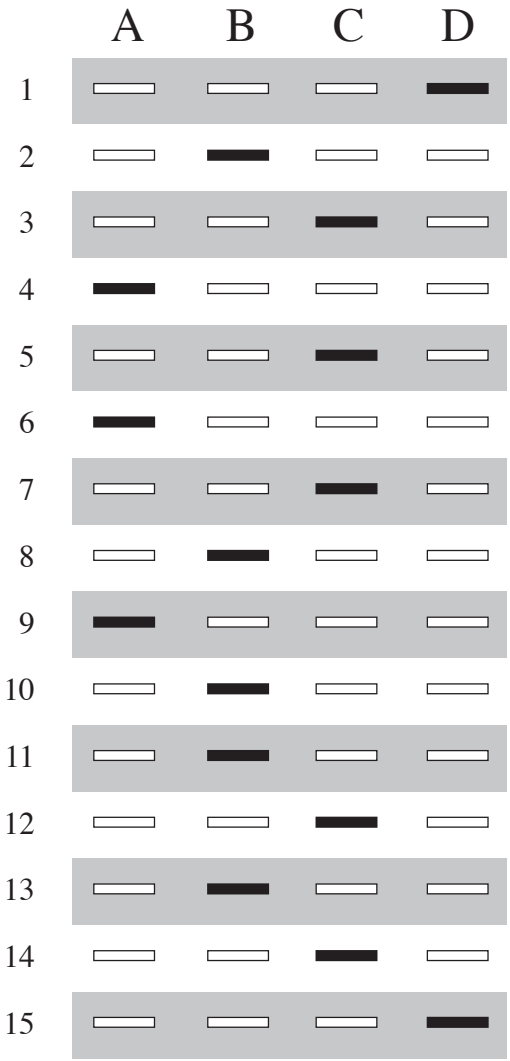
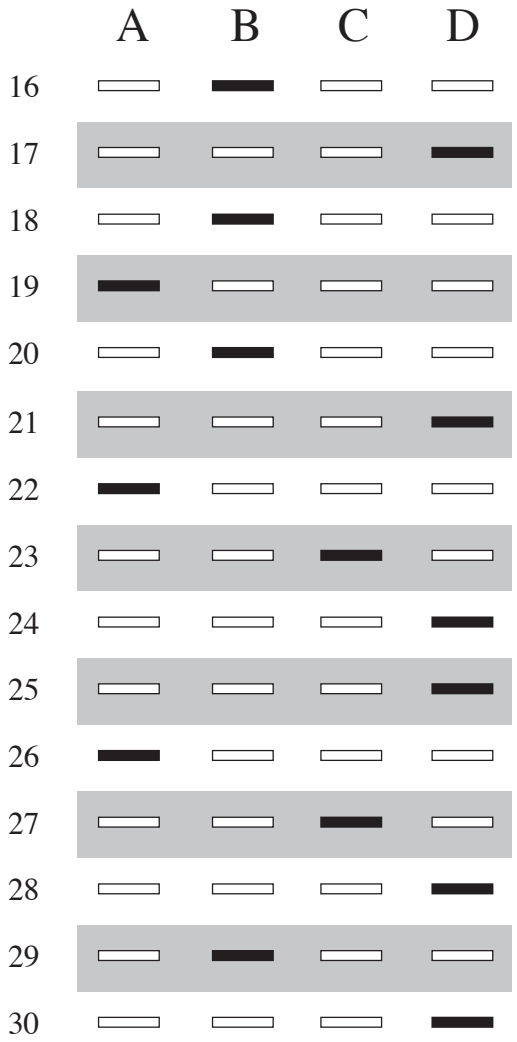
KHS Chemistry

Advanced Higher Prelim Mark Scheme





Prelim	*Year*	*Question*
Q1	2004	1
Q2	2006	2
Q3	2005	5
Q4	2003	4
Q5	2013	1
Q6	2013	6
Q7	2003	2
Q8	2013	8
Q9	2002	17
Q10	2006	8
Q11	2006	9
Q12	2005	12
Q13	2013	10
Q14	2013	9
Q15	??	??
Q16	2003	12
Q17	2007	19
Q18	2007	18
Q19	??	??
Q20	2003	9
Q21	2013	22
Q22	2013	23
Q23	2013	27
Q24	2013	24
Q25	2013	26
Q26	2003	39
Q27	2004	39
Q28	2013	29
Q29	2013	25
Q30	2006	38

Source	*KHS Question*			*Acceptable Answer*	*Mark*	*Unacceptable Answer*	*Negates*
SQA 2004 Q1	*Q1*	*a)*	*i)*	Increasing nuclear charge/more protons/greater attraction from nucleus ***or*** Decreasing atomic radius ***or*** Atoms getting smaller	**1**	More electrons More protons and more electrons Atoms getting more stable	use of word 'molecules' instead of 'atoms'
			ii)	Nitrogen has a half filled p sub-shell or set of p-orbitals ***or*** Oxygen has two electrons paired in a p-orbital → electron/electron repulsion makes it easier to remove one of these electrons	**1**	Orbital instead of p subshell Orbital box notation given without any further explanation Because of Hund's Rule	use of word 'molecules' instead of 'atoms'
		b)		2nd ionisation of Lithium involves removal of electron from 1 s ***orbital*** which is ***closer to nucleus*** Lowest shell ***or*** full shell ***or*** lower energy level ***or*** stable ***or*** full 1s orbital ***or*** breaking into new shell ***or*** Li^+ has noble gas arrangement	**1**		

Source	*KHS Question*			*Acceptable Answer*	*Mark*	*Unacceptable Answer*	*Negates*
SQA 2004 Q6	*Q2*	*a)*		$MnO_4^-(aq) + 5Fe^{2+}(aq) + 8H^+(aq) \rightarrow 5Fe^{3+}(aq) + Mn^{2+}(aq) + 4H_2O(1)$ Ignore state symbols	**1**		e^- on both sides
		b)	*i)*	Number of moles of Fe^{2+} in 30.1 cm^3 of 0.002 mol l^{-1} $= 6.02 \times 10^{-5}$ Number of moles of $MnO_{4\,(aq)}^-$ = 1/5 x number of moles of $Fe^{2+}_{(aq)}$ $= 1.204 \times 10^{-5}$ Can also use other methods of doing this calculation Follow on from wrong equation (a)	**1** **1**		

Source	*KHS Question*			*Acceptable Answer*	*Mark*	*Unacceptable Answer*	*Negates*
SQA 2004 Q6	*Q2*	*b)*	*ii)*	Number of moles of $MnO_{4\,(aq)}^-$ and hence $Mn^{2+}_{(aq)}$ in 100 cm^3 flask $= 4 \times 1{\cdot}204 \times 10^{-5} = 4{\cdot}816 \times 10^{-5}$ Mass of manganese = $54{\cdot}9 \times 4{\cdot}816 \times 10^{-5}$ $= 2{\cdot}64 \times 10^{-3}$ g $\%Mn = \frac{2{\cdot}64 \times 10^{-3}}{1{\cdot}11} \times 100\%$ $= 0{\cdot}238\%$ or $0{\cdot}24\%$ 0·2% Do not deduct marks for rounding errors Various alternative answers following on from wrong answers in part (b) (i) and part (a)	**1** **1**	Deduct 1 mark for not multiplying by 4. Deduct 1 mark if use a value for RAM other than 54·9	
		c)		Spectrophotometer/colorimeter/intensity of absorption AAS/AES light spectroscopy ½	**1**	Calorimeter Mass spectrometer/spectrometer EDTA Gravimetric analysis Prepare derivative Calibration graph on its own	

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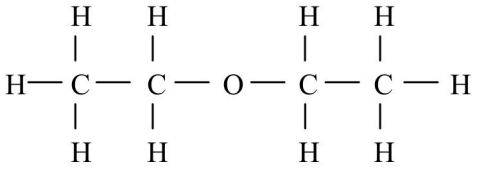
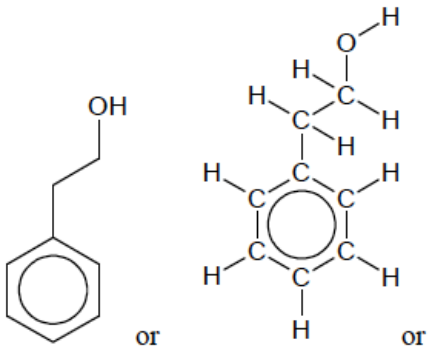
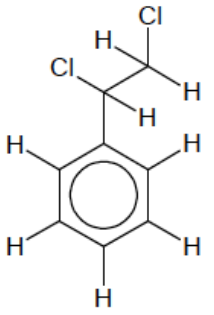
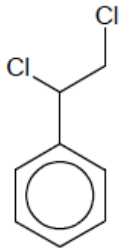
Rev AdvH 2013 Q1	*Q3*	*a)*		Equal energy/same energy	**1**		
		b)			**1**		
		c)		A mixing of one s orbital and three p orbitals/sp3 hybridisation To form four degenerate (hybrid) orbitals	 **2**		

Source	*Question*			*Acceptable Answer*	*Mark*	*Unacceptable Answer*	*Negates*
Rev AdvH 2013 Q5	***Q4***	***a)***		4	**1**		
		b)		Mass of nickel in DMG complex = 0·942 × (58·7/288·7) = 0·1915 g 1 % Ni in impure salt = (0·1915/0·968) × 100 = 19·8 % 1	**2**	20·9 % (%Ni in pure salt) 20·3 % use of 0·968 instead of 0·942 in first line	
		c)	***i)***	Hexaaquanickel(II)	**1**		
		c)	***ii)***	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^8$	**1**		
		d)	***i)***	Red and blue are absorbed/green light transmitted or not absorbed	**1**		
		d)	***ii)***	NH_3 results in greater ligand field splitting which means that more energy is needed to promote electron. 1 Since $E \alpha \frac{1}{\lambda}$ the wavelength of light absorbed will be less 1	**2**		
		d)	***iii)***	Purple (lilac)	**1**		

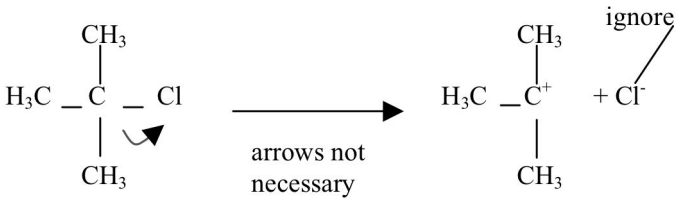
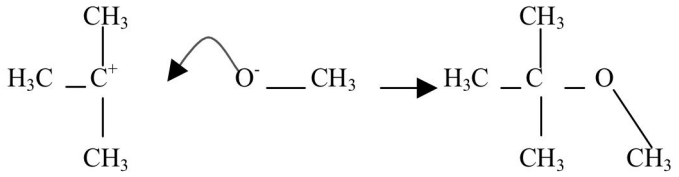
Source	*Question*			*Acceptable Answer*	*Mark*	*Unacceptable Answer*	*Negates*
Rev AdvH 2013 Q9	*Q5*	*a)*		Fairly high molecular mass/available in high purity/ thermodynamically stable/soluble in water	**1**		
		b)		1. Calculate the mass needed. 2. Accurately weigh required mass of Na_2CO_3 and dissolve completely in small volume of water. 3. Transfer the solution to a standard flask, rinsing the beaker with deionised water and transferring the rinsing's to the flask. 4. Add deionised water up to the mark adding the last few drops with a dropper. 5. Invert to mix.	**2**		
		c)		Calculate volume of the original solution required, $(M_1V_1 = M_2V_2)\ V = \frac{0{\cdot}2 \times 250}{1} = 50cm^3$ Measure 50cm3 of stock solution using a pipette and transfer to a 250cm3 standard flask. Add deionised water up to the mark, stopper and invert. (1 for correct volume, 1 for correct procedure)	**2**		

Source	*Question*			*Acceptable Answer*	*Mark*	*Unacceptable Answer*	*Negates*
Rev AdvH 2013 Q11	*Q6*	*a)*		Phosphoric acid (or suitable alternative)/aluminium oxide/conc sulphuric acid	**1**		
		b)	*i)*	One mole cyclohexanol gives one mole cyclohexene moles cyclohexanol = 4·36/100 = 0·0436 moles 1 theoretical yield of cyclohexene = 0·0436 × 82 = 3·575 (g) 1 % yield = 3·14 × 100/3·575 = 87·8 (%) 1	**3**		
			ii)	Impure starting materials/mechanical losses/mass transfer losses/reaction may not go to completion/ side reactions	**1**		
		c)		***1 mark:*** The student has demonstrated a limited understanding of the chemistry involved. The student has made some statement(s) which is/are relevant, showing that at least a little of the relevant chemistry is understood. ***2 marks:*** The student has demonstrated a reasonable understanding of the chemistry involved. The student makes some statements which are relevant showing understanding of the problem. ***3 marks:*** The maximum available mark would be awarded to a student who has demonstrated a good understanding of the chemistry involved. The student has shown a good understanding of the chemistry involved and has provided a logically correct answer to the question asked. This type of response might include a statement of the principles involved, a relationship or an equation and an application of these to answer the question. This does not mean that the answer has to be what might be termed an 'excellent' or 'complete' answer.			

Source	*Question*			*Acceptable Answer*	*Mark*	*Unacceptable Answer*	*Negates*
SQA 2005 Q9	*Q7*	*a)*	*i)*	Sodium or any other Group I metal Accept Ba	**1**		
			ii)	Acidified dichromate/permanganate (Hot) copper oxide/copper (II) oxide any other suitable oxidising agent	**1**	Tollens', Benedict's, Fehlings' reagents Copper (I) oxide	
		b)		$CH_3CH_2OCH_2CH_3$ or  If full Structural Formula drawn then all bonds should be drawn correctly. Allow as a slip, 1 H missing as long as bond is given	**1**	C_2H_5 instead of CH_2CH_3	
		c)		Bonds Broken(ΔH +ve) Bonds made (ΔH -ve) 1 x C=C (+602) 2xC-CI (-652) 1 x Cl-Cl (+243) 1 xC-C (-346) $\Delta H = 602 + 243 - 652 - 346 = -153$ kJ mol^{-1} or kJ First mark for values in brackets (ignore signs)	**1** **1**		

Source	*Question*			*Acceptable Answer*	*Mark*	*Unacceptable Answer*	*Negates*
Rev AdvH 2013 Q10	*Q8*	*a)*		Electrophilic substitution/alkylation/substitution	**1**	Nucleophilic substitution	
		b)		Chlorine molecules have changed into chlorine radicals or chlorine atoms or both atoms retain one electron from the covalent bond.	**1**		
		c)		 or or any other correct SF.	**1**		
		d)		Elimination	**1**		
		e)		 or  or any other correct SF	**1**		

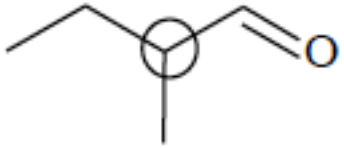
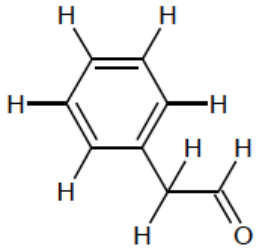
Source	*Question*			*Acceptable Answer*	*Mark*	*Unacceptable Answer*	*Negates*
SQA 2007 Q11	***Q9***	***a)***		4 and 5	**1**		
		b)		Structural fragment/section of a molecule which gives it pharmacological/biological activity/causes biological reaction or structural fragment/section of a molecule that binds to receptor/triggers response	**1**	Group of atoms/active part of drug functional group	
		c)		*saturated* due to the absence of multiple bonds or single bonds only between carbons (tertiary) *amine* due to presence of N group *ester* due to presence of carboxylate group	**1**		

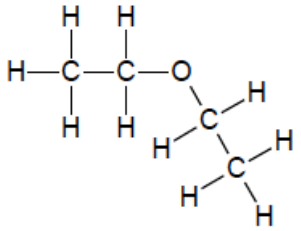
Source	*Question*			*Acceptable Answer*	*Mark*	*Unacceptable Answer*	*Negates*
SQA 2004 Q10	*Q10*	*a)*		Ethers or alkoxyalkanes	**1**		
		b)		Add sodium metal/alkali metal/group 1 metal ***or*** $2Na + 2CH_30H \rightarrow 2CH_3ONa + H_2$ (or word equation)	**1**		
		c)	*i)*	First step - show the heterolytic fission of the C-Cl bond to form the carbocation  Second step - show the nucleophilic attack of the methoxide ion  Must show 2 steps Correct text acceptable for 2 marks	**2**	If wrong carbocation - may still get 2nd mark. Shown as 1 step = 0 marks No carbocation at all = 0 marks Any suggestion of S_N2 = 0 marks	S_N2 mechanism

Source	*Question*			*Acceptable Answer*	*Mark*	*Unacceptable Answer*	*Negates*
SQA 2004 Q10	*Q10*	*c)*	*ii)*	Can give one of two reasons, students wording may vary but should mention one of two concepts ***either*** the carbocation formed has three methyl (alkyl) groups attached which can feed in electron density stabilising the positive charge thus making an SNI mechanism more favourable. Tertiary (carbo)cation stable ***or*** the tertiary haloalkane has three methyl groups attached which offer steric hindrance w.r.t. the formation of the five co-ordinate transition state seen as part of the SN2 mechanism bulky groups/too crowded/steric hindrance	**1** **1**	Tertiary on own without explanation Not possible to invert as it would be with S_N2	

Source	*Question*			*Acceptable Answer*	*Mark*	*Unacceptable Answer*	*Negates*
Based on SQA 2004 Q12 but using data from SQA 2009 Q11	***Q11***	***a)***		C = O bond / C = O / carbonyl / ester	**1**	aldehyde C = O ketone C = O	
		b)	***i)***	***mass of carbon*** = 0.420 x 12/44 = 0.1145 or 0.114g ***mass of hydrogen*** = 0.172 x 2/18 = 0.0191 or 0.019g both masses	**1**		
				mass of oxygen = 0.210 - 0.114 - 0.019 = 0.077g	**1**		
			ii)	***C : H : O*** 0.114/12 : 0.019/1 : 0.077/16 0.0095 : 0.019 : 0.0048 2 : 4 : 1 Empirical formula C_2H_4O	**1**	any error	

Source	*Question*			*Acceptable Answer*	*Mark*	*Unacceptable Answer*	*Negates*
	Q11	***c)***	***i)***	RFM = 88 so $C_4H_8O_2$	**1**		
			ii)	$[CH_3CH_2CO]^+$ or $C_2H_5O^+$	**1**	negative charge on ion	
		d)		methyl propanoate	**1**		

Source	*Question*			*Acceptable Answer*	*Mark*	*Unacceptable Answer*	*Negates*
Rev AdvH 2013 Q10	*Q12*	*a)*		$C_6H_8N_2$	**1**		
		b)			**2**		
		c)		3 peaks Phenylethanal  1 3 peaks since there are 3 different proton environments. 9·3 aldehyde proton 3·2 protons adjacent to carbonyl carbon 6·7 aromatic protons 1	**2**		
		d)		Agonist	**1**		

Source	*Question*			*Acceptable Answer*	*Mark*	*Unacceptable Answer*	*Negates*
Rev AdvH 2013 Q12	*Q13*	*a)*		Mass of C = (12/44 × 11·9) = 3·25 g Mass of H = (2/18 × 6·08) = 0·68 g So mass of O = 5·00 – 3·25 – 0·68 = 1·07 g 1 C : H : O 3·25 : 0·68 : 1·07 Ratio of moles 0·2714 : 0·68 : 0·067 4 : 10 : 1 1 Empirical formula $C_4H_{10}O$ 1	**3**		
		b)		C-O (stretch)	**1**		
		c)		$C_4H_{10}O$	**1**		
		d)		 (accept skeletal or shortened structural formula of ethoxyethane)	**1**		