Selected Response

1 D	2 C	3 D	4 A	5 A	6 B	7 D	8 C	9 D	10 C	
11 C	12 D	13 C	14 C	15 D	16 C	17 C	18 B	19 C	20 A	
21 C	22 D	23 D	24 C	25 A	26 B	27 B	28 A	29 C	30 C	
31 C	32 B	33 C	34 D	35 B	36 C	37 B	38 D	39 D	40 B	

$$\Delta T = \frac{q}{mc} = \frac{+100.0\,J}{(5.00\,g)(0.420\,J/g^{\circ}C)}$$

$$\Delta T = 47.6^{\circ}C$$

$$22.4^{\circ}C = T_i$$
$$+\ 47.6^{\circ}C = \Delta T$$

(D)

6) $q = n\Delta H$ $\quad n = \frac{q}{\Delta H} = \frac{15000\,J}{10800\,J/mol}$

$= 1.4\,mol$

$m = n \times M$

$= 1.4\,mol \times \frac{26.98\,g}{mol}$

$= 37\,g$

$n_{C_3H_8} = \frac{q}{\Delta H} = \frac{-1800\,kJ}{-2200\,kJ} = 0.818\,mol\,C_3H_8$

$0.818\,mol\,C_3H_8 \times \frac{3}{1} = 2.5\,mol\,CO_2$

$\frac{1}{3}\,C_3H_8 + \frac{5}{3}\,O_2 \rightarrow 1\,CO_2 + \frac{4}{5}\,H_2O + 733\,kJ$

$C = mc$ $\quad \frac{1.8\,kJ}{^{\circ}C} = m\left(\frac{0.455\,J}{g\,^{\circ}C}\right)$

1. A 150.0ml solution of 0.200M NaOH is mixed with a 150.0ml solution of 0.200M HCl in a simple calorimeter. After the solutions are mixed, the temperature of the solutions increases by 5.5°C. Calculate the molar enthalpy of reaction of NaOH. (5 marks)

System	Surroundings
$\Delta H = ?$	$m = 300.0g$ $(1_S = 1ml)$
$n = ?$	$\Delta T = +5.5°C$
$q = ?$	$C = 4.1845 J/g°C$
$n_{NaOH} = (0.200M)(0.150L)$	$q_{surr} = mC\Delta T$
$= 0.0300 mol$	$= 6900J$
	q_{sur}

$q_{sys} = -q_{surr}$

$q_{sys} = -6900J$

$$\Delta H = \frac{-6900J}{0.0300mol} = \left(-230 kJ/mol\right)$$

2. a. The combustion of Pentane is shown below. Use the data provided to determine the enthalpy of formation of Pentane, C_5H_{12}. (4 marks)

$C_5H_{12(\ell)} + 8O_{2(g)} \rightarrow 5CO_{2(g)} + 6H_2O_{(g)} + 3536\ KJ$

$\Delta H_{Rxn} = -3536 KJ$

Compound	Enthalpy of Formation (KJ/mol)
CO_2	-393.5
H_2O	-241.8

$\Delta H_f\ C_5H_{12} = ?$

$\Delta H_{Rxn} = \sum \Delta H_f^\circ Prod - \sum \Delta H_f^\circ React$

$-3536KS = [5(-393.5KJ/mol) + 6(-241.8KJ/mol)] - [8(0KJ/mol) + \Delta H_f C_5H_{12}]$

b. Draw an enthalpy diagram for the above reaction (1 mark)

$-3536KJ = [-3418.3KJ] - [\Delta H_f C_5H_{12}]$

$-117.7KJ = -\Delta H_f C_5H_{12}$

$\Delta H_f C_5H_{12} = +117.7\ KJ$

3. Using appropriate theories, explain the following observations.

a. Fast acting Tylenol is a powder in a capsule, while slow release tylenol is a large tablet. (2 marks)

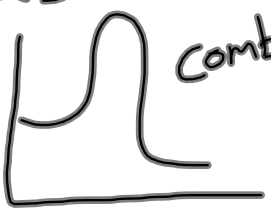
- Surface Area → Increasing S.A of a solid reactant Increases # collisions ∴ Rxn Rate

b. Sugar combusts at a temperature of over 400°C, but can undergo respiration at 37°C. (2 marks)

Note: Combustion and respiration are the same overall reaction

$C_{12}H_{22}O_{11(s)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$

→ Body uses enzymes (catalysts) to lower E_A for



c. Baking Soda reacts faster in 0.100M HCl than in 0.100M CH3COOH. (2 marks)

→ Acid Strength (Nature of Reactants)

4. A 3.00 mol sample of N_2 and a 4.00 mol sample of O_2 are placed into a 2.00L evacuated flask and is allowed to reach equilibrium. When equilibrium is established, 25.0% of the N_2 has reacted. Determine the value of the equilibrium constant. (4 marks)

$$N_{2(g)} + 2O_{2(g)} \rightleftharpoons N_2O_{4(g)}$$

	$N_{2(g)}$	+	$2O_{2(g)}$	$\rightleftharpoons$	$N_2O_{4(g)}$
I	1.50M		2.00M		0 M
C	$-x$		$-2x$		$+x$
E	$1.50M - x$ $= 1.125M$		$2.00M - 2x$ $= 1.25M$		x $= 0.375M$

$x = (0.25)(1.50M)$

$= 0.375M$

$$K = \frac{[N_2O_4]}{[N_2][O_2]^2} = \frac{(0.375)}{(1.125)(1.50)^2} = \boxed{0.213}$$

5. Calculate the pH, pOH, [OH] and [H3O+] of a 200.0ml 0.300M $Mg(OH)_2$ solution that is diluted to a final volume of 800.0 ml. (5 marks)

$$Mg(OH)_{2(s)} \longrightarrow Mg^{2+}_{(aq)} + 2\,OH^-_{(aq)}$$

$$C_iV_i = C_fV_f$$

$$C_f = \frac{(0.2000L)(0.300M)}{0.8000L} = 0.0750M = [Mg(OH)_2]$$

$$C_{OH^-} = 0.0750M \times \frac{2}{1} = [0.150M]$$

$[OH^-] = 0.150M$

$pOH = -\log(OH^-)$

$pOH = -\log(0.150M)$

$= 0.824$

$pH = 14 - pOH$

$pH = 14 - 0.824$

$= 13.176$

$[H_3O^+] = 10^{-13.176}$

$= 6.66 \times 10^{-14}$

6. Calculate the pH of a 0.250M solution of Ammonium Chloride, NH_4Cl. (5 marks)

NH_4^+

Cl^-

Acids	Bases
H_2O	H_2O
NH_4^+	Cl^-

Strongest

$$NH_4^+{}_{(aq)} + H_2O_{(l)} \rightleftharpoons NH_{3(aq)} + H_3O^+_{(aq)}$$

I	0.250M	0	~0
C	$-x$	$+x$	$+x$
E	$0.250M - x$	x	x

(From Table)

$K_A = 5.8 \times 10^{-10}$

$$K_A = \frac{[H_3O^+][NH_3]}{[NH_4^+]}$$

$$5.8 \times 10^{-10} = \frac{x^2}{(0.250M)}$$

Rule of 500

$\frac{[NH_4^+]}{K_A}$

$\frac{0.250M}{5.8 \times 10^{-10}} = Big! > 500$

(Drop x)

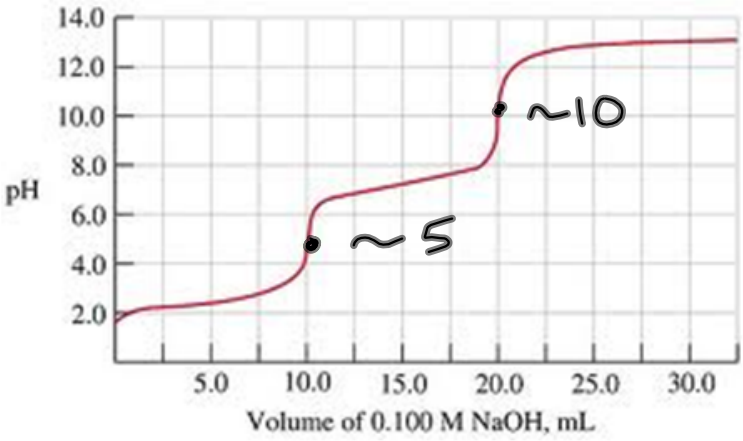
$$\sqrt{(5.8 \times 10^{-10})(0.250)} = x$$

$x = 1.2 \times 10^{-5}$

$pH = -\log(1.2 \times 10^{-5})$

$= 4.92$

7. The titration curve shown below is between an unknown acid and Sodium Hydroxide.



2 steps....
Diprotic

Suggest a possible acid that could produce this type of titration curve. (1 mark)

H_2SO_3, H_2SO_4, $H_2PO_4^-$, H_2S

Suggest an indicator that would be suitable for each equivalence point. Explain your choices (3 marks)

1st Indicator needs range ~5 ∴ Methyl Red

2nd " " " ~10 Thymolphthalein

8. For the following unbalanced reaction:

Cu^{2+} SO_4^{2-}

$CuS_{(aq)} + HNO_{3(aq)} \rightarrow CuSO_{4(aq)} + NO_{(g)} + H_2O_{(aq)}$

a. Determine the oxidation numbers for each element in the reaction (4 marks)

Reactants		Products	
Copper =	+2	Copper =	+2
Sulfur =	−2	Sulfur =	+6
Hydrogen =	+1	Hydrogen =	+1
Nitrogen =	+5	Nitrogen =	+2
Oxygen =	−2	Oxygen =	-2

gets reduced → HNO_3

gets oxidized → CuS

b. Identify the oxidizing agent and the reducing agent. (2 marks)