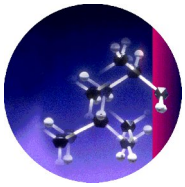

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SUGGESTED SOLUTIONS TO 2009 CHEMISTRY TRIAL EXAM 2

Section A

1 B		**11 C**	If a reaction procedes the oxidant must be higher on the table than the reductant. 1st reaction X > Y 2nd reaction Y^+ > Z 3rd reaction X > Z X > Y^+ > Z^+
2 C		**12 A**	Electrochemical Cell, so object 1 is voltmeter. Electrons flow from X to Z thus X must be losing electrons and thus be the anode.
3 B		**13 D**	Rb^{2+} is a weaker oxidant than water, water will be reduced at the cathode to produce OH^- ions. The pH around the cathode will increase. Water is the only reductant present at anode and will be oxidised to H^+ ions. The pH will decrease around the anode.
4 D		**14 B**	Pd^{2+} + 2e → Pd Ag^+ + e → Ag If same number of mole flowing, then there will be half as many mole Pd prodcued as Ag. With their molar masses similar, there will be roughly double the mass of Ag produced.
5 B	Removing product will cause equilibrium to shift to the right to try and increase the amount of product.	**15 A**	Ni is a stronger reductant thanCl^- ions, so Ni will undergo oxidation to Ni^{2+} ions and Cl_2 will be reduced.
6 C	Adding HCl will cause reaction to move backwards using up some NH_3. However, as HCl was added the equilibrium concentration will still be higher even though the reaction has moved bcackwards.	**16 C**	As reaction is endothermic, as temperature increase will cause K to increase.
7 A		**17 B**	Molten KBr, only K^+ and Br^- ions present so K^+ is reduced to K at the cathode and Br_2 at the anode.
8 C	$[H^+] = 10^{-14}/2.5$ pH = -log ($10^{-14}/2.5$) = 14.4	**18 B**	ΔH = H (products – reactants) = 300 – 250 = 50 Endothermic Ea forward = 450 – 250 = 200 Ea reverse = 450 – 300 = 150
9 C	As reaction is endothermic, T increase will cause K increase and reaction moves to the right. $[H^+]$ increase and pH decreases. Solution remains neutral due to $[H^+] = [OH^-]$	**19 D**	At anode water is the only reductant in contact with the electrode, so water will undergo oxidation to oxygen.
10 B	n(HCl) = 0.08 x 0.02 = 0.0016 mol n(NaOH) = 0.05 x 0.03 = 0.0015 mol n(HCl) xs = 0.0016 – 0.0015 = 0.0001 mol [HCl] = 0.0001 / [(20 + 30)/1000] = 0.002M pH = -log (0.002) = 2.7	**20 C**	Copper will not react at the cathode (-ve) electrode as copper is a reductant. Water will be reduced to hydrogen. The mass of copper is unaffected. Cations will move towards the negative electrode – to the right.

Section B ❶ = 1 mark

Question 1
(a) (i) ΔH / molar mass = Enrgy per gram
Petrol 5460/114 = 47.9 Kerosene 10 000/210 = 47.6 Hydrogen 285/2 = 142.5
Ethanol 1370/46 = 29.8
Hydrogen has greatest energy per gram❶

(b)mass = d x V = 80 000 x 0.69 = 55 200g ❶
Mole = 55200g / 114 = 484.21mol ❶
Energy = 484.21 x 5460 = **2.64×10^6 kJ** ❶

(c) 1mol H_2 = 285kJ
x mol = 2.64×10^6 kJ
x = 2.64×10^6 / 285 = 9276.5mol❶

pV = nRT

$V(H_2) = \frac{9276.5 \times 8.31 \times 298}{100}$
= 229720 = **2.30×10^5 L** ❶

Question 2
(a) Carbon dioxide produced. ❶

(b) A larger surface area of crushed particles will have a larger area of contact and result in more fruitful collisions between particles.❶
A higher concentration will mean there are more acid particles present in the solution and more chance of successful collisions between particles. ❶
Both of these situations will lead to an increase in the rate of the reaction. ❶

(c) The temperature of the room will have been higher. ❶ 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 3
a) $Sn(s) \rightarrow Sn^{4+}(l) + 4e$

b) Q = 0.2 x 5 x 60 x 60 = 3600C ❶
n(e) = Q/F = 3600/96500 = 0.0373 mol ❶
n(Sn) = 0.0373 / 4 ❶
m(Sn) = n x 118.7 = **1.12g** ❶

Question 4

Predominant Reaction $CH_3COOH\ (aq) + H_2O(l) \rightarrow CH_3COO^-\ (aq) + H_3O^+\ (aq)$ ❶

$$Ka = \frac{[CH_3COO^-]\,[H^+]}{[CH_3COOH]}$$ ❶

$$1.80 \times 10^{-5} = \frac{[H_3O^+]^2}{1.5}$$ ❶

$[H^+] = 0.00519\ M$ ❶

pH = -log 0.00519 = **2.3** ❶

Question 5

a) $2Cl^-\ (aq) \rightarrow Cl_2\ (g) + 2e$ ❶

b) Positive ❶

c) In aqueous solution water is a stronger oxidant than Na^+ ❶and water will be preferentially reduced. ❶

d) Molten NaCl. ❶

Question 6

a) **Advantage:** Increase rate of reaction. ❶ As temperature decreases K increases however, rate of reaction will be slow so a catalyst is used to speed up rate and not compromise yield. ❶

b) As pressure increases favours side with smaller mole of particles ❶, in this reaction it is to the right. ❶ Thus $[NO_2]$ will increase. ❶

c) i) $K = \frac{[N_2O_4]}{[NO_2]^2}$ ❶

ii) & iii)

	NO_2	N_2O_4
n(initially)	0.132	0
n (reacts)	2 x 0.0400 = 0.08 ❶	0.0400
n(At equilibrium)	X = 0.132-0.08=0.052 mol❶	0.0400 mol
Concentration at equilibrium	0.052 M	0.04M

iii) $K = \frac{0.04}{(0.052)^2}$ ❶ = **$14.8\ M^{-1}$** ❶

iv) As K decreased when temperature increased the reaction is exothermic. ❶❶ As energy is a product, increasing temperature will cause reaction to move backwards.

v) **Change:** Temperature decreased❶ Reaction is endothermic as temperature decreases K decreases❶, reaction moves backwards more N_2O_4 is produced. ❶

Question 7

a) **Anode** $Pb\ (s) + SO_4^{2-}\ (aq) \rightarrow PbSO_4\ (s) + 2e$ ❶ **or** $Pb\ (s) \rightarrow Pb^{2+}\ (aq) + 2e$

Cathode $PbO_2\ (s) + 4H^+\ (aq) + SO_4^{2-}\ (aq) + 2e \rightarrow PbSO_4\ (s) + 2H_2O\ (l)$ ❶
Or $Pb^{4+}\ (aq) + 2e \rightarrow Pb^{2+}\ (aq)$

b) Concentration decreases/ density decreases/ pH increases ❶

c) **Advantage** rechargable/ delivers large amounts of energy ❶

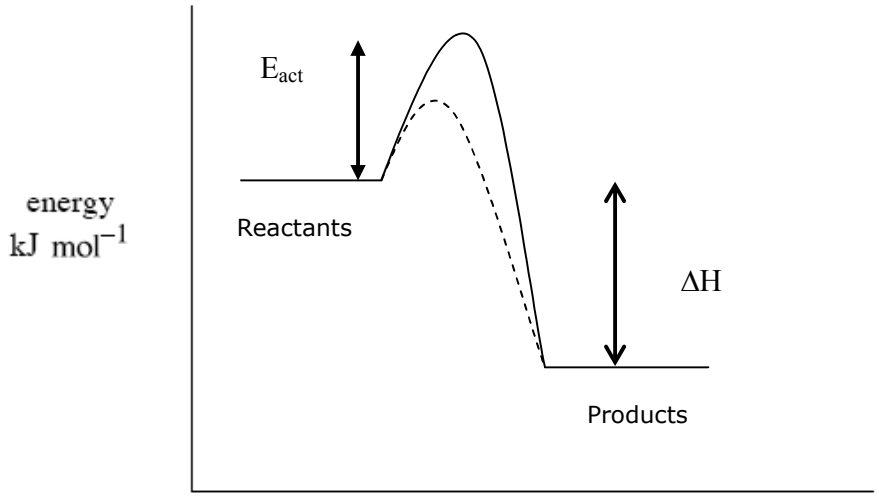
Disavantage bulky/ acid spillage/ heavy/ toxic ❶

Question 8

a) Exothermic ❶ Heat is produced during reaction. ❶

b) Small ❶as reaction proceeds at room temperature. ❶

c) ❶❶



d) dotted line ❶