Chung Cheng High School (Yishun)
Secondary 4 Express Pure Chemistry Preliminary Examination 2020
Marking Scheme

Paper 1

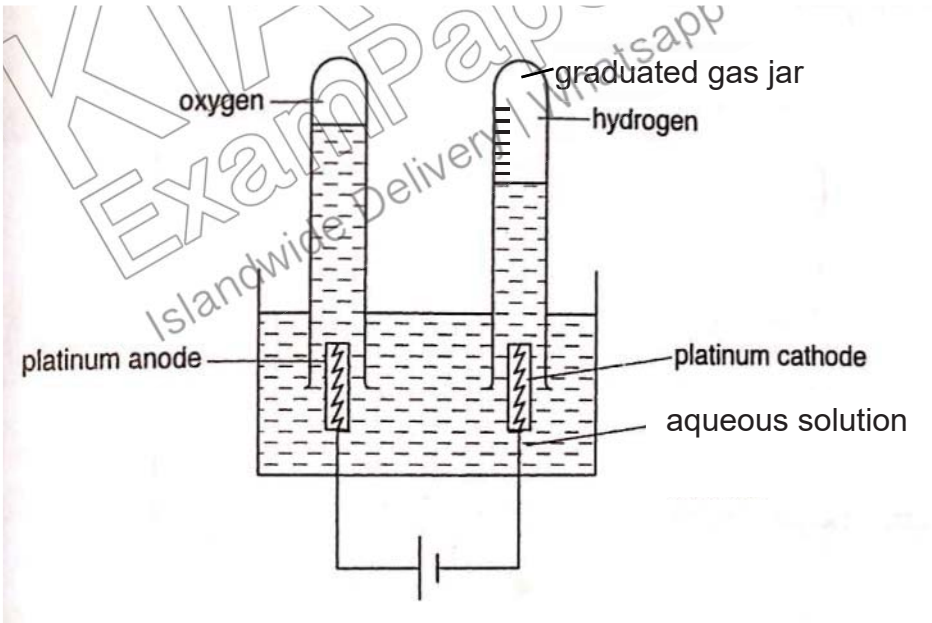
1	D	**6**	B	**11**	B	**16**	A	**21**	B	**26**	D	**31**	D	**36**	C
2	A	**7**	A	**12**	A	**17**	C	**22**	C	**27**	D	**32**	D	**37**	D
3	D	**8**	C	**13**	D	**18**	B	**23**	C	**28**	C	**33**	C	**38**	D
4	B	**9**	C	**14**	A	**19**	D	**24**	B	**29**	B	**34**	B	**39**	D
5	C	**10**	D	**15**	D	**20**	A	**25**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

Paper 2

Q/No.	Marking points/Marker's Report	Marks
A1(a)	neon-20 and neon-34	1
(b)	chlorine-37 and calcium-40	1
(c)	hydrogen-3 and caesium-131	1
(d)	neon-20 and neon-34	1
	Total:	**4**
A2(a)	$\left(84 \times \frac{1}{100}\right) + \left(86 \times \frac{10}{100}\right) + \left(87 \times \frac{7}{100}\right) + \left(88 \times \frac{82}{100}\right)$	1
	= 87.7	1
(b)	$n_{Sr} : n_{O}$ $\frac{180}{88} : \frac{245-180}{16}$ 2.0455 : 4.0625	1
	$\frac{2.0455}{2.0455} : \frac{4.0625}{2.0455}$ 1 : 1.98 Empirical Formula: SrO_2	1
(c)	Oxygen oxidised Sr, increasing Sr oxidation state from 0 in Sr to +4 in SrO_2.	1
	By removing electron/accepting electron from Sr	1
(d)	Superoxide: O_2^-	1
(e)	$Sr(O_2)_2$ has a higher melting point. The electrostatic forces of attraction between Sr^{2+} and O_2^- is stronger than between Na^+ and O_2^-	1
	Total:	**8**

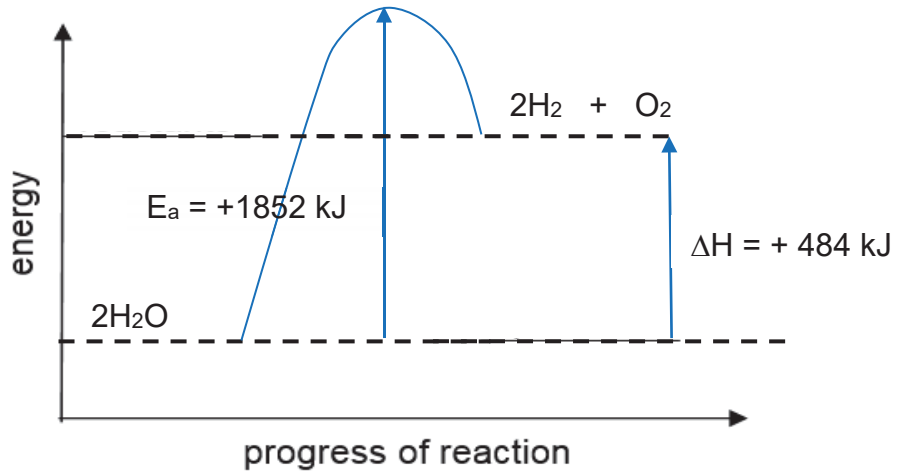
Q/No.	Marking points/Marker's Report	Marks
A3(a)	Particles (atoms) in strontium are closely packed and in an orderly manner.	1
	Particles (molecules) in chlorine are very far apart and in random arrangement.	1
(b)	Strontium has a giant metallic structure with **strong forces of attrcation between the Sr^{2+} and sea of free electrons**, hence the particles (atoms) are held closely together.	1
	Chlorine has a simple covalent structure with discrete molecules. These **molecules are held by weak forces of attraction** hence the particles are free to move.	1
(c)	Sr loses valence electrons to Cl forming Sr^{2+} and $2Cl^-$	1
	The oppositely charged ions attract each other and form $SrCl_2$	1
	Full credit for diagram showing the transfer of electrons from Sr to Cl, and finally forming $SrCl_2$	
(d)	Added substance has different atom sizes, **disrupted the orderly arrangement of the pure Sr atoms**	1
	A larger force has to be applied to slide the layers of Sr atoms	1
	Making the alloys harder and stronger	1
	2 credit for diagram showing the before and after adding diff. size atoms	
(e)	Sr is more rare/less abundant hence needs to be conserved for future generation	Any 2, 1 mark for each reason
	Sr is harder to extract/more expensive to extract, hence more economical to recycle	
	Sr is corrosion-resistant, hence it's easier/cheaper to recycle as compared to iron which rusts easily	
	Total:	**11**
A4(a)	Fe^{2+} Reject Fe and Fe^{3+}	1
(b)	$S_2O_8^{2-} + 2I^- \rightarrow 2SO_4^{2-} + I_2$	1
(c)	Mg^{2+} is unable to lose/donate electron to reduce $S_2O_8^{2-}$ to SO_4^{2-}	1
	Total:	**3**
A5(a)	$3H_2 + N_2 \rightleftharpoons 2HN_3$	1
(b)	**A** is H_2 , **B** is N_2	1
	$V_{H2} > V_{N2}$	
	C is NH_3 as amount of product increase as reaction progress	1
(c)	Reaction does not go to completion as it is a reversible reaction	Any 2, 1 mark for each reason
	Reaction must be carried out at ~450°C, 200 atm and with iron catalyst	
	$n_{H2} : n_{N2} = V_{H2} : V_{N2} = 3 : 1$ But 15 g of $H_2 = \frac{15}{2} = 7.5$ mol 5 g of $N_2 = \frac{5}{28} = 0.18$ mol The mole ratio is not 3 : 1	
	Total:	**5**

<table>
<tr><th>Q/No.</th><th>Marking points/Marker's Report</th><th>Marks</th></tr>
<tr><td>A6(a)</td><td>Contains oxygen</td><td>1</td></tr>
<tr><td></td><td>Can dissociate in water to form H^+ ions</td><td>1</td></tr>
<tr><td>(b)</td><td>
<table>
<tr><th>name of acid</th><th>chemical formula</th><th>reaction with magnesium (all acids have the same concentration)</th><th>oxidation state of chlorine</th></tr>
<tr><td>hypochlorous acid</td><td>HClO</td><td>only a few bubbles seen</td><td>+1</td></tr>
<tr><td>chlorous acid</td><td>HClO_2</td><td>reacts readily</td><td>+3</td></tr>
<tr><td>chloric acid</td><td>HClO_3</td><td>vigorous</td><td>+5</td></tr>
<tr><td>perchloric acid</td><td>HClO_4</td><td>very vigorous</td><td>+7</td></tr>
</table>
</td><td>2 marks

1 wrong minus 1 mark</td></tr>
<tr><td rowspan="2">(c)</td><td>Strength of acid increases as OS of Cl increases</td><td>1</td></tr>
<tr><td>When OS of Cl increases from +1 to +7, the reaction between the acid and Mg become more vigorous.</td><td>1</td></tr>
<tr><td rowspan="2">(d)</td><td>perchloric acid or HClO_4</td><td>1</td></tr>
<tr><td>Strongest acid, indicating the highest concentration of mobile H^+ ion</td><td>1</td></tr>
<tr><td>(e)</td><td>Measure the volume of H_2 produced at a regular time interval</td><td>1</td></tr>
<tr><td></td><td>Plot V_{H2} produced vs time on a graph</td><td>1</td></tr>
<tr><td></td><td>Total:</td><td>10</td></tr>
<tr><td>A7(a)</td><td> 

To note relative Vol of H_2 and O_2 and check that they are collected at the correct terminal (anode: O_2, cathode H_2)</td><td>2 marks
Label 1
Diagram 1</td></tr>
<tr><td>(b)</td><td>Pure water has no mobile ions to carry electric current.</td><td>1</td></tr>
</table>

<table>
<tr><th>Q/No.</th><th>Marking points/Marker's Report</th><th>Marks</th></tr>
<tr><td>(c)</td><td>
<table>
<tr><th>solution</th><th colspan="2">name of products of electrolysis</th><th>ionic equation for reaction at each electrode</th></tr>
<tr><td rowspan="2">dilute aqueous sodium chloride</td><td>at negative electrode</td><td>hydrogen</td><td>$2H^+ + 2e \rightarrow H_2$</td></tr>
<tr><td>at positive electrode</td><td>water and oxygen</td><td>$4OH^- \rightarrow 2H_2O + O_2 + 4e$</td></tr>
<tr><td rowspan="2">concentrated aqueous sodium chloride</td><td>at negative electrode</td><td>hydrogen</td><td>$2H^+ + 2e \rightarrow H_2$</td></tr>
<tr><td>at positive electrode</td><td>chlorine</td><td>$2Cl^- \rightarrow Cl_2 + 2e$</td></tr>
</table>
Ionic equation and name of products to be correct to get 1 mark for the electrode.
</td><td>1
1
Both eqn correct to get 1 mark
1</td></tr>
<tr><td rowspan="2">(d)</td><td>Dilute aqueous sodium chloride.</td><td>1</td></tr>
<tr><td>The overall equation for the electrolysis is $2H_2O \rightarrow 2H_2 + O_2$</td><td>1</td></tr>
<tr><td>(e)</td><td>Concentration of the solution will increase</td><td>1</td></tr>
<tr><td></td><td>As water is decomposed but the amount of NaCl remained.</td><td>1</td></tr>
<tr><td></td><td>Total:</td><td>10</td></tr>
<tr><td>B1(a)</td><td>Water molecule H atom attracted to negative SO_4^{2-} ion</td><td>2</td></tr>
<tr><td rowspan="2">(b)</td><td>Forces of attraction between the H_2O molecules and Na^+ and Cl^- is much greater than the attraction between Na^+ and Cl^-</td><td>1</td></tr>
<tr><td>but forces of attrcation between the H_2O molecules and Ag^+ and Cl^- is much weaker than the attraction between Ag^+ and Cl^-</td><td>1</td></tr>
<tr><td>(c)</td><td>K_{sp} increase as temperature increase</td><td>1</td></tr>
<tr><td>(d)</td><td>Barium sulfate</td><td>1</td></tr>
<tr><td>(e)</td><td>lead chloride/lead sulfate/any insoluble ionic compound</td><td>1</td></tr>
<tr><td rowspan="3">(f)</td><td>Concentration of Ca^{2+} = 0.01 mol/dm^3
Concentration of SO_4^{2-} = 0.0025 mol/dm^3</td><td>1</td></tr>
<tr><td>Ionic product = 0.01 x 0.0025
= 0.000025 > 0.00002</td><td>1</td></tr>
<tr><td>$CaSO_4$ will be precipitated out</td><td>1</td></tr>
<tr><td rowspan="2">(g)</td><td>Decrease temperature of the saturated solution</td><td>1</td></tr>
<tr><td>Evaporate the solvent to increase the concentration of the ions</td><td>1</td></tr>
<tr><td></td><td>Total:</td><td>12</td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

<table>
<tr><th>Q/No.</th><th>Marking points/Marker's Report</th><th>Marks</th></tr>
<tr><td>B2(a)</td><td> 
</td><td>Reaction pathway with reactants and products correctly labelled [1]

Ea 1

ΔH 1

Values ofΔH 1</td></tr>
<tr><td>(b)</td><td><table>
<tr><td>fuel</td><td>enthalpy change when 1 mol of H_2 is completely burned in kJ/mol</td><td>enthalpy change when 1 kg of H_2 is completely burned in kJ/kg</td></tr>
<tr><td>hydrogen, H_2</td><td>-484/2 = - 242</td><td>N_{H2} = 1000/2
500 x (-242) = -121 000</td></tr>
</table></td><td>1 mark each</td></tr>
<tr><td>(c)</td><td>No.
Source of H_2 from cracking of petroleum will also result in air pollutants e.g. N_xO_y, SO_2

Yes.
When H_2 burns as fuel, only the non-polluting H_2O is formed.</td><td>Either 1 with reason 2 marks</td></tr>
<tr><td></td><td>Total:</td><td>8</td></tr>
<tr><td>Either B3(a)</td><td>$2Cs(s) + 2H_2O(l) \rightarrow 2CsOH(aq) + H_2(g)$

Equation 1 State symbol 1</td><td>2</td></tr>
<tr><td>(b)</td><td>Easier for Cs to lose 1 valence electron to achieve stable gas configuration than Na as the valence electron is further away from the positively charged nucleus, thus is less strongly attracted.</td><td>1</td></tr>
<tr><td rowspan="2">(c)</td><td>Na will react with the water present in the aqueous solution present in larger amount.</td><td>1</td></tr>
<tr><td>Both iron carbonate and zinc carbonate are insoluble in water.</td><td>1</td></tr>
<tr><td>(d)</td><td>Assuming all 3 carbonates decompose on heating</td><td>1</td></tr>
<tr><td></td><td>Weigh 1.00 g of the 3 carbonates each</td><td>1</td></tr>
<tr><td></td><td>Heat the carbonates using the same flame intensity</td><td>1</td></tr>
<tr><td></td><td>Measure time taken to collect 10 cm^3 of CO_2</td><td>1</td></tr>
<tr><td></td><td>The shorter the time taken, the less reactive the metal in the carbonate is</td><td>1</td></tr>
<tr><td>OR</td><td></td><td></td></tr>
<tr><td></td><td>Assuming all 3 carbonates decompose on heating</td><td>1</td></tr>
<tr><td></td><td>Weigh 1.00 g of the 3 carbonates each</td><td>1</td></tr>
<tr><td></td><td>Heat the carbonates using the same flame intensity for a fixed duration</td><td>1</td></tr>
<tr><td></td><td>Measure the mass loss after cooling to room temperature</td><td>1</td></tr>
<tr><td></td><td>The more mass loss, the less reactive the metal in the carbonate is</td><td>1</td></tr>
<tr><td></td><td>Total:</td><td>10</td></tr>
</table>

Q/No.	Marking points/Marker's Report	Marks
Or B3(a)	~90% CO_2 <5% N_2 and other gases	1
	No O_2	1
(b)	Max: Venus has ~95% CO_2 but Earth has <5% CO_2 (based on data, do not penalise if cited as 0.03% or 3%)	1
	Min: Venus has <5% N_2 but Earth has ~80% N_2	1
	Venus has no O_2, but Earth has ~20% O_2	1
(c)	Plants appeared on Earth first	
	Plants absorb CO_2 during photosynthesis to make food and give out O_2	1
	$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$	1
	Resulted in the drastic decrease in %CO_2	
	Animals then appeared on Earth	
	Animals take in O_2 during respiration and give out CO_2	1
	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$	1
	Human activities such as combustion further added on to the change in the composition.	1
	Total:	**10**