

Anglo-Chinese Junior College

JC2 Preliminary Examination Higher 1



A Methodist Institution (Founded 1886)

CHEMISTRY

Paper 1 Multiple Choice

8873/01 9 September 2024 1 hour

Additional Materials: Multiple Choice Answer Sheet Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, Centre number and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

1	С	11	D	21	С
2	В	12	В	22	A
3	С	13	С	23	В
4	В	14	A	24	С
5	В	15	A	25	A
6	D	16	В	26	D
7	С	17	С	27	С
8	A	18	A	28	В
9	D	19	D	29	В
10	В	20	A	30	D

ACJC H1 Chem Prelim 2024 Paper 1 Answers

1	Carbon sulfide, CS ₂ , is a volatile flammable liquid used in the manufacture of cellophane.							
	On combustion, CS ₂ is oxidised as follows.							
			CS_2	(g) + 3O ₂ (g) →	CO ₂ (g	g) + 2SO ₂ (g)		
	A 20 cm ³ sample of carbon disulfide vapour is ignited with 100 cm ³ of oxygen. The final volume of gas after burning is treated with an excess of aqueous alkali.							
	Wha	t percentage of th	is fina	I volume dissolve	s in th	e alkali?		
	[all v	olumes measured	at th	e same temperatu	ure an	d pressure.]		
				Γ	1	Γ	1	
	Α	20%	В	40%	С	60%	D	80%
	Ans	wer: C					1	
	Thin	king process						
	only	acid will react & d	lissolv	e in alkali. From t	he abo	ove equation, CO	2 & S	D_2 are both
	acidi	c gases [learn in	o <mark>erio</mark> d	icity]		•		
	since the reactants & products are all gases, we can assume volume ratio as mole ratio.							
	$CS_2(g) \equiv CO_2(g) \equiv 2SO_2(g)$ 20 : 20 : 2(20)							
	So th	ne reaction produc	ces 20	$0 + 40 = 60 \text{ cm}^3 \text{ of}$	acidio	c gases.		

Volume of O_2 required to burn 20cm^3 of $CS_2 = 20 \times 3 = 60 \text{cm}^3$ Volume of O_2 unreacted = 100 - 60
= 40cm^3 Total volume of gas at the end of reaction = (acidic gases $CO_2 + SO_2 + \text{unreacted } O_2)$
= $60 + 40 = 100 \text{ cm}^3$ % of final vol that dissolve in alkali = $60/100 \times 100 \% = 60 \%$

2	 2 moles of nitric acid, HNO₃, a powerful oxidising agent, reacts with 3 moles of hydrogen sulfide, H₂S, to form three products, one of which is water. In this reaction, the oxidation number of nitrogen decreases by 3. What are the other two products of this reaction? 						
	A N2O2 and H2SO4 C NO and SO2						
	B NO and S D N ₂ O ₂ and H ₂ SO ₃						
	Ans	wer: B					
	O.S Lool	of N in HNO₃ =+5 →+2 king for N with OS=2, → <u>NO</u>					
	1 m 2 m	ol of HNO_3 gains 3 moles of electrons of of HNO_3 gains 6 moles of electrons					
	6 moles of electrons lost by 3 moles of H_2S 2 moles of electrons lost by 1 mole of H_2S						
	O.S of S in H ₂ S =-2 $\rightarrow 0$ Looking for S with OS=0, $\rightarrow \underline{S}$						
	Proc	ducts are <u>NO and S</u>					

$$\begin{array}{c|c} \textbf{3} & \mbox{Consider the following half-equations.} \\ & \mbox{MnO}_4^- + 8 H^+ + 5 e^- \rightarrow Mn^{2+} + 4 H_2 O \\ & \mbox{F} e^{2+} \rightarrow F e^{3+} + e^- \\ & \mbox{C}_2 O_4^{2-} \rightarrow 2 C O_2 + 2 e^- \end{array} \\ & \mbox{What volume of 0.01 mol dm}^{-3} \mbox{KMnO}_4 \mbox{ is required to oxidise 15 cm}^3 \mbox{ of an acidified solution} \\ & \mbox{of 0.01 mol dm}^{-3} \mbox{F} e C_2 O_4? \end{array}$$

		_						
A	3 cm ³	в	6 cm ³	С	9 cm ³	D	15 cm ³	
Answer: C								
The oxidation of FeC ₂ O ₄ is represented by this overall equation [O]: $Fe^{2+} + C_2O_4^{2-} \rightarrow Fe^{3+} + 2CO_2 + 3e^{-}$								
Therefore 3 mol of MnO_4^- will react completely with 5 mol of FeC_2O_4 (balance out the electrons).								
Over	rall Eqn: 3 MnO ₄ -+	- 5 Fe ²	²⁺ + 5 C ₂ O ₄ ^{2–} + 24	$H^{+} \rightarrow 3$	3Mn ²⁺ + 5Fe ³⁺ + 10) CO ₂ -	+ 12H₂O	
No. of moles of FeC ₂ O ₄ = $\frac{15}{1000} \times 0.01$ = 1.5 × 10 ⁻⁴ mol								
No. of moles of MnO ₄ ⁻ = $\frac{3}{5} \times 1.5 \times 10^{-4}$ = 9.0 x 10 ⁻⁵ mol								
Volume of MnO ₄ ⁻ = $\frac{9.0 \times 10^{-5}}{0.01} \times 1000$ = 9 cm^3								

4	Use of the Data Booklet is relevant to this question.							
	The table shows statements made by three students about the s, p and d electrons in the atoms of the element with atomic number 30.							
	student statement							
	X There are s electrons in 4 different quantum shells.					ells.		
		Y	1	There are p electrons in 2 different quantum shells.				
	Z The d electrons have the same principal quantum number as the outermost s electrons.					um		
	Whie	ch students are co	orrect)				
	Α	X, Y and Z	В	X and Y	С	Y and Z	D	X and Z
	Ans	wer: B						
	Keyword: atoms of the element with atomic number 30 => up to period 4							
	e.g.	1s² 2s² 2pº 3s² 3p	° 3d '	4s ² (30 electro	ons)			
	Student X obviously correct as each period/ quantum shells will have s electrons. (there are 1s, 2s, 3s and 4s electrons)							
	Stuc elec	lent Y stated that t trons so he is corr	here ect.	are p electrons	in 2 diffe	erent shells: there	are 2	p and 3p

1

Student Z is wrong as in Period 4, d electrons are the 3d and outermost s electrons are the 4s





7	Some car paints contain small flakes of silica, SiO ₂ .							
	In the structure of solid SiO ₂							
	 each silicon atom is bonded to x oxygen atoms, each oxygen atom is bonded to y silicon atoms, each bond is a z type bond. What is the correct combination of x, y and z in these statements? 							
		X	У	Z				
	Α	2	1	covalent				
	В	2	1	ionic				
	С	4	2	covalent				
	D	4	2	ionic				
	Answer: C SiO ₂ exists in the form of a giant molecular diamond-like structure, with each silicon atom being tetrahedrally bonded to four oxygen atoms, and each oxygen forming two bonds to silicon. The bonds are covalent in nature.							

8	What is the order of increasing volality at room temperature?							
	1 2,3-dimethylbut-2-ene							
		2 cis-hex-3-ene						
	3 trans-hex-3-ene							
	A 2, 3, 1 C 3, 2, 1							
	B 1, 2, 3 D 1, 3, 2							
	Ans	wer: A						
	 Answer: A Volatility is inversely proportional to the boiling point and strength of intermolecular forces of attractions. Surface area of contact between molecules is smaller for the branched 2,3-dimethylbut-2-ene as compared to cis-hex-3-ene and trans-hex-3-ene. There is a slight difference in boiling point between cis and trans isomers. Trans-hex-3-ene has zero dipole moment whereas cis-hex-3-ene has overall dipole moment. 							

9	Whi	ch sta	tement can be explained in term	s of h	ydrogen bonding?		
		1	The apparent relative molecula	r mas	s of ethanoic acid in benzene is 120.		
		2	HF_2^- is formed when HF is diss	olved	in molten NaF.		
		3	The boiling point of propanoic a	icid is	higher than ethanoic acid.		
	4 Ice is less dense than water.						
	Α	1, 2,	, 3	С	2, 3, 4		
	в	1, 3,	, 4	D	1, 2, 4		
	Ans	wer:	D		•		
	Propanoic acid has higher boiling point than ethanoic acid due to the larger electron cloud						
	size	of the	e molecule which will imply that it	has s	stronger id-id interactions.		

10	Elements A and B are both in Period 3. Element A has the smallest atomic radius in Period 3. There are only two elements in Period 3 which have a higher melting point than element B . Elements A and B react together to form compound C . Which compound could be C ?						
	Answer: B C/ has the smallest atomic radius in Period 3. Mg has the third highest melting point of the elements in Period 3, after Si and A/. Hence, compound C is MgC/ ₂ .						

11	Use of the Data Booklet is relevant to this question.						
	The properties of chlorine, bromine (denoted as X_2 in their elemental state) and their compounds are compared.						
	Whi	ch property is smaller for bromine thar	for c	hlorine?			
		1 pressure to liquefy $X_2(g)$ at the	same	temperature			
		2 oxidising power of X_2 3 first ionisation energy of $X(q)$					
	Α	1 and 2	С	2 and 3			
	В	1 and 3	D	1, 2 and 3			
	Ans	wer: D					
	Opti of in pres lique	on 1 is correct. The ease of liquefaction termolecular forces. Gases with static sure to liquefied. C_{l_2} has weaker id-id efy.	on of g ronge than	gases generally depends on the strength er intermolecular forces requires lower Br ₂ and thus requires higher pressure to			
	Opti redu shel elec Opti is 11	on 2 is correct. The oxidising power of 0 action, each halogen atom gains an electron due to the nucleus for CI_2 tron due to the greater electrostatic attention 3 is correct. The first ionisation energy 140 kJ mol ⁻¹ .	Cl ₂ is getron than ractic	greater than that of Br_2 . When undergoing and this electron is added to the valence Br_2 . Hence it is easier for CI_2 to gain the on, hence its greater oxidising power. f $CI(g)$ is 1260 kJ mol ⁻¹ while that of $Br(g)$			
	Г Г						
12	An e elem the e	element in the Period 2 of the Period nent a group higher in the Period 3. Th elements and their compounds.	ic Tal is is k	ble often shows similar properties to the nown as a diagonal relationship between			
	An e	example of a diagonal relationship is be	etwee	n beryllium and aluminium.			
	Whi	ch statement about BeO and $BeCl_2$ is	incor	rect?			
	Α	BeO is amphoteric in nature but BeC	l ₂ is a	acidic in nature.			
	В	BeO is predominantly covalent but B	eCl₂ i	s predominantly ionic.			
	С	BeO is insoluble in water but BeCl ₂ p	artial	ly hydrolyses in water.			
	D	BeO has a giant lattice structure but	BeCl	has a simple lattice structure.			
	Ans	wer: B					
	All o	ptions are correct except B .					
	BeO	is predominantly <i>ionic</i> but BeCl ₂ is predominantly	edom	ninantly <i>covalent</i> .			

40	AP(many theory and have a first addP() is far and to reach a disclosed						
13	Nitromethane can be used as a fuel additive for motor racing and fockets.						
	$4CH_{3}NO_{2}(g) + 3O_{2}(g) \rightarrow 4CO_{2}(g) + 6H_{2}O(l) + 2N_{2}(g)$						
	Values of standard enthalpy changes of formation are in the table.						
	compound		compound		Δ <i>H</i> _f / kJ mol ^{−1}		
			CH ₃ NO ₂ (g)		–113		
			CO ₂ (g)		-394		
	H ₂ O(<i>l</i>)		$H_2O(l)$		-286		
	Wha	t is the enthalpy	change of this reaction	on?	_		
	Α	–3744 kJ mol ^{_1}	I	С	–2840 kJ mol ^{–1}		
	в	+3744 kJ mol-	1	D	+2840 kJ mol ⁻¹		
	Answer: C $\Delta H_{f}^{\theta} = \sum n\Delta H_{f}^{\theta} \text{ (products)} - \sum m\Delta H_{f}^{\theta} \text{ (reactants)}$ $= 4 \Delta H_{f}^{\theta} (CO_{2}) + 6 \Delta H_{f}^{\theta} (H_{2}O) - 4 \Delta H_{f}^{\theta} (CH_{3}NO_{2})$ $= 4 (-394) + 6 (-286) - 4 (-113)$ $= -2840 \text{ kJ mol}^{-1}$ Note that enthalpy change of formation of elements at standard state is zero.						

14	Use of the Data Booklet is relevant to this question.						
	Butane is used as a fuel for cooking.						
	When 0.025 mol of butane was burnt under a vessel containing 250 g of water, it was found that the temperature of the water rose by 50 °C.						
	Whie	ch value for the enthalpy change of co	mbust	tion of butane is given by these results?			
	A −2090 kJ mol ⁻¹ C −13 500 kJ mol ⁻¹						
	в	–2100 kJ mol ⁻¹	D	–13 580 kJ mol ^{–1}			

Answer: A Heat evolved = $mc\Delta T$ = (250)(4.18)(50) = 2250 J = 52.25 kJ
$\Delta H_c = (-) \frac{\text{Heat evolved during combustion(in kJ)}}{\text{No. of moles of substance burnt}} \text{ kJ mol}^{-1}$
= -52.25/0.025 = -2090 kJ mol ⁻¹

15	The sod Whi	The lattice energies of the caesium chloride, caesium fluoride, sodium chloride and sodium fluoride are given below in the options, not necessarily in this order. Which value corresponds to the lattice energy of caesium chloride?								
	A −661 kJ mol ⁻¹ C −780 kJ mol ⁻¹									
	в	–740 kJ mol ^{–1}	D	–918 kJ mol ^{−1}						
	Answer: ARecall that magnitude of lattice energy $\propto \frac{Q_+Q}{r_++r}$.Since all the cations and anions have the same charge in all the compounds, the difference is in the sum of their ionic radii. Caesium chloride has the largest sum of ionic radii, hence the magnitude of the lattice energy should be the smallest (least exothermic)									

16	For a reaction $2\mathbf{U}(aq) + 3\mathbf{V}(aq) \rightarrow 2\mathbf{W}(aq)$, the rate equation is rate = $k[\mathbf{U}]^2[\mathbf{V}]$.								
	reaction temperature / °C initial [U] initial [V] initial rate / mol dm ⁻³ / mol dm ⁻³ / mol dm ⁻³ s ⁻¹							ial rate dm ⁻³ s ⁻¹	
	1 25 1.0		1.0		r				
		2	55	0.5		0.5		q	
	It is a What	also given that th t is the initial rate	e rate doul	bles for every n 2, q ?	10 °C	rise in tempera	ture.		
	Α	0.5 <i>r</i>	B r		C	2 r	D	4 r	
	Ansv	wer: B							

At 25 °C, when initial [11] and initial [V] are halved, from rate equation
A 20 0, when initial [0] and initial [1] are naived, non-rate equation,
pew rate $-(0.5)^2(0.5)r - 0.125r$
1000 face = (0.5)(0.5)(-0.125)
At 55 °C (increase by 30 °C)
At 55 C (increase by 50 C),
$p_{0} = p_{1} + p_{2} + p_{3} + p_{3$
$1000 \text{ for } 1201 \times 2^{-1} = 1$

17	 A radioactive element has two isotopes, X and Y, with half–lives of 2 min and 6 min respectively. An experiment starts with z times as many atoms of X as of Y. After 6 min, the number of atoms of X and Y are both equal. Given that radioactive decay is a first order reaction, what is the value of z? 								
	Α	0.5	В	2	С	4	D	8	
	Let the no. of atoms of Y after 6 min be 1. Since the half-life of Y is 6 min, the no. of atoms of Y at start of experiment will be 2. Since the no. of atoms of X at start of experiment is <i>z</i> times that of Y , the no. of atoms of X at the start will be 2 <i>z</i> .								
	t = X: Y: Since 0.25.	$\begin{array}{llllllllllllllllllllllllllllllllllll$	4 ı 0. A = B	min 6 min 5 <i>z</i> 0.25 <i>z</i> 1 after 6 min,					

18 The gas-phrase reaction of hydrogen and nitrogen monoxide produces nitrogen and water.

$$2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$$

A series of experiments was carried out in a reaction vessel at constant pressure and the results obtained are given in the table.

[NO] / mol dm ⁻³	[H ₂] / mol dm ⁻³	initial rate / mol dm ⁻³ s ⁻¹
0.250	0.250	0.212
0.250	0.125	0.106
0.125	0.125	0.027

Which statement about this reaction is correct?

A	The overall order of the reaction is 3.
В	The reaction is second order with respect to [H ₂].
С	The reaction is first order with respect to [NO].

	D	The theoret	ical rate equati	ion for this	reaction is ra	ate = [H ₂] ^m [NO] ⁿ .
	Ans	wer: A					
	Lool Hen	Looking at the first two experiments, when $[H_2]$ is halved, the initial rate is halved too. Hence order of reaction with respect to H_2 is one.					
	Lool rate two.	king at the se increases by	econd and third 4 times from e	experimer expt 3 to 2.	nts, when [N Hence, orde	O] is doubled the of reaction v	from expt 3 to 2, the vith respect to NO is
	Ove	rall order of r	eaction = $1 + 2$	2 = 3			
	Opti	on D is wron	g as the rate co	onstant is r	nissing from	the rate equat	ion.
19	The exar 1.0	gas-phase mple of an ec mol of CO(g)	reaction of ca quilibrium. The in a 0.4 dm ³ fla	rbon monor reaction w ask and all	oxide with h as investigat owing equilit	ydrogen form ted by mixing 2 prium to be est	ing methanol is an 2.0 mol of H ₂ (g) with ablished at 300 K.
				2H ₂ (g)	+ CO(g)	, CH	l₃OH(g)
			initial amount	2.0	1.0		0
	At e	auilibrium. 0.	2 mol of H ₂ had	d reacted v	vith CO.		
	Wha	at is the value	of the equilibr	ium consta	ant $K_{\rm a}$ at 300) K?	
	Δ	1.2×10^{-2}					
	B	1.2×10^{-2}					
	C	3.4×10^{-2}					
	D	55×10^{-3}					
	Δns						
		Wer. D		2H ₂ (g)	+ CO(g)	⇔ CH₃OH(g)	
			initial moles	2.0	1.0	0	
			change	-0.2	-0.1	+0.1	
			eqm moles	1.8	0.9	0.1	
			I	$X_c = \frac{(\frac{0.1}{0.4})}{(\frac{0.9}{0.4})(\frac{1}{0})}$	$\frac{)}{(\frac{1}{2})^2} = 5.5 \times 1$	0 ⁻³	
	 -						
20	The	Haber proc	ess involves a	reversible	e reaction be	etween hydrog	gen and nitrogen to

20	achi	eve lar	ge scale production of ammonia.
			$3H_2(g) + N_2(g) \longrightarrow 2NH_3(g) \Delta H < 0$
	Whi	ch stat	ements about the Haber process is correct?
		1	Addition of iron catalyst speeds up the reaction and increases the yield of ammonia.

		2	The pressure used should be as high as possible to increase the yield of
			ammonia.
		3	Increasing the temperature speeds up the reaction but lowers the yield of ammonia.
	Α	3 only	у
	В	1 and	d 2 only
	С	1 and	d 3 only
	D	all of	the above
	Ans	wer: A	N
	Stat	ement same.	1 is incorrect. Catalyst will speed up reaction rate but yield of ammonia stays
	Stat pres with	ement sures stand I	2 is incorrect. Higher pressure increases yield of ammonia but extremely high will increase risk of explosion. More expensive equipment is also needed to high pressures.
	Stat amn exce	ement nonia (ess hea	3 is correct. Increasing temperature speeds up the rate of reaction. Yield of decreases as the backward endothermic reaction is favoured to absorb the at.
	· _ ·		
21	The	conce	ntration-time graph of a reversible reaction is shown below.



D	catalyst was added
Ansv	wer: C
A is	a incorrect. If concentration of reactant was changed, there should be a sharp ease/decrease to either A or B (vertical straight line up or down at time t).
B is B sh	incorrect. If volume of the reaction vessel was changed, both concentrations of A and hould show a sharp increase/decrease at time t.
C is so th read	correct. A change in temperature would result in a shift in POE to absorb/release heat ne concentrations of A and B would show gradual changes until a new equilibrium is hed. There will not be sharp changes in concentrations of A and B at time t.
D is exte esta	incorrect. Catalyst will speed up the forward and backward reaction rate to the same nt. However, POE will not change so there should not be a new equilibrium being blished.

22 Three unknown solutions **P**, **Q** and **R** contain a strong monobasic acid, a weak monobasic acid and a strong monoprotic base, but not necessarily in the same order. The concentration and pH of each solution are shown below. Ρ Q R 1.00 mol dm⁻³ 0.01 mol dm⁻³ 0.001 mol dm⁻³ pH = 12.0 pH = 1.8pH = 3.0Which statement is incorrect? **P** contains the strong acid. Α В **Q** contains the strong base. Mixing equal volumes of **P** and **Q** will produce a buffer solution. С Mixing 10 cm³ of **Q** and 100 cm³ of **R** will produce a solution of pH 7. D **Answer: A** P and R are acids while Q is the strong base. Strong monoprotic acids will fully ionise so the concentration of acid will be the same as the concentration of hydrogen ions. If **P** was a strong acid: pH = -lg(1.00) = 0Therefore, **P** is not a strong acid and has to be the weak acid. If **R** was a strong acid: pH = -lg(0.001) = 3.0Therefore, **R** is a strong acid. Mixing equal volumes of P and Q will result in a mixture of weak acid and its salt. A buffer solution will be formed.

Mixing 10 cm ³ of Q and 100 cm ³ of R will result in equimolar amounts of strong acid and
strong base reacting. Complete neutralisation will result in a solution of pH 7.

23	The value of the ionic product of water, K_{w} , varies with temperature.					
	H₂O(I) → OH ⁻(ag) + H⁺(ag)					
				- ()		
			temperature / °C	<i>K</i> _w / mol² dm ^{−6}	pH	
			0	0.1 × 10 ⁻¹⁴	7.5	
			10	0.3 × 10 ⁻¹⁴	7.3	
			25	1.0 × 10 ⁻¹⁴	7.0	
			35	2.1 × 10 ⁻¹⁴	6.8	
	Whi	ch sta	tements about the ionis	sation of water are co	prrect?	
		1	The reaction is endot	thermic.		
		2	At 10 °C, [H ⁺] is less	than 1.0 × 10 ⁻⁷ mol	dm ⁻³ .	
		3	Water is more acidic	at 35 °C than at 25 °	C as pH is less than 7.0.	
	Α	1 on	ly			
	В	1 an	d 2 only			
	С	3 on	ly			
	D	all of	the above			
	Answer: B					
	Statement 1 is correct. Ionic product increases with temperature which means that the forward reaction is favoured. This implies that the forward reaction is endothermic to absorb the excess heat.			5		
	Statement 2 is correct. At 25 °C, the pH of water is 7 and $[H^+] = 1.0 \times 10^{-7}$ mol dm ⁻³ . At 10 °C, the ionic product is smaller than at 25 °C, which means POE has shifted left such that $[H^+]$ and $[OH^-]$ are smaller.) .t		
	Statement 3 is incorrect. At 35 °C, the POE shifts right which increases [H ⁺] and [OH ⁻] to the same extent. Since [H ⁺] = [OH ⁻], water is still neutral even though pH <7.)		

24	Which of the following underlined species is not acting as a Brønsted-Lowry acid?		
	Α	$\underline{H_2O}(I) + NH_3(aq) \rightarrow NH_4^+(aq) + OH^-(aq)$	
	В	$\underline{HC}{l}(g) + NH_3(g) \to NH_4C{l}(g)$	
	С	$\underline{HNO_3}(I) + H_2SO_4(I) \rightarrow H_2NO_3^+(I) + HSO_4^-(I)$	
	D	$CH_3COO^{-}(aq) + \underline{H_2O}(I) \rightleftharpoons CH_3COOH(aq) + OH^{-}(aq)$	

Answer: C

 $\mathsf{HNO}_3(\mathsf{I}) + \mathsf{H}_2\mathsf{SO}_4(\mathsf{I}) \to \mathsf{H}_2\mathsf{NO}_3^+(\mathsf{I}) + \mathsf{HSO}_4^-(\mathsf{I})$

 $H_2SO_4(I)$ is the Brønsted-Lowry acid as it donates a proton to $HNO_3(I)$. $HNO_3(I)$ is the Brønsted-Lowry base as it accepts the proton.

25	Which of the following does not explain the wall climbing ability of geckos?		
	Α	Strong covalent bonds form between the geckos' feet and ceilings.	
	В	Geckos' feet contain nanostructures that have high surface area to volume ratio.	
	С	Instantaneous dipole-induced dipole interactions support the geckos' body weight.	
	D	Geckos can move along walls simply by pulling their feet at different angles.	
	Answer: A		
	Id-id interactions are the forces of attraction that allow the gecko to stick to the walls and ceilings. If covalent bonds were to form, the gecko would be stuck as these bonds are too strong.		



Both are conductors of electricity as all the carbon atoms have p orbitals that can overlap sideways with the p orbitals of neighbouring C atoms. Electrons are delocalised over the entire length of the graphene layer and poly(ethyne) layer.

All the carbon atoms in graphene and poly(ethyne) are sp² hybridised.

Graphene has a much higher melting point than poly(ethyne).

Both layers of graphene and layers of poly(ethyne) are held by weak id-id attraction so graphite is soft and slippery and poly(ethyne) is soft.

27	When 1 mol of cocamide DEA is heated with excess aqueous sodium hydroxide, a product			
	mixture was obtained.			
		0		
		OH		
		cocamide DEA		
	Whi	ch statement about the product mixture is correct?		
	••••			
	Α	The product mixture exists as an organic layer and an aqueous layer.		
	В	The organic products are $CH_3(CH_2)_nCOOH$ and $HOCH_2CH_2NHCH_2CH_2OH$.		
	С	The organic products react completely with 1 mol of dilute sulfuric acid.		
	D	The product mixture cannot be separated by heating.		
	Answer: C			
	_			
	Products formed after alkaline hydrolysis of amide: CH ₃ (CH ₂) _n COO ⁻ Na ⁺ and			
	HOCH ₂ CH ₂ NHCH ₂ CH ₂ OH are formed in excess NaOH in aqueous medium.			
	$CH_3(CH_2)_nCOO$ Na ⁺ forms ion-dipole interactions with water in aqueous medium and each molecule of HOCH_CH_NHCH_CH_OH can form 3 hydrogen bonds with water so it			
	will be soluble in water as well. There will not be an organic layer			
	The products of alkaline hydrolysis are $CH_3(CH_2)_nCOO^-$ and $HOCH_2CH_2NHCH_2CH_2OH$.			
	The products will react completely with 1 mol of $H_2SO_2(aq)$, 1 mol of H_2SO_2 will fully			
	dissociate to produce 2 mol of H ⁺ .			
	$CH_3(CH_2)_nCOO^- + H^+ \rightarrow CH_3(CH_2)_nCOOH$			
	$HOCH_2CH_2NHCH_2CH_2OH + H^+ \rightarrow HOCH_2CH_2N^+H_2CH_2CH_2OH$			
	-			
	I he product mixture can be separated by heating using fractional distillation as the			
	proc	iucis nave unterent politity politis.		



29	A section of nylon-6,6 is shown below.			
		-CO(CH ₂) ₄ CONH(CH ₂) ₆ NHCO(CH ₂) ₄ CONH(CH ₂) ₆ NH-		
	Whi	Which deductions can be made about nylon-6,6?		
	1 It is a polyamide.			
	2 It can be made from monomers HO ₂ C(CH ₂) ₆ NH ₂ and HO ₂ C(CH ₂) ₄ NH ₂			
	3 Hydrogen bonding forms between two polymer chains.			
	Α	1 on	У	
	В	1 and 3 only		
	С	2 and 3 only		
	D	D all of the above		
	Answer: B			
	Statement 1 is correct. There are multiple -CONH- (amide groups) in the structure shown. Statement 2 is incorrect. The monomers that form the structure are $H_2N(CH_2)_6NH_2$ and $HO_2C(CH_2)_4CO_2H$.			

Statement 3 is correct. There is a hydrogen atom bonded to a highly electronegative N
atom in the amide linkage, allowing the formation of hydrogen bonds between polymer
chains.

AOA

30	Poly(vinyl chloride) (PVC) and poly(vinyl alcohol) (PVA) are represented by the following			
	structures.			
		$ \begin{array}{c c} H & H & H & OH \\ \hline C & C & C & - C \\ \hline H & C \\ H & C \\ PVC & PVA \end{array} $		
	Whi	ch statement is incorrect ?		
	Α	PVC and PVA are both addition polymers.		
	В	PVA is water-soluble and is found in eye drops.		
	С	PVC is tough and flexible and can be used to make water pipes.		
	D	PVC is water-soluble and can be used to make glues.		
	Answer: D			
	PVC	is water-resistant as it cannot form hydrogen bonds with water.		