SAJC Prelim 2012 P3 solutions 1 - SAJC PRELIM 2012 P3 solutions

No.	Solutions				
1(a)(i)	Aspirin has a lower pKa hence a higher Ka thus aspirin is a stronger acid				
	Aspirin has a RCOOH group and the conjugate base that is formed is more stable as the				
	negative charge on the carboxylate ion is delocalised over O-C-O bond (charge delocalised over				
	two oxygen atoms) by resonance effect.				
	The conjugate base of phenol is less stable as the negative charge (lone pair of electrons on O)				
	of the phenoxide ion is only delocalised into the benzene ring.				
(ii)					
	H A NU CH3				
	HO Or Or				
	NaOH(aq) CH3CH2Br/I/C/				
	heat				
	Маланан (1997) Настанан (1997)				
	N C CH3				
	()				
	CH ₃ CH ₂				
	Phenacetin				
(iii)	Add aqueous sodium carbonate / sodium bydrogen carbonate				
(iii)	Add aqueous sodium carbonate / sodium hydrogen carbonate Aspirin gives hubbles that will form white ppt, with aqueous calcium hydroxide. Salicin does not				
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(iii)	Add aqueous sodium carbonate / sodium hydrogen carbonate Aspirin gives bubbles that will form white ppt. with aqueous calcium hydroxide. Salicin does not give white ppt or bubbles. $2 \bigcirc 0^{1/2} - CH_3 + Na_3(O_3 \rightarrow 2 \bigcirc 0^{1/2} - CH_3 + H_3O + CO_2$ $2 \bigcirc 0^{1/2} - CH_3 + Na_3(O_3 \rightarrow 2 \bigcirc 0^{1/2} - CH_3 + H_3O + CO_2$				
(iii)	Add aqueous sodium carbonate / sodium hydrogen carbonate Aspirin gives bubbles that will form white ppt. with aqueous calcium hydroxide. Salicin does not give white ppt or bubbles. $2 \bigcirc 0^{(2)} - CH_3 + Na_2(O_3 \rightarrow 2 \bigcirc 0^{(2)} + H_2O + CO_2$ $COO^{-}NA^+$ OR				
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(iii) (iv) (b)(i)	Add aqueous sodium carbonate / sodium hydrogen carbonate Aspirin gives bubbles that will form white ppt. with aqueous calcium hydroxide. Salicin does not give white ppt or bubbles. $ \begin{array}{c} & & & & & & & & & & & & & & & & & & &$				



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(iii)	iii) $O_2 + 4H^+ + 4e$ Bà $2H_2O + 1.23 V$						
	When the pH increases, the cathodic reaction shifts to the left to replenish H ⁺ .						
	Hence, the E ^q _{cell} becomes more negative.						
	-	1	I	1	1		
(b)(i)	A: [Cu(H ₂ O) ₆] ²⁺	B: NO ₂	C: Cu(OH) ₂	D: CuO			
	E: [Cu(NH ₃) ₄ (H ₂ O) ₂] ²⁺	F: [CuCl ₄] ²⁻	G/H: HNO₂ and	HNO ₃			
• C: $[Cu(H_2O)_6]^{2+}(aq) + 2OH^{-}(aq)$ Cu(OH) ₂ (s) + 6H ₂ O (l)							
	3 (dq)						
	• D: $Cu(OH)_2(s) \stackrel{\text{all}}{=} CuO(s) + H_2O(l)/(g)$ • $F \cdot [Cu(H_2O)_2]^{2+}(2g) + 4NH_2(2g) \stackrel{\text{all}}{=} [Cu(NH_2)/(H_2O)]^{2+}(2g) + 4H_2O(l)$						
	• E. $[Cu(\Pi_2 \cup J_6] (aq) + 4IN\Pi_3 (aq)] \leftarrow [Cu(IN\Pi_3)_4(\Pi_2 \cup J_2] (aq) + 4\Pi_2 \cup (I)$ • E. $[Cu(NH_3)_4(H_3 O)_3]^{2+}(aq) + 4HCl (aq) \triangleq [Cu(Cl_1)^{2-}(aq) + 2H_2 O(I) + 4NH_3 + (aq)]$						
	OR [Cu(NH ₃) ₄ (H ₂ O	$(2)_{2}^{2+}(aq) + 4Cl^{2}(aq)$	à $[CuCl_4]^{2-}(aq) +$	$2H_2O(l) + 4NH_3(aq)$			
		,2] (aq) iei (aq)					
(ii)							
	:0.						
	HXUX N 2. C						
	3 bond pairs of electrons	repels each other e	qually OR lp-lp>lp-	bp>bp-bp			
	Hence, the shape is trigonal planar.						
2(a)(i)	1/ No (a) + 3/ Ho (a) 🔁 NHo	(g)					
5(a)(l)	¹ /2 IV2 (B) + ⁻ /2 ^Π 2 (B) а IVΠ3 (B) + 111 8						
(11)	$3N_2H_4(l) \longrightarrow 4NH_3(g) + N_2(g)$						
	3z						
		/ y					
	$3N_{2}(g) + 6H_{2}(g)$						
	Using bond energy from t	he data booklet:					
	y = [2BE (N ^o N) + 6BE (H-H)] – 12 BE (N-H)]					
	y = - 76 kJ mol⁻¹						
	Using energy cycle:						
	3z + y = 111.8						
	Z = +62.6 kJ mol ⁻¹						
(b)(i)	-3 to -2						
(ii)	N is oxidised, Cl ⁻ is formed	l or NaCl where Cl_2	must be reduced.				
	Note: HCl not accepted gi	ven that NaOH is th	ie medium.				
(iii)	$2OH^{-} + 2NH_{3} + Cl_{2} a N_{2}H_{4}$	+ 2Cl ⁻ + 2H ₂ O					
	Note: No spectator ions.						

r					
(c)					
	Hydrazone: H				
3(d)(i)	HNO ₃ + BF ₃ $\stackrel{\bullet}{a}$ NO ₂ ⁺ + [BF ₃ OH] ⁻ CH ₂ CH ₃ $\downarrow \downarrow $				
(ii)	B has an empty orbital. Hence, B can accept a lone pair of electrons from OH ⁻ via dative bonding.				
(iii)	Sn and concentrated HCl with heat followed by aq NaOH				
(iv)	CH ₂ —CH ₂ Cl				
(v)	Limited chlorine gas / in CCl ₄ + UV OR by heating				
(v) (vi)	Free radical substitution				
	Nucleophilic substitution				
(vii)	Difficult to control the position and number of substitution by Cl during FRS. OR difficult to control NS.				
4(a)(i)	Using Ksp for $Ag_2CrO_4 = [Ag^+]^2[CrO_4^{2-}] = 9 \times 10^{-12}$ [Ag ⁺] needed to form the red ppt = $[(9 \times 10^{-12})/(0.8)]^{1/2} = 3.35 \times 10^{-6} \text{ mol dm}^{-3}$ Using Ksp for AgCl = $[Ag^+][Cl^-] = 1.6 \times 10^{-6}$ [Cl ⁻] = $(1.6 \times 10^{-10})/(3.35 \times 10^{-6}) = 4.78 \times 10^{-5} \text{ mol dm}^{-3}$				
(ii)	Percentage of Cl ⁻ precipitated = $\frac{0.005 - 4.776 \times 10^{-5}}{100\%} \times 100\% = 99.0\%$				
	Since almost all of the Cl ⁻ is precipitated when the first trace of red ppt appears, CrO ₄ ⁻ acts as an indicator for the titration.				
(b)(i)	At the cathode (negative electrode), K^+ and H_2O compete to be reduced. $K^+ + e \textbf{Ba} K -2.92 V$ $2H_2O + 2e \textbf{Ba} H_2 + 2OH^ 0.83 V$ Since the $E^q (H_2O/OH^-) = -0.83 V$ is more positive than $E^q (K^+/K) = -2.92 V$ H_2O is preferentially reduced. Cathode: $2H_2O + 2e \textbf{a} H_2 + 2OH^-$				
	At the anode (positive electrode),				
	Cl ⁻ and H ₂ O compete to be oxidised.				
	Cl ₂ + 2e ISA Cl + 1.36 V				

	0 ₂ + 4H ⁺ + 4e Bà 2 H ₂ O +1.23 V					
	Although the E^q (Cl ₂ /Cl ⁻) = + 1.36 V is more positive than E^q (O ₂ /H ₂ O) = +1.23 V					
	Cl ⁻ is preferentially oxidised due to its high concentration.					
	Anode: 2Cl ⁻ à Cl ₂ + 2e					
(ii)	3Cl ₂ + 6KOH à KClO ₃ + 5KCl + 3H ₂ O					
	Note: Ionic eqn accepted.					
(iii)	High temperature of electrolyte must be used.					
(iv)	$Cl^{-} + 3H_2O$ à $ClO_3^{-} + 6H^{+} + 6e$					
	OR Thus, 1 mole of ClO ₃ ⁻ is formed from 6F.					
	122.6 g of KClO ₃ = 1 mole of KClO ₃ = 579 000 C					
	$30 \text{ g of KClO}_3 = 0.245 \text{ moles} = 141 680 \text{ C}$					
	Using Q = It					
() ()	t = (141 680) / 3 = 47227 seconds OR 13.1 hours.					
(c)(i)	$KCIO_x$ (s) a KCI (s) + x/2 O_2 (g)					
(ii)	$P_{oxygen gas} = P_{total} - P_{water vapour} = 100525 - 2800 = 97725 Pa$					
	Using $PV = nRT$					
	$9//25 \times 650 \times 10^{\circ} = n_{oxygen} \times 8.314 \times (22 + 2/3)$					
	Hoxygen – 0.0200 1101.					
	- KC10 2.12 1					
	$\frac{n K C l O_X}{m O} = \frac{89.1 + 85.5 + 16X}{0.0350} = \frac{1}{x}$					
()	$x = 2.99 \approx 3$					
(a)	$RBrO_3$ is more easily decomposed than $RCiO_3$ OR $RBrO_3$ is thermally less stable.					
	BrO_3 has a larger electron cloud than ClO_3 hence K is more able to polarise the larger electron cloud marging of $Pr O$ band					
5(a)(i)	Pate a 1/ time					
(ii)	Fraction of					
(")	molecules having molecules having					
	energy E energy E≥ E _a at					
	тк					
	Number of					
	molecules having					
	energy E ≥ E _a at					
	(1+10)K (TL 10)K					
	E _a France					
	Energy					
	When temperature is increased, the melocular said kinetic energy and move shout factor. This					
	when temperature is increased, the molecules gain kinetic energy and move about laster. This increases the number of molecules having energy $E > E_{a}$. As a result, the frequency of effective					
	collisions increases. Reaction rate thus increases.					

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