Year 12 Chemistry   **UCR Assignment 1**   NAME_____

1.   Identify the following as reactions that release energy or reactions that absorb energy:
     (a) combustion   /1
     (b) respiration   /1
     (c) photosynthesis   /1

2.   Glucose is produced by photosynthesis according to the following equation:
     $$6CO_{2(g)} + 6H_2O_{(l)} \rightarrow C_6H_{12}O_{6(aq)} + 6O_{2(g)} \qquad \Delta H = +2820 \text{ kJ mol}^{-1}$$
     Write the thermochemical equation for the aerobic respiration of glucose.   /3

3.   (a)   State whether the following reactions are endothermic or exothermic:
           (i) $N_{2(g)} + O_{2(g)} \rightarrow 2NO_{(g)}$ $\Delta H = +180 \text{ kJ mol}^{-1}$ /1
           (ii) $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ $\Delta H = -394 \text{ kJ mol}^{-1}$ /1
           (iii) $C_2H_{6(g)} + 3.5O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_2O_{(g)}$ $\Delta H = -360 \text{ kJ mol}^{-1}$ /1
           (iv) $6CO_{2(g)} + 6H_2O_{(l)} \rightarrow C_6H_{12}O_{6(aq)} + 6O_{2(g)}$ $\Delta H = +2820 \text{ kJ mol}^{-1}$ /1

     (b)   State which of the reactions in part (a) would cause, per mole of substance reacting:
           (i)   the most amount of heat energy absorbed?   /1
           (ii)   the least amount of heat energy released, ignoring reactions that absorb energy?   /1

4.   When 50.0 mL of 2.00 mol L^{-1} hydrochloric acid is mixed with 50.0 mL of 2.00 mol L^{-1} sodium hydroxide in a
     calorimeter, the temperature goes up 22.2°C. (Specific heat of water = 4.18 J g^{-1} K^{-1})
     (a)   Calculate the energy change for the reaction.   /2
     (b)   Calculate the enthalpy of neutralization for the reaction (kJ mol^{-1}).   /3
     (c)   Explain why it is preferable to use a polystyrene foam cup as a calorimeter instead of a glass beaker.   /2
     (d)   State why the solution should be stirred during the reaction.   /1

5.   (a)   State the meaning of the following two thermochemical equations:
           $$KOH_{(s)} + H_2O_{(l)} \rightarrow K^+_{(aq)} + OH^-_{(aq)} \qquad \Delta H = -55 \text{ kJ mol}^{-1}$$
           $$KOH_{(aq)} + HCl_{(aq)} \rightarrow KCl_{(aq)} + H_2O_{(l)} \qquad \Delta H = -57.1 \text{ kJ mol}^{-1}$$ /2
     (b)   Calculate the heat released when 100 g of potassium hydroxide is dissolved in excess water.   /2
     (c)   Calculate the heat released when 200 mL of 0.500 mol L^{-1} hydrochloric acid is mixed with 300 mL of 0.400
           mol L^{-1} potassium hydroxide.   /3
     (d)   Calculate which releases more heat – dissolving 50 g of potassium hydroxide in excess water, or combining
           500 mL of 2 mol L^{-1} potassium hydroxide with excess acid.   /3

6.   Ammonium nitrate (NH_4NO_3) is a substance commonly used in cold packs athletes use to treat injuries.
     (a)   The accepted value for the enthalpy of solution of ammonium nitrate is +26.2 kJ mol^{-1}.
           Write the thermochemical equation for the dissolving of ammonium nitrate in water.   /3
     (b)   An experiment to determine the enthalpy of solution was carried out in a school laboratory, and the following
           data was obtained:
           Mass of ammonium nitrate = 3.00 g
           Mass of water = 100 g
           Initial temperature = 21.4°C
           Final temperature = 19.3°C
           (Specific heat of water = 4.18 J g^{-1} K^{-1})
           (i)   Calculate the number of moles of ammonium nitrate added.   /2
           (ii)   Calculate the amount of heat, in kJ, lost by the 100 g of water in the experiment.   /2
           (iii) Calculate, from the experiment, the enthalpy of solution of ammonium nitrate.   /2
     (c) Suggest and explain one possible reason for the difference between the accepted value and the calculated value
     for the enthalpy of solution of ammonium nitrate.   /2

                                                                    TOTAL   /41