{mass}{molar\ mass} = \frac{1.535}{32} = 0.048$ mol

0.048 mole of $CH_3OH \rightarrow$ -39.16 kJ
1 mole of $CH_3OH \rightarrow \rightarrow \overset{X}{\rightarrow}$? kJ
1 x -39.16 = ?kJ x 0.048

heat = $\frac{1\ x\ -39.16}{0.048}$ = -816 kJ
≈-817 kJ

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a) -8.17×10^5 kJ/mol	b) - 817 kJ/mol 	c) 1.88 kJ/mol	d) 817 kJ/mol

6. To which one of the following reactions, occurring at 25°C, does the symbol $\Delta H_f^\circ[H_2SO_4]$ refer?

a) $H_2(g) + S(s) + 2O_2(g) \rightarrow H_2SO_4(l)$	
b) $H_2SO_4(l) \rightarrow H_2(g) + S(s) + 2O_2(g)$	X
c) $H_2(g) + S(g) + 2O_2(g) \rightarrow H_2SO_4(l)$	X
d) $H_2SO_4(l) \rightarrow H_2(g) + S(g) + 2O_2(g)$	X
e) $2H(g) + S(g) + 4O(g) \rightarrow H_2SO_4(l)$	X

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7. Given: $SO_2(g) + ½\ O_2(g) \rightarrow SO_3(g)$ $\Delta H°_{rxn} = -99$ kJ, what is the enthalpy change for the following reaction ? $2\ SO_3(g) \rightarrow 2\ SO_2(g) + O_2(g)$

a) 99 kJ	b) -99 kJ	c) 198 kJ	d) -198 kJ

$SO_2(g) + ½\ O_2(g) \rightarrow SO_3(g)$ $\Delta H°_{rxn} = -99$ kJ

$2SO_3(g) \rightarrow 2\ SO_2(g) + O_2(g)$ $\Delta H°_{rxn} = +99 \times 2 = 198$ kJ

Chapter one

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a) 99 kJ	b) -99 kJ	c) 198 kJ	d) -198 kJ

8. Find the standard enthalpy of formation of ethylene, $C_2H_4(g)$, given the following data:

$C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)$ $\Delta H°_f = -1411$ kJ

$C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H°_f = -393.5$ kJ

$H_2(g) + ½\ O_2(g) \rightarrow H_2O(l)$ $\Delta H°_f = -285.8$ kJ

a) 731kJ	b) 2.77 x 10^3 kJ	c) 1.41x10^3 kJ	d) 52 kJ

$2C + 2H_2 \rightarrow C_2H_4(g)$

$2C(s) + 2O_2(g) \rightarrow 2CO_2(g)$ $\Delta H°_f = -393.5 \times 2$

$2H_2(g) + ½O_2(g) \rightarrow 2H_2O(l)$ $\Delta H°_f = -285.8 \times 2$

$2CO_2(g) + 2H_2O(l) \rightarrow C_2H_4(g) + 3O_2(g)$ $\Delta H°_f = +1411$

$2C(s) + 2H_2(g) \rightarrow C_2H_2(g)$

$\Delta H°_f = (-393.5x2)+(-285.8x2)+(1411) = 52.4$ kJ

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a) 731kJ	b) 2.77×10^3 kJ	c) 1.41×10^3 kJ	d) 52 kJ

9. Calculate $\Delta H°_{rxn}$ for the combustion reaction of CH_4 shown below given the following :

$\Delta H°_f\ CH_4(g) = -74.8$ kJ/mol, $\Delta H°_f\ CO_2(g) = -393.5$ kJ/mol, $\Delta H°_f\ H_2O(l) = -285.5$ kJ/mol

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

a) -604.2 kJ	b) 889.7 kJ	c) -997.7 kJ	d) -889.7 kJ

$$\Delta H^0_{rxn} = \Sigma\ n\Delta H^0_f(\text{products}) - \Sigma\ m\Delta H^0_f(\text{reactants})$$

$$\Delta H°_{rxn} = (\Delta H°_f\ CO_2 + 2x\ \Delta H°_f\ H_2O) - (\Delta H°_f\ CH_4)$$

$$= (-393{,}5 + 2x\ -285.5) - (-74.8) = -889.7 \text{ kJ}$$

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a) 99 kJ	b) -99 kJ	c) 198 kJ	d) -198 kJ

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10. A 1.3 g sample of benzoic acid ($C_7H_6O_2$) was burned in a bomb calorimeter. The heat capacity of the entire apparatus, including the bomb, pail, thermometer, and water, was found to be 11145 J/K. As a result of the reaction, the temperature of the calorimeter and water increased by 4.627K. What is the molar heat of combustion of benzoic acid?

a) 4.84 x 10^6 kJ/mol	b) -2.96 kJ/mol	c) -4844 kJ	d) 549.1 kJ

$q_{rxn} = -(q_{water} + q_{bomb})$

$q_{rxn} = -q_{calorimeter}$

$q_{calorimeter} = C \times \Delta t$

$= 11145 \times 4.627$

$= 51567.9$ J

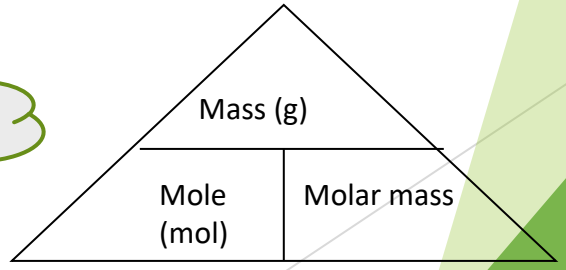
$= 51.6$ kJ

To change from J to kJ dived on 1000

$q_{rxn} = -51.6$ kJ

mole of $C_7H_6O_2 = \frac{mass}{molar\ mass} = \frac{1.3}{122} = 0.0107$ mol

Molar mass of $C_7H_6O_2$ = 7x12 + 6x1 +2x16 =122



0.0107 mole of $C_7H_6O_2 \rightarrow$ -51.6 kJ

1 mole of $C_7H_6O_2 \rightarrow \rightarrow \rightarrow$? kJ

1 x -51.6 = ?kJ x 0.0107

heat = $\frac{1\ x\ -51.7}{0.0107}$ = -4822 kJ

≈-4844 kJ

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