

SSS 2024 4E Pure Chemistry Prelim Mark Scheme

Paper 1

1	2	3	4	5	6	7	8	9	10
C	A	C	C	C	B	D	B	A	A

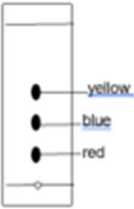
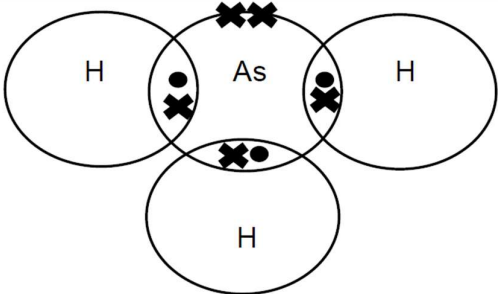
11	12	13	14	15	16	17	18	19	20
A	B	B	B	C	B	B	A	C	B

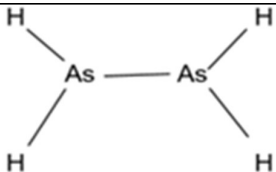
21	22	23	24	25	26	27	28	29	30
D	C	C	A	A	A	A	D	A	A

31	32	33	34	35	36	37	38	39	40
A	D	C	C	B	B	D	A	A	C

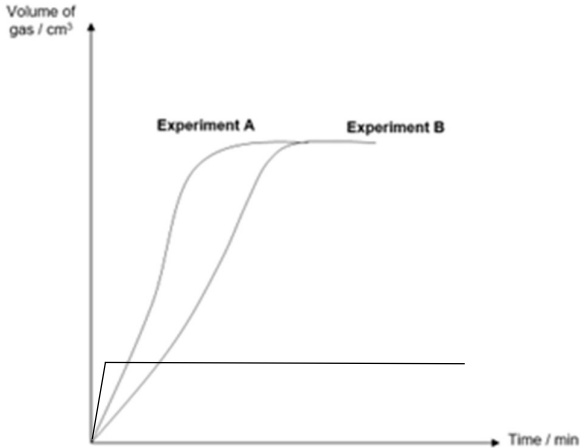
Paper 2

Section A			Marker's comments
1a	A/	1	
b	N or O	1	
c	Fe	1	
d	Ca	1	
e	C	1	
f	O	1	
2a	Yellow and purple Both answers must be correct.	1	
b	Rf yellow dye = 0.08 (@ 64/200 x 100 = 32% ethanol)	1	
c	Rf value for yellow dye in pure water is 0 , which means that the yellow dye cannot be separated; [1]	2	

	Rf value for red dye in pure ethanol is 0, which means that the red dye cannot be separated;. [1] <i>*both correct but no Rf value mentioned minus 1m</i> <i>*1 correct but no Rf value 0m</i>		
d	At 80% ethanol in the solvent mixture, [1] -All 3 dyes have the same Rf values of 0.4. -All the dyes present travel the same distance/travel at the same speed /rate. -All the 3 dyes have the same solubility. <i>Any one</i> [1]	2	
e	 The order and position of the dyes must be correct	1	
3ai	$\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$	1	
aii	$\text{AsH}_3 / \text{H}_3\text{As}$	1	
aiii		2	

	[1] lone (not used for bonding) pair [1] shared electrons btw As and H																					
bi	<table><tr><td></td><td>As</td><td>H</td></tr><tr><td>percentage / %</td><td>97.4</td><td>2.6</td></tr><tr><td>A_r</td><td>75</td><td>1</td></tr><tr><td>number of moles / mol</td><td>97.4/75 = 1.30</td><td>2.6/1 = 2.60</td></tr><tr><td>simplest ratio</td><td>1.30/1.30 = 1</td><td>2.60/1.30 = 2</td></tr></table> Empirical formula is AsH₂ [1] no. of moles expressed to 3 sf [1] ratio expressed to nearest whole no					As	H	percentage / %	97.4	2.6	A _r	75	1	number of moles / mol	97.4/75 = 1.30	2.6/1 = 2.60	simplest ratio	1.30/1.30 = 1	2.60/1.30 = 2	2		
	As	H																				
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simplest ratio	1.30/1.30 = 1	2.60/1.30 = 2																				
bii	n = 154 / 77 = 2 Molecular formula is As ₂ H ₄ / H ₄ As ₂				1																	
biii					1																	
4a	Halogens gain (one) electrons when they react / form ions. R: require an electron				1																	
b	<table><tr><td></td><td>At₂ (aq)</td><td>Br₂ (aq)</td><td>Cl₂ (aq)</td></tr><tr><td>At⁻ (aq)</td><td></td><td>✓</td><td>✓</td></tr><tr><td>Br⁻ (aq)</td><td>✗</td><td></td><td>✓</td></tr><tr><td>Cl⁻ (aq)</td><td>✗</td><td>✗</td><td></td></tr></table> one row / one column correct (1) all correct (2)					At ₂ (aq)	Br ₂ (aq)	Cl ₂ (aq)	At ⁻ (aq)		✓	✓	Br ⁻ (aq)	✗		✓	Cl ⁻ (aq)	✗	✗		2	
	At ₂ (aq)	Br ₂ (aq)	Cl ₂ (aq)																			
At ⁻ (aq)		✓	✓																			
Br ⁻ (aq)	✗		✓																			
Cl ⁻ (aq)	✗	✗																				
ci	colourless to brown				1																	

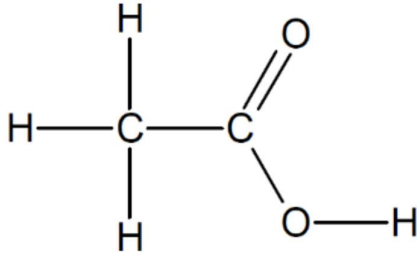
bi	Carbon monoxide/unburnt hydrocarbon/ sulfur dioxide/ oxides of nitrogen	1	
bii	CO and unburnt hydrocarbon- ensure there is sufficient oxygen for complete combustion of petroleum. Sulfur dioxide- flue gas desulfurisation or sulfur dioxide from chimney gases are absorbed by calcium carbonate.	1	
6a	No effervescence/bubbles were observed when aluminium is placed in sulfuric acid	1	
bi	Copper is below hydrogen in the metal reactivity series and hence cannot displace hydrogen from sulfuric acid.	1	
ii	Place a piece of lead metal in a beaker containing aqueous copper(II) nitrate. If lead metal is more reactive than copper, a brown solid will be formed/ blue solution will turn colourless. If lead metal is less reactive than copper, there will be no visible change. (accept any other possible test)	1 1 1	
c	Example: using zinc or magnesium blocks on ship's hull / underground pipes / bridge [1] Explain: Zinc or magnesium is more reactive than iron and will corrode in place of iron. [1]	2	
7a	Experiment B. (<i>no mark w/o reason given</i>) Lumps of lead(II) carbonate has a larger particle size compared to the powder form; thus it has smaller surface area exposed for collisions. [1]	2	

	Hence lumps will have a lower frequency of effective collisions between reactant particles and thus have a lower rate of reaction. [1]		
b	Experiment using CaCO_3 (x/100 mol) will have a larger amount of carbonate present compared to PbCO_3 (x/267 mol), as CaCO_3 has a smaller molar mass than PbCO_3. [1] Thus, greater volume CO_2 will be produced in the reaction that uses CaCO_3 [1]	2	
ci	 steeper gradient than A; lower volume of gas	1	
cii	The rate of reaction is fast initially as sulfuric acid is a dibasic acid and hence has a twice the number of H^+ per unit volume / compared to HNO_3 in experiment A [1] The small volume of gas produced quickly remains constant as PbCO_3 reacts with sulfuric acid to form insoluble PbSO_4 which forms a protective layer around the carbonate and prevents further reaction from taking place. [1]	2	

8a	$\text{Cu}^{2+} + 2\text{e} \rightarrow \text{Cu}$	1	
b	Filter the mixture; [1] Rinse the copper with water and allow to dry Weigh the pure, dry copper using an electronic weighing balance [1] Add the mass of this pure dry copper to the mass of the increase of copper at the negative electrode to obtain the total mass of the copper produced. Or find the gain in mass of copper at the negative electrode and add it to the mass of pure, dry copper obtained after filtration. [1]	3	
c	(i) Yes, I agree. Keeping the current constant e.g at 0.3A, when time is doubled (from 10 mins to 20 min), total mass of copper produced is doubled (0.06g to 0.12g) [1] (ii) Yes, I agree. Keeping time constant e.g. 20 minutes, when current is doubled (from 0.3 A to 0.6 A), the total mass of copper produced is double (0.12 g to 0.24 g) [1]	2	
d	3 answers: The solution becomes acidic; [1] Copper(II) ions are selectively discharged at the cathode while hydroxide ions are discharged at the anode. [1] As a result, the concentration of hydrogen ions is greater than hydroxide ions. [1] Or The blue electrolyte fades/colourless. [1] This is because copper(II) ions which gives the blue colour of the electrolyte are selectively discharged at the cathode. [1] As a result, the concentration of copper(II) ions in the electrolyte decreases overtime. [1]	3	

e	Mass of copper = 0.24 (from the graph) No. of moles of copper = $0.2464 = 0.00375$ mol [1] No. of copper atoms = $0.00375 \times 6 \times 10^{23}$ = 2.25×10^{21} atoms [1]	2	
9a	Helium is a noble gas with a stable electronic configuration of 2. [1] <i>OR</i> Helium has a fully filled valence electron shell . Hence, helium does not need to gain, lose or share electrons and will not react with other substances. [1]	2	accept "stable electronic configuration of noble gas"
b	<i>Any two of the following</i> • Heating is involved in both separation methods. • Both separation methods separate miscible liquids. • The substances with the lower boiling point will be separated out / collected first for both methods. <i>OR</i> Both separation methods are based on difference in boiling points of the substances .	2	reject "Both are separation techniques" reject "Both can obtain pure substances" reject "both methods involves use of tubes"
ci	Signal A – toluene Signal B – mesitylene	1	both must correct; reject if spelling incorrect
cii	amount of toluene : amount of mesitylene = Signal A height : Signal B height = 3 : 5	2	Allow error carry forward if student has identify the signals wrongly in 9c(i)

	Percentage amount of toluene $= 3 / (3+5) \times 100$ $= 37.5 \% [1]$ Percentage amount of mesitylene $= 5 / (3+5) \times 100 = 62.5 \% [1]$ OR $100\% - 37.5\% = 62.5\%$		
di	A higher flow rate will result in shorter retention time. [1] For example, with hexane when the flow rate increases from 20 cm/min to 35 cm/min, the retention time decreases from 5.54 min to 3.99 min. [1]	2	Reject "faster time" include any set of data from chromatograms accept "from above 5 min to below 5 min"
dii	The flow rate was too fast, so the mixture of benzene and hexane was not separated / both reach the detector at the same time.	1	Must have two parts (1) concept of time, and (2) not separated reject "causes their retention time to be the same" without indicating flow rate too high reject "one of the retention time could not be recorded"

Section B			Marker's comments
10a	Ethanoic acid  1 mark for both	1	
b	The sugar molecules in apple juice are first broken down into glucose by yeast. Fermentation takes place whereby the glucose is broken down into ethanol and carbon dioxide by yeast [1] at an optimal temperature of 37°C and absence of oxygen. [1] $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ [1]	3	
ci	They have the same molecular formula [1] but different structural formula.[1]	2	
ii	The more branching the molecule has, the higher the octane rating.	1	
iii	$C_7H_{16} \rightarrow CH_4 + 3C_2H_4$ [1] Correct products and balanced equation <u>Bubble the gases separately into aqueous bromine / bromine solution.</u> [1] Gas B turns <u>reddish-brown aqueous bromine</u> colourless whereas aqueous bromine <u>remained reddish-brown</u> when methane was bubbled into it. [1]	3	

11a	Addition polymerisation $\begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ -\text{C}- & \text{C}- & \text{C}- & \text{C}- \\ & & & \\ \text{COOH} & \text{OH} & \text{COOH} & \text{OH} \end{array}$ Condensation polymerisation $\begin{array}{ccccccc} \text{O} & \text{H} & \text{H} & \text{O} & \text{H} & \text{H} \\ & & & & & \\ -\text{C}- & \text{C}= & \text{C}- & \text{O}- & \text{C}- & \text{C}= & \text{C}-\text{O}- \end{array}$	2	
b	$\begin{array}{ccccccc} & \text{O} & & \text{H} & & \text{H} & & \text{O} \\ & & & & & & & \\ \text{H}-\text{O}- & \text{C}- & \text{C}- & \text{C}- & \text{C}- & \text{O}- & \text{H} \\ & & & & & & \\ & & \text{OH} & & \text{H} & & \end{array}$ 1 – COOH bonds on both sides 1- OH on one of the center C	2	
c	No. of mol of succinic acid $(25.0/1000 \times 0.05) = 1.25 \times 10^{-3} \text{ mol}$ [1] Comparing mol ratio, succinic acid : sodium hydroxide (1:2), Mol of sodium hydroxide used is $(1.25 \times 10^{-3} \times 2) = 2.5 \times 10^{-3} \text{ mol}$ Volume of sodium hydroxide is $(2.5 \times 10^{-3} / 0.0200) = 0.125 \text{ dm}^3$ $= 125 \text{ cm}^3$ [1]	2	Allow ECF
di	No. of repeating units required for the upper range $(20000/226) = 88.49$ No. of repeating units required for the lower range $(12000/226) = 53.1$ [1] for both Therefore, to be within the range of the average number of repeating units should be 54 to 88 [1]	2	Allow ECF

dii	Similarity – Both repeating units contain the <u>amide linkages</u>. [1] Difference – Nylon-5, 10 has <u>different number of carbon</u> / is <u>longer than</u> <u>Nylon-6,6</u>. [1]	2	
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