General Comments for Section A

The examiners felt that there was visible attempt form the students to answer the questions as thoroughly as they can. However, what was most glaring was the insufficient amount of key-words and jargons provided by the students' answers, which actually highlights that there was insufficient detailed studying of the topics. Of the 4 questions in Section A, Q2 and Q4 were generally poorly answered.

1a	No.	of mol of Cu ₂ O = 0.286 ÷ (63.5+63.5+16.0) = 0.00200			
	l mo	mol of $C_6H_{12}O_6 \equiv 1$ mol of Cu_2O			
	No.	o. of mol of $C_6H_{12}O_6 = 0.00200$			
	M _r o	$f C_6 H_{12} O_6 = 12.0(6) + 1.0(12) + 16.0(6) = 180.0$			
	Mas	s of $C_6H_{12}O_6 = 0.00200 \text{ x} 180.0 = 0.360g$			
	Perc	centage of glucose in the food sample = $0.360 / 5.00 \times 100\% = \frac{7.20\%}{100\%}$			
	Note	e: Answers are to show 3 significant figures to gain full marks.			
b	1s ² :	2s ² 2p ⁶ 3s ² 3p ⁶ 3d ⁹			
С	i	Isotopes are atoms of the same element with the same number of protons and different number of neutrons.			
	ii	Relative atomic mass of copper = (69.2/100 x 63) + (30.8/100 x 65)			
		= 63.62			
		= 63.6 (1 dec place)			
d	Nun	nber of protons= 29			
•	Nun	nber of neutrons= 34			
	Nun	nber of electrons= 29			
е	I				
		6 3 ₀ , 2+			
		16°			
		229			
		source 32			
		³² S ²⁻			
	ii	As <u>angle of deflection α charge / mass</u> , the angle of deflection for a sample			
		of ${}^{52}S^{2^{-1}}$ is predicted to be <u>twice</u> that of ${}^{53}Cu^{2^{+}}$ as its mass is two times			

2a	Dynamic equilibrium is reached when the rate of the forward reaction and the rate of the backward reaction is the same.								
	Com	iments:							
	•G	enerally well a	answered.						
b	i CH ₃ CH ₂ COOH (I) + CH ₃ CH ₂ OH (I) ← CH ₃ CH ₂ COOCH ₂ CH ₃ (I)+H ₂ O(I) No marks awarded if no state symbols given					H₂CH₃ (I)+H₂O(I)			
	ii	Ethyl propan	oate						
С			CH ₃ CH ₂ CO	OH + CH ₃ CH ₂ OH	$H \longrightarrow CH_3CH_2CO$	DOCH ₂ CH ₃ +H ₂ O			
	Initi	al no. of mole	0.6	0.5	0	0			
	Δi	n no. of mole	0.4 – 0.6 = -0.2	-0.2	+0.2	+0.2			
	N	o. of mole at eq ^m	0.4	0.5 – 0.2 = 0.3	0.2	0.2			
	Let the volume of the vessel be V dm ³ .								
	$K_{c} = [CH_{3}CH_{2}COOCH_{2}CH_{3}][H_{2}O]$								
	[CH ₃ CH ₂ COOH][CH ₃ CH ₂ OH]								
	=	(0.2/V) (0.2/	V)						
		(0.4/V) (0.3/	V)						
	=	0.333							

d	i	Position of equilibrium will shift to the right hand side. By Le Chatelier's principle, when ethanol is added, the system will favour the forward reaction so as to decrease the concentration of ethanol. Hence, the position of equilibrium will shift to the right hand side.
	ii	The position of equilibrium shifts to the left-hand side. By Le Chetalier's principle, increasing temperature of the system will favour the endothermic reaction to absorb the excess heat. Hence, the backward reaction is favoured as it is endothermic, and position of equilibrium shifts to left hand side.

3	а	i	Aspirin is insoluble in water due to the presence of the large hydrophobic benzene ring.
		ï	$O \rightarrow OH \qquad O \rightarrow ONa^{+} \qquad O \rightarrow O$
			In NaOH(aq), aspirin forms an <u>ionic salt</u> , which is able to form <u>ion-dipole</u> interactions with water molecules. Hence, it is soluble in water.
	b	i	Amphoteric refers to the ability to function as either as an acid or a base.
		ii	Reaction of $Al(OH)_3$ with acids is typical of a metal.
			$Al(OH)_3 + 3H^+ \rightarrow Al^{3+} + 3 H_2O$
			Reaction of $A/(OH)_3$ with bases is typical of a non-metal.
			$A/(OH)_3 + OH^- \rightarrow A/(OH)_4^-$
2	<u>ر</u>	i	Across the period, there is a general increase in the 1 st IF due to the
,	0	•	increase in the nuclear charge and the constant shielding effect from one element to the other because electrons are added successively to the same shell. Hence the effective nuclear charge increases, the nuclear attraction on the valence electrons and more energy is needed to remove the electron.
		ii	The 1 st IE of B is lower than that of Be.
			$_{5}$ B: $1s^{2} 2s^{2} 2p^{1}$ $_{4}$ Be: $1s^{2} 2s^{2}$ <u>The 2s subshell is nearer to the nucleus than the 2p subshell, hence the</u> <u>electrostatic attraction between the nucleus and the 2s electron is stronger</u> <u>than between the nucleus and the 2p electron</u> . Hence, a <u>lower amount of energy</u> is required to remove the 2p electron from B than to remove the 2s electron from Be.
			The 1 st IE of O is lower than that of N.
			$_{8}O$ 1_{1} 1_{1} 1_{1} 1_{1} $1_{7}N$ 1_{1} $1_{$
			The <u>mutual electronic repulsion of the paired electrons</u> in a 2p orbital of O makes the removal of one electron from that orbital easier compared to a 2p electron of N which does not experience such repulsion. Hence <u>less</u> <u>energy needed</u> to remove the electron in O.

4a	I	Comparing experiment 1 and 3. [NaOH] is kept constant. Increasing the [chloromethylbenzene] by 1.5 times causes the rate of reaction to increase by 1.5 times. Therefore, reaction is first order with respect to chloromethylbenzene. Comparing experiment 1 and 2. [NaOH] doubles and [chloromethylbenzene] doubles too. But rate of reaction only doubles. Since, reaction is first order with respect to chloromethylbenzene, this implies that the reaction is independent of NaOH.
		Therefore, reaction is zero order with respect to NaOH. Rate = k[chloromethylbenzene]
	ii	[phenylmethanol] 0.75 n 0.5 n 0.5 n 0.5 n 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 +
b	I	 Strength of the covalent bond is dependent on the effectiveness of overlapping of the atomic orbitals. The smaller the atoms, the more effective the overlap, the stronger the covalent bond. <i>Cl</i> is the smallest atom followed by Br and then I being the largest. Between C and <i>Cl</i>, there will be the most effective overlapping of orbital and hence the C-C<i>l</i> bond is the strongest and the C-I bond is the weakest.
	ii	From the rate equation, the rate of formation of phenylmethanol is determined by the strength of the $C - X$ bond. The stronger the $C - X$ bond, more energy is required to break it and hence the faster the rate of reaction.
C	Rate	e of reaction slows down.



5	(a)		Limonene is soluble in benzene / tetrachloromethane / any non-polar solvents. Limonene is a <u>non-polar molecule</u> and is soluble in non-polar solvents
			through <u>induced dipole-induced dipole interactions</u> .
	(b)	(i)	Observations: 1. Reddish-brown bromine solution is decolourised. 2. White fumes of HBr observed. Structural formulae of the product: $\begin{array}{c} CH_3 \\ F \\ F \\ H_3C \\ CH_2Br \end{array}$
		(ii)	Reagents/Conditions : Na metal Observations : Colourless, odourless gas evolved that extinguishes lighted splinter with a 'pop' sound. Balanced equation :





		(ii)	ii) Step II: Ethanolic NaCN, reflux Step III: Dilute HC/(aq), heat under reflux			
			Comments:			
			 (d)(i) was generally well answered with students being able to list the type of reactions accordingly. 			
			 However, some students neglect 	ed conditions for step I and II.		
			 The examiners would like to reite mineral acid being used. Hence present 	erate that in step III, it must be aqueous e, the term (aq) or aqueous have to be		
			present.			
6	(a)	The forward reaction is exothermic. Thus, high temperature will result in the equilibrium position to shift left, favouring the backward reaction. Hence, reducing the yield of NH_3 .				
		How brok cann	ever, in the formation of ammonia, s en. Hence, the activation energy fo ot be conducted a low temperatures	strong N≡N and H– H bonds are to be r the reaction is high, thus the reaction		
		Thus facto	a relative high temperature will be ors.	e needed so as to balance these two		
	(b)	(b) graph				
		n(NH ₃)				
		(b)(i) graph (with reference to time)				
		0.30 (b)(i) (b)(i) (b)(i) (c) (c) (c) (c) (c) (c) (c) (c) (c) (c				
		• No axis labels -½m				
	(c)	(i)	A weak base is one which dissocia	tes partially into its ions in water.		
		(ii)	(ii) $pH = 11.2$ pOH = 14-11.2 = 2.80 $[OH^{-}] = 10^{-2.80} = 1.58 \times 10^{-3} \text{ mol dm}^{-3}$ $[NH_3] = 0.15 \text{ mol dm}^{-3} > [OH^{-}]$. Therefore, NH_3 is a weak base.			
		(iii)	Indicator used: Methyl orange.			
			An acidic salt is formed. pH at equivalence point if lower than 7, thus it is best to use an indicator whose working pH is in the acidic region.			
	(d)	(i)	A buffer solution is one whose pH remains relative constant despite small amounts of strong acid or strong base is added to it.			
		(ii)	The pH of the resultant solution ren	nains relatively unchanged.		
			$NH_3 + H^+ \rightarrow NH_4^+$			

(e)

(i)

HCl

	(ii)	$MgCl_2 + 6H_2O \longrightarrow [Mg(H_2O)_6]^{2+} + 2Cl^{-}$
		$[Mg(H_2O)_6]^{2^+}$ $(Mg(OH)(H_2O)_5]^+$ + H^+
		$SiCl_4 + 2H_2O \rightarrow SiO_2 + 4HCl$
	(iii)	Mg ²⁺ being small and highly polarizing is able to further polarize the O–H bond of water bonded datively to it.
		Hence, causing the water molecules to dissociate to release a proton. Therefore producing a mildly acidic solution.
		Si contains low lying empty d-orbital which can accept lone pair of electrons from water molecules to start of hydrolysis reaction.
		As SiC l_4 undergoes full hydrolysis while MgC l_2 undergoes partial hydrolysis, hence the aqueous solution of SiC l_4 is more acidic.

7	(a)	(i)	Standard enthalpy change of combustion is the enthalpy change when 1 mole of octane is burnt with excess Ω_2 at standard conditions, which is		
			298 K and 1 atm.		
		(ii)	$\Delta H_{a}^{\theta} = -(250)(4.18)(71 - 25)/(1/18)$	(12) + 18(1)]	
		()	= - 5479 ≈ - 5480 kJ mol ⁻¹ (3s	sf)	
		(iii)	The assumption is that the transfer	er of heat energy from the burning of	
			Octane is totally transferred to the v	vater in the container.	
			reaction to the beaker of water.		
			Comments:		
			• The examiners noted that many students have left out the exact standard conditions in their definition in (a)(i).		
			• In (a)(ii), the examiners saw many students using specific heat capacity of water as 4.2 in their calculation and not 4.18 which is found in the data booklet. Thus, these students were penalised.		
	(b)	(i)	$\Delta H_2 = \Delta H_1 + \Delta H_3$		
		(ii)	ΔH_c^{θ} (ethanol) = 2 $\Delta H_f(CO_2)$ + 3 $\Delta H_f(H_2)$ - ΔH_f (ethanol)		
			= 2(-393) + 3(-286) - (-277)		
			$= -1367 \text{ KJ mol}^{-1}$		
				SI)	
		(iii)	$CH_2CH_2 + H_2O \rightarrow CH_3CH_2OH$		
			Bonds broken	Bond formed	
			$1 \times C = C$	1XC-H	
			$L_{AH_{1}} = (+610 + (+460)) - (+410)$	$0 + (+360) + (350)) = -50 \text{ k } 1 \text{ mol}^{-1}$	
			$\Delta I = (+0.10 + (+400)) - (+4.10 + (+300) + (300)) = -50 \text{ KJ [II0]}$		
			Or.		

		$\Delta H_{reaction} = \sum BE(reactants) - \sum BE(products)$
(c)	(i)	1g of E20 fuel contains 0.2g of ethanol and 0.8g of octane.
		Heat evolved from 0.2g of ethanol = (0.2/46) x 1367 = 5.94 kJ
		Heat evolved from 0.8g of octane = (0.8/114) x 5506 = 38.64 kJ
		Heat evolved from 1g of E20 fuel = 5.94 + 38.64 = 44.58 ≈ 44.6 kJ
	(ii)	Heat evolved from 1g of octane = (5506/114) = 48.3 kJ
		Heat evolved from 1g of ethanol = (1367/46) = 29.7 kJ
		Using ethanol in the fuel will ensure Brazil become less dependent on petrol / reduce carbon emission to the environment.
		In addition, this mixture will not sacrifice the energy requirement which the fuel needs to possess to run the cars.
(d)	(i)	I: K_2CrO_7/H^+ , heat under reflux. II: $CH_3CH_2CH_2OH$, conc. H_2SO_4 , heat under reflux.
	(ii)	
	(iii)	Reagent: 2,4-Dinitrophenylhydrazine Conditions: WarmObservations: Ethanal will produce an orange precipitate, while ethanol will not produce such a precipitate.Explanation:
		Explanation:

12

