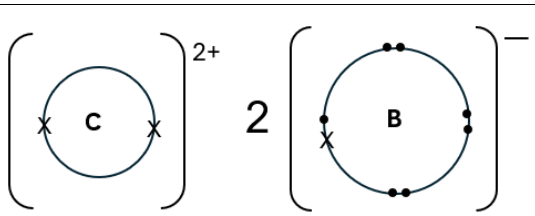
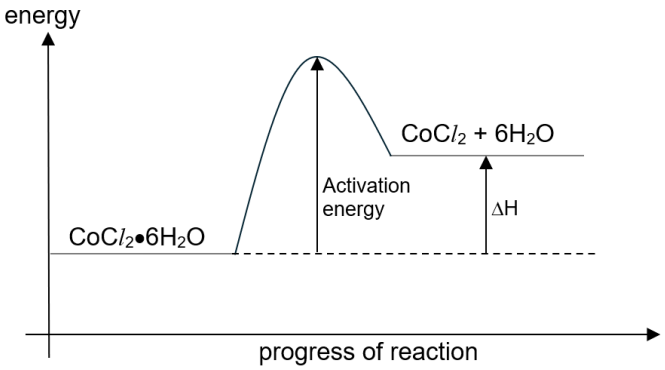
2024 CCHM Chemistry Prelim Mark Scheme

1	(ai)	C	1
	(aii)	E	1
	(aiii)	B	1
	(aiv)	D	1
	(b)	 Correct structure of C^{2+} ion; Correct structure of B^- ion; Correct ratio of C^{2+}: B^- ; (award only if structure of ions are correct) Allow $BeCl_2$ and [ ]$^{2+}$ [ ]$^-$ [ ]$^-$ arrangement	2
			[Total: 6]
2	(ai)	Filter the mixture; Wash the residue with distilled water and dry the salt between filter paper;	1 1
	(aii)	Filter the reaction mixture to remove silver dichromate. To the filtrate, add <u>aqueous sodium chloride</u>. (or any chloride or iodide solution) If white precipitate is observed, silver nitrate solution is added in excess. (No visible change is observed in the reaction mixture if silver nitrate solution has been used up.) If student didn't filter, 1m for suitable reagent, 1m for positive result	1 1 1
	(bi)	+6 (cao)	1
	(bii)	$2Ag^+(aq) + Cr_2O_7^{2-}(aq) \rightarrow Ag_2Cr_2O_7(s)$ 1m – balanced chemical equation 1m – correct state symbols (award only if formula is correct)	2
	(ci)	The dichromate ion (M_r of 216) has a larger relative molecular mass/molar mass than the silver ion (A_r of 108). Hence silver ion <u>diffuses</u> faster than dichromate ion and the red line is formed <u>nearer</u> to ammonium dichromate.	1 1
	(cii)	Shorter; When heated, the <u>ions/particles gain energy and moves faster</u> (allow gain KE). Hence, they diffuse faster towards each other.	1
		*If answer lack the idea of 'particles' in (ci) and (cii), deduct 1m from (c)	
			[Total: 11]

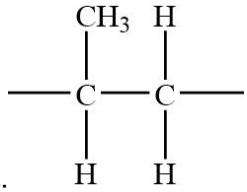
<table>
<tr><td>3</td><td>(a)</td><td>Decrease;
Water was produced and escaped as vapour / water vapour is produced.</td><td>1</td></tr>
<tr><td></td><td>(b)</td><td>To ensure that reaction or decomposition is complete / to completely remove water.</td><td>1</td></tr>
<tr><td></td><td>(ci)</td><td>Energy taken in = $\frac{88.1}{238}$ x 2 ---------- [1]
= 0.740336
= 0.740 kJ (cao) [1]</td><td>1

1</td></tr>
<tr><td></td><td>(cii)</td><td> 

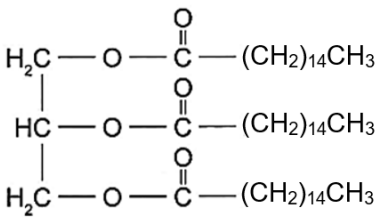
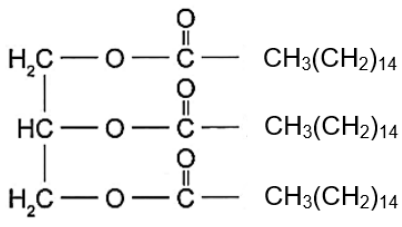
1m - correct profile with equation;
1m - correct activation energy as shown (reject double-headed arrow);
1m - correct enthalpy change as shown (reject double-headed arrow);
Award max 1m for activation energy if profile is wrong</td><td>1
1
1</td></tr>
<tr><td></td><td></td><td>[Total: 7]</td><td></td></tr>
<tr><td>4</td><td>(a)</td><td>Cobalt and nickel have identical or similar relative atomic masses.</td><td>1</td></tr>
<tr><td></td><td>(b)</td><td><u>Any two</u>

<table>
<tr><td>Transition elements</td><td>Halogens</td></tr>
<tr><td>High melting/boiling point</td><td>Low Melting/boiling point</td></tr>
<tr><td>High density</td><td>Low density</td></tr>
<tr><td>Good conductor of heat and electricity</td><td>Poor conductor of heat, non-conductor of electricity</td></tr>
<tr><td>Form positive ions by losing electrons</td><td>Form negative ions by gaining electrons</td></tr>
<tr><td>Good catalysts</td><td>Not catalyst</td></tr>
<tr><td>Form coloured compounds</td><td>Form white compounds (allow do not)</td></tr>
<tr><td>Have variable oxidation states in their compounds</td><td>Have fixed oxidation state in their compounds</td></tr>
</table></td><td>2</td></tr>
<tr><td></td><td>(ci)</td><td>Hydrogen atom loses one electron to form ion of +1 charge OR
Hydrogen atom has one valence electron</td><td>1</td></tr>
</table>

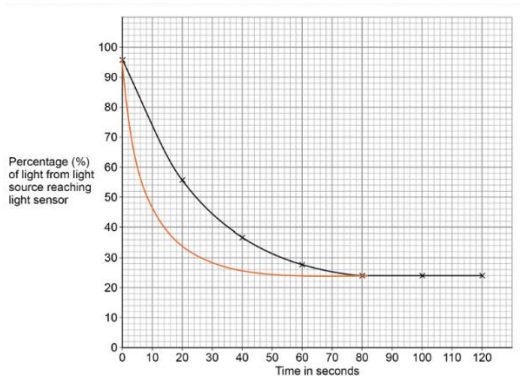
	(cii)	Any one • Hydrogen atom gains one electron to form ion of -1 charge; • Hydrogen atom can form diatomic molecule through sharing of electrons; • Hydrogen has low melting/boiling point;	1
			[Total: 5]
5	(a)	Oxidation; Hydrogen loss electrons to form H^+ ion	1
	(b)	Water	1
	(c)	$O_2(g) + 4H^+(aq) + 4e^- \rightarrow 2H_2O(g)$	1
	(d)	Advantage: Water is the only product so it is non-polluting unlike pollutant such as carbon dioxide or carbon monoxide or unburnt hydrocarbon which is produced in a petrol engine; Disadvantage: Unlike petrol, hydrogen is a gas making it difficult to be transported/stored OR There is a risk of hydrogen gas leaking and hence reacting explosively;	1 1
			[Total: 5]
6	(a)	Oxygen produced at the anode reacts with graphite at high temperature to form carbon dioxide;	1 1
	(b)	Molten cryolite is an impurity in molten aluminium oxide; This mixture melts at a lower temperature than pure aluminium oxide; Hence, less energy is needed to keep the electrolyte molten during electrolysis	1 1
	(c)	SO_4^{2-} and OH^- ions are attracted to the positive electrode made of aluminium. OH^- ions are lower than SO_4^{2-} ions in the electrochemical series and are selectively discharged, producing oxygen; $4OH^-(aq) \rightarrow O_2(g) + 2H_2O(l) + 4e^-$ 1m – balanced equation 1m – explanation of OH^- being selectively discharged	1 1
	(di)	Aluminium, metal **X** and metal **Y**	1
	(dii)	Grey solid form; (reject ppt) Green solution turns colourless;	1 1
	(diii)	Aluminium is more reactive than metal X. Hence, it displaces X from its chloride solution, forming grey solid X and colourless aluminium chloride solution. 1m – more reactive + displace ; 1m – identify products formed	1 1
			[Total: 11]

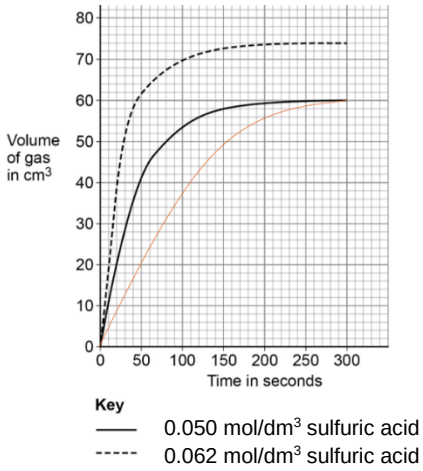
7	(a)	Poly(propene) Repeat unit: 	1 1
	(bi)	Depolymerisation is a process in which polymers are broken down into their monomers (using water in the presence of an acid catalyst).	1

	(bii)	<u>Social issues</u>
		• more convenient to throw away recyclable plastics
		• unaware of proper way to recycle plastics
		• takes time and effort to adopt a recycling lifestyle
		
		<u>Economic issues</u>
		• can be expensive
		  ○ transport cost
		  ○ cost of sorting and cleaning
		  ○ energy cost
		• recycling plastic waste may cost more than the recycled plastic
			1
			
			1

			[Total: 5]
8	(ai)	Stearic acid has a <u>higher M_r or longer carbon chain</u> than palmitic acid. Hence, <u>more energy</u> is needed to overcome the <u>stronger intermolecular forces of attraction</u> between stearic acid molecules than between palmitic acid molecules.	1 1
	(aii)	Presence of C=C bonds decreases the melting point of carboxylic acid.	1
	(aiii)	<u>Add aqueous bromine</u> into the monomer. <u>Reddish brown</u> aqueous bromine will <u>decolourise rapidly</u>. 1m – describe the test 1m – test result	1 1
	(b)	 Reject: 	1

	(ci)	Mass of I_2 = $\frac{0.237}{0.256}$ x 100 = 92.6 g	1
	(cii)	No. of moles of I_2 = $\frac{mass}{molar\ mass}$ = $\frac{92.6}{2\ x\ 127}$ = 0.364 mol [1] No. of moles of oil = $\frac{100}{782}$ = 0.128 mol [1] 1 mol of I_2 exactly saturates 1 mol of C=Cbond Mole ratio of oil : I_2 0.128 : 0.364 1 : 2.84 Average number of C=C bonds per oil molecule in olive oil is 2.84 (cao) [1]	3
			[Total: 10]
9	(a)	Carbon dioxide is a <u>greenhouse gas</u> which <u>traps heat;</u> Having excessive amount of carbon dioxide in the atmosphere may lead to <u>global warming</u>.	1 1
	(b)	More CO_2 per unit volume can be transported.	1
	(ci)	$Mg_2SiO_4(s) + 2CO_2(l) \rightarrow 2MgCO_3(s) + SiO_2(s)$ 1m – balanced chemical equation 1m – correct state symbols (award only if first mark is awarded)	2
	(cii)	<u>Solid</u> magnesium carbonate and silicon dioxide formed might <u>block</u> the liquid CO_2 <u>pipelines</u>.	1
	(d)	Release of iron compounds pollutes the ocean OR Burning of fossil fuel to run vessels will release excessive CO_2 into the atmosphere.	1
	(e)	Number of moles of 1 kg Fe = 1000 ÷ 56 = 17.857 mol [1] Based on Redfield ratio Fe : C 0.001 : 106 1 : 106 000 17.857 : 106 000 x 17.857 = 1 892 842 No. of mole of C = 1 892 842 [1] (allow ecf)	3

		Mass of CO_2 = 1 892 842 x 44 = 83 285 048 g = 83 285.048 kg = 83 000 kg [1] (rounded to the nearest thousand)	
			[Total: 10]
10	(a)	Sulfur is a solid / precipitate / insoluble substance, preventing light from reaching the sensor. Percentage of light reaching the light sensor decreases because <u>more</u> sulfur is produced with time.	1 1
	(bi)	Rate of reaction decreases; because concentration of reactants decreases;	1 1
	(bii)	Hydrochloric acid is used up	1
	(c)	 Reaction is faster. - Steeper initial gradient - End earlier	1
	(d)	When temperature increase, reacting particles <u>gain energy and move faster</u> (allow increase KE); <u>More</u> reacting particles will have energy equal to or more than the activation energy; This <u>increases the frequency of effective collision between reacting particles;</u> Speed of reaction increase, hence reaction takes a shorter time to complete.	1 1
	(e)	When mass of S produced = 0.35 g $\frac{volume\ of\ sodium\ thiosulfate}{volume\ of\ hydrochloric\ acid} = \frac{110}{440} = 0.25$ Hence, ratio of sodium thiosulfate solution : hydrochloric acid = 1 : 4 (cao) 1m – volume of sodium thiosulfate and HCl at any fixed mass 1m – correct ratio	2
			[Total: 10]

11	(a)	The delivery tube is in sulfuric acid.	1
	(bi)	Sulfuric acid; When concentration of sulfuric acid increases, the volume of hydrogen gas produce increases. (A change in the amount of limiting reactant used will result a change in the amount of product produced.)	1 1
	(bii)	Any one • the reaction using 0.05 mol/dm^3 sulfuric acid takes longer to end • the reaction using 0.05 mol/dm^3 sulfuric acid produces less gas in a fixed time • the initial gradient of the graph for 0.05 mol/dm^3 sulfuric acid is less steep or the gradient of the graph for 0.05 mol/dm^3 sulfuric acid at a fixed time before 200 s is less steep	1
	(c)	 Reaction is slower. - Gentle initial gradient - End later	1
	(d)	No effervescence will be observed because insoluble calcium sulfate formed will coat calcium carbonate preventing further reaction. 1m – observation; 1m – explanation	1 1
	(e)	Hydrochloric acid is a monobasic acid while sulfuric acid is a dibasic acid. Hence, for the same volume and concentration used, the concentration of H^+ ion in HCl is lower than that in H_2SO_4. As the number of reacting particles per unit volume decreases; Frequency of effective collision between reacting particles decreases; Hence, the rate of reaction is slower and reaction takes a longer time to complete.	1 1 1
			[Total: 10]

Paper 1 Answers

1	D	11	B	21	A	31	D
2	C	12	B	22	C	32	D
3	C	13	C	23	D	33	C
4	A	14	D	24	C	34	A
5	B	15	A	25	C	35	B
6	D	16	C	26	D	36	B
7	A	17	A	27	A	37	C
8	C	18	D	28	D	38	D
9	C	19	A	29	C	39	B
10	B	20	B	30	B	40	A