Task 1 Thermochemistry
Part B: Calorimetry & Measuring heat; solving problem.

1) What is calorimetry? Select an example of calorimeters and explain the calorimetry techniques.

Calorimetry is the process of measuring the amount of heat released or absorbed during a chemical reaction. Coffee cup calorimeter is an example of constant-pressure calorimetry, since the pressure remains constant during the process.

2) What is meant by specific heat capacity

The heat required to raise the temperature of the unit mass of a given substance by a given amount.

3) If we know the mass of a substance and its specific heat, we can determine the amount of heat, entering or leaving the substance by measuring the temperature change before and after the heat is gained or lost. Based on above statement, write the equation to calculate heat change.

Equation to calculate heat change:
$\Delta H = mc\theta$

m = Mass
ΔH = Heat change
θ = Temperature change
c = Specific heat capacity

4) Flask containing 800g of water is heated, and the temperature of the water increases from 21 °C to 85 °C. How much heat did the water absorb? (The specific heat of water is 4.184 J/g °C)

$\Delta H = mc\theta$
$= (800)(4.184)(64)$
$= 214220.8$ J

5) A piece of unknown metal weighs 348 g. When the metal piece absorbs 6.64 kJ of heat, its temperature increases from 22.4 °C to 43.6 °C. Determine the specific heat of this metal (which might provide a clue to its identity).

$c = \Delta H/m\theta$
$= 6640/(348)(21.2)$
$=0.900$ J/g °C

Part C: Type of heat reaction

1) What is meant by heat of Precipitation. Construct energy level diagram for a reaction that involves precipitation.

The heat of precipitation is the heat change when 1.0 mol of a precipitate is formed from its ions.

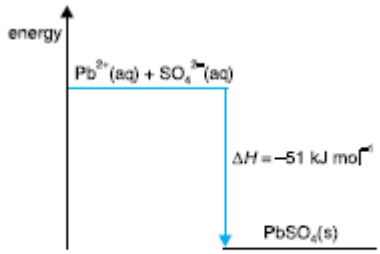


Figure 4.16 The energy level diagram for the precipitation of lead(II) sulphate

2) What is meant by heat of displacement. Construct energy level diagram for a reaction that involves heat of displacement.

The heat of displacement is the heat released when 1.0 mol of a metal is displaced from its salt solution by a more electropositive metal

Figure 4.19 The energy level diagram for the displacement reaction of iron by magnesium

3) What is meant by heat of neutralisation. Construct energy level diagram for a reaction that involves heat of neutralization.

The heat of neutralisation is the heat released when 1.0 mol of H+ ions react with 1.0 mol of OH– ions to produce 1.0 mol of water molecules

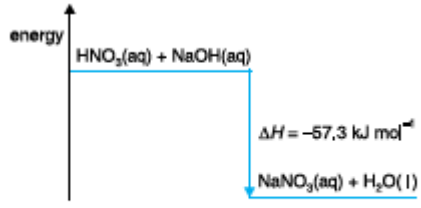


Figure 4.24 Energy level diagram for the reaction between $HNO_3(aq)$ and $NaOH(aq)$

4) What is meant by heat of Combustion. Construct energy level diagram for a reaction that involves heat of combustion.

The heat of combustion is the heat released when 1 mol of a substance is burnt completely in excess oxygen.

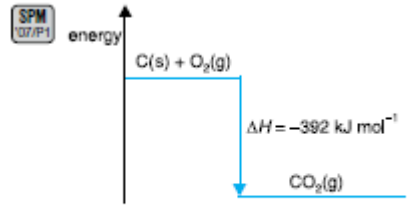


Figure 4.30 Energy level diagram for the combustion of carbon

5) What is fuel value regarding heat of combustion. Explain fuel value and how it impacts the environment. What factors contributes to the selection of fuel?

Fuel value is the heat energy released when 1.0 g of fuel is burnt in excess oxygen. Fuel value is also known as heat value.

Most fuels produce a lot of soot when burnt and this causes air pollution. Fuels such as hydrogen are known as clean fuels. They are good fuels because they do not produce soot or poisonous gases that pollute the air. Liquid fuels and gaseous fuels do not leave ashes after combustion. They are therefore better fuels than solid fuels.

When selecting a suitable fuel for a specific purpose, three main factors must be considered. The first one is the fuel value, the effects on the surroundings of the fuel and the cost per gram of the fuel.

Part D: Numerical Problems

1)a) $AgNO_3(aq) + NaBr(aq) \rightarrow AgBr(s) + NaNO_3(aq)$

b)

Number of moles of $AgNO_3$	No. of moles of NaBr
$MV/1000 = mol$	$MV/1000 = mol$
$\frac{(0.5)(50)}{1000} = 0.025 mol$	$\frac{(2)(100)}{1000} = 0.2 mol$

0.025 mol of silver nitrate react with excess sodium bromide to produce 0.025 mol of silver Bromide.

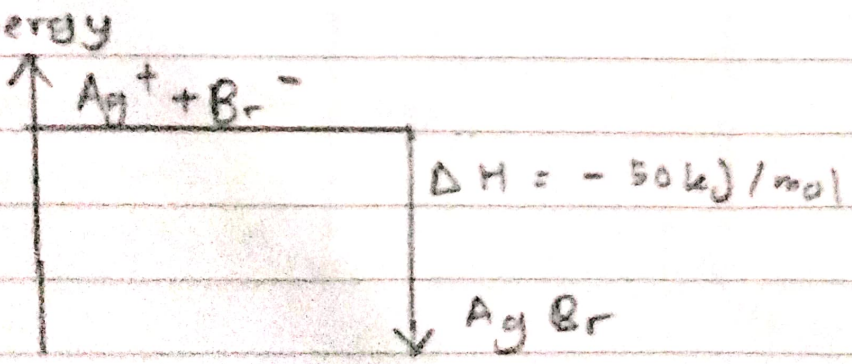
c) $50 kJ/mol \times 0.025 mol = 1.25 kJ$

$Q = mc\theta$

$1250 = (100 + 50)(4.2)\theta$

$\theta = 2^\circ C$

d)



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2) $BaCl_2(aq) + Na_2SO_4(aq) \rightarrow BaSO_4(s) + 2NaCl(aq)$

$Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$

$Q = mc\theta$

$Q = (25+25)(4.2)(34-29)$

$= (50)(4.2)(5)$

$= 1050\ J$

No. of moles of $BaCl_2$

$MV/1000 = mol$

$(1)(25)/1000 = 0.025$

No. of moles of Na_2SO_4

$MV/1000 = mol$

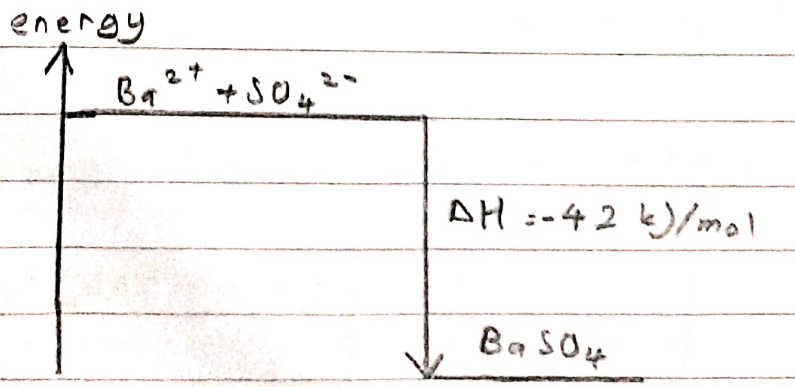
$(1)(25)/1000 = 0.025$

0.025 mol of $BaCl_2$ reacts with 0.025 mol of Na_2SO_4 to produce 1050 J of energy

$\frac{1050}{0.025} = 4200\ J$

$= 42\ kJ$

Thus, 1 mol of $BaCl_2$ reacts with 1 mol of Na_2SO_4 to produce 42 kJ of energy



3 a) $CuCl_2 + Zn \rightarrow ZnCl_2 + Cu$

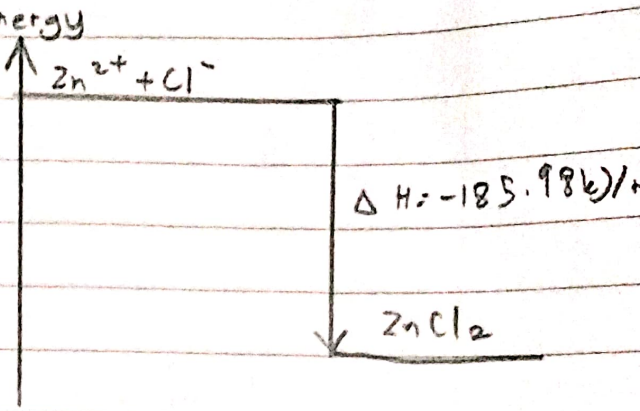
$Zn^{2+} + Cl^- \rightarrow ZnCl_2$

$Q = mc\theta$

$= (50+4)(4.2)41)$

$= 9298.8\ J$

b)



No. of moles : $MV/1000 = mol$

of $CuCl_2$ $\frac{(1)(50)}{1000} = 0.05\ mol$

0.05 mol of $CuCl_2$ reacts with excess zinc powder to produce 9.988 J

$\frac{9298.8}{0.05} = 185976$

$= 185.98\ kJ$

Therefore, 1 mol of $CuCl_2$ react with excess zinc powder to produce 185.98 kJ

4) $C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$ $\Delta H = ?$

No. of moles of ethanol

$mol = \frac{mass}{RAM}$

$mol = \frac{2.3}{(12+12+5+16+1)}$

$= 0.05\ mol$

$Q = mc\theta$

$= (800)(4.2)(20)$

$= 67200\ J$

$= 67.2\ kJ$

0.05 mol of ethanol burn to release 67.2 kJ

$\frac{67.2}{0.05} = 1344\ kJ$

Thus, 1 mol of ethanol burn to release 1344 kJ

$\Delta H = -1344\ kJ/mol$

5) No. of moles of glucose

$$\text{mol} = \frac{\text{mass}}{\text{RAM}}$$

$$= \frac{36}{(12\times6)+(1\times12)+(16\times6)}$$

$$= 0.2 \text{ mol}$$

$$\frac{2400\text{ kJ}}{1\text{ mol}} \times \frac{0.2\text{ mol}}{1} = 480\text{ kJ}$$

$$= 480\,000\text{ J}$$

$$Q = mc\theta$$

$$\theta = \frac{Q}{mc}$$

$$= \frac{480000}{(2000)(4.2)}$$

$$\theta = 57.143^{\circ}\text{C}$$