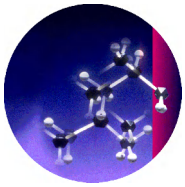

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SUGGESTED SOLUTIONS TO 2008 CHEMISTRY TRIAL EXAM 2

Section A

1 D		**11 D**	If a reaction procedes the oxidant must be higher on the table than the reductant. 1st reaction 4 > 1 2nd reaction 3 > 4 3rd reaction 1 > 2
2 B		**12 B**	EMF = E^0(oxidant) - E^0(reductant) 0.22 = 0.80 – A A = +0.58 volts
3 D	ΔH = H (products – reactants) = 250 – 200 = 50 Exothermic Ea uncatalysed = 350 – 200 = 150	**13 C**	Silver is a stronger reducatant than Cl^-
4 B	Volume increase = pressure decrease favours side with greater number of particles. Backwards. [NO_2] decreases as volume has increased.	**14 B**	Chloride ions migrate to anode side and silver ions migrate to the cathode side. The presence of these ions in both half cells would cause precipate of silver chloride to form.
5 B	High yield favoured by Temp. decrease as reaction is exothermic and pressure increase as smaller number of particles occurs on the products side.	**15 C**	n(propanol) = 0.6 / 60 = 0.01molheat releasded for 0.01 mol = 2021 x 0.01 = 20.21kJ. E = m x C x ΔT 20210J =200 x 4.18 x ΔT ΔT = 24.17 Final Temp. = 24.17 + 21 = 45.2
6 A		**16 C**	. Q = I t = 10.72 x 15 x 60 = 9648 n(e) = Q/F = 9648 / 96500 = 0.10mol Cu^{2+} + 2e → Cu n(Cu) used = 0.1/2 = 0.05mol n(Cu) left = n(Cu) initially - n(Cu) used = (1.0 x 0.2) - 0.05 = 0.15mol [Cu^{2+}] = 0.15/0.2 = 0.75M
7 A	[HCN]^2 / [H_2] x [C_2N_2] = (1.6/2)^2/(0.86/2) x (2.8/2) = 2.47 Trial Keq > Keq Trial Keq needs to be less, reaction needs to move backwards.	**17 C**	
8 D	[H^+] = 10^{-14}/2.5 pH = -log (10^{-14}/2.5) = 14.4	**18 D**	
9 D	Hin^- (yellow) will gain H^+ to become H_2In (red)	**19 B**	Object to be plated is placed at cathode in electrolysis cell where reduction of metal ion occurs, Cu^{2+} + 2e → Cu.
10 C	Na_2O_2 → O_2 Ox. No. 2 x (+1) + (-2) =0 0 Each O = -1 Oxygen changes from -1 → 0 increases by 1	**20 C**	Zinc will oxide at at anode as it is the strongest oxidant in contact with anode. Copper will still form as Cu^{2+} is still the strongest oxidant present. Cu^{2+} > Zn^{2+} .

Section B ❶ = 1 mark

Question 1
(a) (i) ΔH is the enthalpy difference between reactants and products.
Specifically H(products) –H(reactants) ❶

(ii) exothermic ❶

(b) n($CaCl_2$) = 50.0 / 111.1 = 0.45mol ❶ Energy = 0.45 x 75.6 = **34.0 kJ** ❶

Question 2
(a) Requires some explanation about the corrosion process occurring on the iron nails due to the differing concentrations of available oxygen with reduction occurring at higher concentrations of oxygen and oxidation occurring at lower concentrations of oxygen. ❶This is the reason for the 'pitting' of the nails inside the wood.

$Fe\ (s) \rightarrow Fe^{2+}\ (aq) + 2e$ ❶

$O_2\ (g) + 2H_2O\ (l) + 4e \rightarrow 4OH^-\ (aq)$ ❶

(b) This question is about the corrosion of the steel signs that were attached to the copper nails.
You need to talk about the electrochemical process that occurs when two metals are in contact.❶
Correctly saying that reduction occurred on the copper nails giving the reduction half equation as $Cu^{2+} + 2e \rightarrow Cu$ ❶

Steel being made of iron will oxidise in preference to copper.
Anode reaction: $Fe\ (s) \rightarrow Fe^{2+}\ (aq) + 2e$❶

(c) You need to mention that the galvanised coating on the wires was in some way damaged or removed by the fire and consequently the exposed iron strands were able to undergo the usual corrosion process after the fire.

Question 3
a) $Al^{3+}\ (l) + 3e \rightarrow Al(l)$ ❶

b) $m = \frac{150000 \times 24 \times 60 \times 60 \times 1 \times 27}{96500 \times 3} = 1208kg$ ❶❶❶

c) i) Anode $2\ Cl^-\ (l) \rightarrow Cl_2\ (g) + 2e$ ❶

ii) Cathode $Ca^{2+}\ (l) + 2e \rightarrow Ca(l)$ ❶ be careful with states **molten** $CaCl_2$
d) give credit for choosing either chlorine gas or oxygen gas as a predicted product as both are possible at anode especially as the concentration of the solution was not mentioned in the question.
i) Anode $2H_2O\ (l) \rightarrow O_2(g) + 4H^+\ (aq) + 4e$ ❶

ii) Cathode $2H_2O$ (l) + 2e → H_2 (g) + 2 OH^- (aq) ❶

Question 4

a) Beaker C as it has the largest surface area of particles at the higher temperature.

b) A larger surface area will have a larger area of contact❶ and result in more fruitful collisions between particles. The higher temperature will result in the particles moving more quickly ❶and will have more energy to be able to overcome the activation energy barrier.❶

Question 5

a) For ammonia N_2 (g) + $3H_2$(g) ↔ $2NH_3$ (g) ΔH –ve ❶❶

Ethene C_7H_{16}(g) ↔ C_2H_4 (g) + C_5H_{12} (g) ΔH +ve

Sulfuric acid $2SO_2$ (g) + O_2 (g) ↔ $2SO_3$(g) ΔH -ve

Nitric acid $4NH_{3(g)} + 5O_{2(g)} \leftrightarrow 4NO_{(g)} + 6H_2O_{(g)}$ ΔH –ve

A discussion of how pressure, temperature and concentration will lead to a maximum yield. For example with ammonia
A high yield will result from a high pressure and low temperature. However, a low temperature will result in a slow rate so a moderate temperature is used with a catalyst to speed up the rate.
A maximum of ❶❶❶❶marks for making correct statements.

Question 6

a) System at equilibrium ❶

b) Exothermic. ❶ As the temperature was increased the reaction moved backwards.❶

c) $[COCl_2] / [CO] \times [Cl_2]$ ❶

d)

Reaction moves ←

	CO	Cl_2	$COCl_2$
n(initially)	0	0	0.1
n (reacts)	0.0106mol	0.0106mol	0.1 – 0.0894 = 0.0106mol ❶
n(At equilibrium)	0.0106mol	0.0106mol	n = CV = 0.0447 x 2 =0.0894mol ❶
Concentration at equilibrium	0.0106mol / 2.0 = 0.0053	0.0106mol / 2.0 = 0.0053 ❶	0.0447

$$K = \frac{0.0447}{(0.0053)^2} = \mathbf{1591\ M^{-1}}$$ ❶

Question 7

a) $[OH^-] = 2 \times 0.0155 = 0.031$ ❶
$[H^+] = 10^{-14} / 0.031$

pH = $-\log (10^{-14} / 0.031)$ = **12.5** ❶

b) $K_a = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]}$ ❶

$1.80 \times 10^{-5} = \frac{[H^+]^2}{0.150}$ ❶

$[H^+] = 0.00164$ M ❶

pH = -log0.00164 = **2.79** ❶

Question 8

a) Anode $H_2(g) + 2OH^-(aq) \rightarrow 2H_2O(l) + 2e$ ❶

Cathode $O_2(g) + 2H_2O(l) + 4e \rightarrow 4OH^-(aq)$ ❶

b) i) Conduct electricity / catalyst/ allow gases to mix / site of oxidation and reduction ❶❶

ii) Any two of:

- Fuel cells are highly efficient in converting chemical energy directly to electrical energy (about 60%). Petrol engines are much less about 25 – 30%
- The product of cell is water. Preferable to polluatnts from petrl engines.
- The reactants, hydrogen and oxygen, can be produced from water and so are renewable sources, unlike petrol ❶❶

c) $n(e) = \frac{7.82 \times 2.00 \times 60 \times 60}{96500} = 0.583$ mol ❶❶

$n(H_2) = ½\ n(e) = 0.292$ mol ❶

$v(H_2) = \frac{0.292 \times 8.31 \times 473}{3000}$ ❶
= 0.382 L or 382 ml ❶

