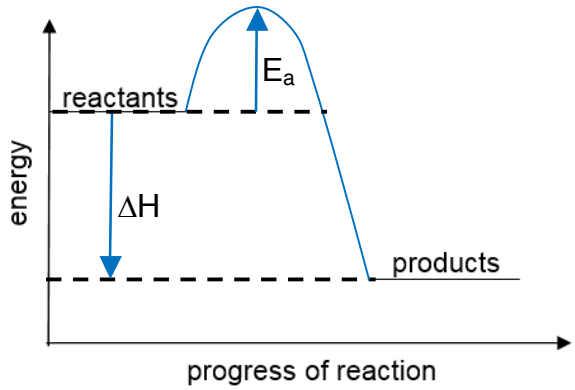
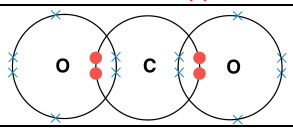
Chung Cheng High School (Yishun)
Secondary 4 Express Pure Chemistry Preliminary Examination 2018
Marking Scheme

Paper 2

Q/No.	Marking points/Marker's Report	Marks
A1(a)	A	1
(b)	D	1
(c)	D	1
(d)	B,C	1
(e)	B	1
	Total:	**5**
A2(a)	$3K + AlCl_3 \rightarrow 3KCl + Al$	1
(b)	Oxidation: K lost electron to form K^+	1
	Reduction: Al^{3+} **OR** $AlCl_3$ gained electrons to form Al	1
(c)	K is more reactive than Al while Cu is less reactive than Al. Thus K can reduce $AlCl_3$ to Al but Cu cannot	1
(d)	K will react with H_2O to form KOH and H_2 **Or** K will explode with H_2O **Or** $AlCl_3$ is soluble in water	1
(e)		Reaction pathway [1] Ea 1 ΔH 1
(f)(i)	Energy of products is less than energy of reactants	1
(ii)	Total energy taken in to break bonds in $AlCl_3$ is Less than Total energy given out to form bonds in KCl	
	• Direction of energy flow	1
	• Specific reactants and products	1
(g)	At higher temperature, more K and $AlCl_3$ particles have energy equal to or greater than the Ea **OR** K and $AlCl_3$ particles have higher kinetic energy	1
	hence frequency of collisions increase, leading to an increased rate of reaction	1
(h)	Electronic structure of argon is 2, 8, 8. Argon has a complete and stable valence shell hence is unreactive.	1
	Total:	**14**
A3(a)	Al_2O_3 is an amphoteric oxide.	1

Q/No.	Marking points/Marker's Report	Marks
(b)	Anode: $2O^{2-}(l) \rightarrow O_2(g) + 2e$	1
	Cathode: $Al^{3+}(l) + 3e \rightarrow Al(l)$	1
(c)		2
(d)	The O_2 produced at the anode burns (reacts with) the graphite (C) electrode at high temperature	1
(e)	Concentrated NaOH	1
(f)	highly alkaline and highly soluble in water, will runoff easily into water body and lower pH of the water, destroying the balance of the ecosystem.	1
(g)	In aq. $AlCl_3$, the H^+ will be preferentially discharged over Al^{3+},	1
	since H is less reactive than Al or producing H_2 instead.	1
(h)	No. Al will corrode preferentially over Fe.	1
(i)	Al is lighter than Cu	1
(j)	The different size Cu atoms disrupt the orderly arranged layers of Al atoms	1
	Hence when a force is applied, harder for the the layers to slide over one another.	1
(k)	Al is a finite resources which we need to conserve for future generation use.	1
	Total:	**15**
A4(a)	Heat the crude oil to vaporise the fractions	1
	Longer chain kerosene will cool and condense before petrol in the fractionating column and be separated from petrol.	1
(b)	Cracking the long C-chain fraction, kerosene, $C_{12}H_{26}$, into shorter C-chain fractions	1
	Increases the supply of the shorter C-chain fractions, which is higher in demand.	1
	Full marks awarded for the idea of cracking long C-chain to meet higher demand for the shorter C-chain	
(c)	$C_{12}H_{26} \rightarrow C_8H_{18} + C_4H_8$	1
	Total:	**5**
A5(a)	H_2 reacts with O_2 to generate electricity directly	1
(b)	Given: ΔH_{petrol} = -5450kJ/mol | Given: ΔH_{H2} = -256kJ/mol	2
	Mr_{petrol} = 8(12) + 18(1) = 114 | Mr_{H2} = 2(1) = 2	
	Per mol = 114 g → -5450kJ | Per mol = 2 g → -256kJ	
	1 g → -5450kJ/114 | 1 g → -256kJ/2	
	= -47.8kJ | = -128kJ	
	[1] for energy output for petrol | [1] for energy output for H_2	
(c)	Petrol is a liquid while H_2 is a gas at room conditions. Hence • it is easier to store petrol than H_2 *(to store H_2, a pressurised container is needed to condense H_2 to a liquid)* • for the same mass of petrol and H_2, a larger volume container has to be used to store H_2 than petrol. **note: 2 g of H_2 = 1 mol of H_2 = 24 dm^3 = 24 l = 16 x 1.5 l coke bottle!*	1
	• For the same mole of petrol and H_2 (per mol), petrol gives out 5450/256 ~ 21 times more energy than H_2 • But comparing the same mass of petrol and H_2 (per gram), H_2 only gives out 128/47.8 ~ 2 times more energy than petrol	1
	Candidates should be able to discuss at least 1 bullet point from each category. ***Note to candidates: when comparing numbers, always use ratio.***	
(d)	When used as fuel, H_2 reacts with oxygen to form the harmless water	1

<table>
<tr><th>Q/No.</th><th>Marking points/Marker's Report</th><th>Marks</th></tr>
<tr><td></td><td>but petrol burns to form the greenhouse gas, CO_2, which will contribute to global warming, leading to the melting of the ice caps, causing flooding of low land etc.</td><td>1</td></tr>
<tr><td></td><td>Total:</td><td>7</td></tr>
<tr><td>A6(a)</td><td>Any ammonium containing salt:
ammonium nitrate/
ammonium chloride/
ammonium sulfate/
ammonium carbonate</td><td>1</td></tr>
<tr><td>(b)</td><td>Calculation of Mr</td><td>1</td></tr>
<tr><td></td><td>Correct N:P:K ratio (whole number)</td><td>1</td></tr>
<tr><td>(c)</td><td>Liming of soil uses $Ca(OH)_2$ which will react with the ammonium fertiliser to form NH_3, which will escape into the air and reduce the N content for the crops.</td><td>1</td></tr>
<tr><td></td><td>Total:</td><td>4</td></tr>
<tr><td>B7(a)</td><td>
<table>
<tr><th>name of oxide</th><th>formula</th><th>physical state at r.t.p.</th><th>oxidation number of N</th><th>nature of oxide</th></tr>
<tr><td>nitric oxide
(nitrogen monoxide)</td><td>NO</td><td>gas</td><td>+2</td><td>neutral</td></tr>
<tr><td>nitrogen dioxide</td><td>NO_2</td><td>gas</td><td>+4</td><td>acidic</td></tr>
<tr><td>nitrogen trioxide</td><td>NO_3</td><td>very unstable</td><td>+6</td><td>acidic</td></tr>
<tr><td>nitrous oxide
(laughing gas)</td><td>N_2O</td><td>gas</td><td>+1</td><td>neutral</td></tr>
<tr><td>nitrogen sesquioxide</td><td>N_2O_3</td><td>liquid or solid</td><td>+3</td><td>acidic</td></tr>
<tr><td>Dinitrogen tetroxide</td><td>N_2O_4</td><td>solid</td><td>+4</td><td>acidic</td></tr>
<tr><td>dinitrogen pentoxide</td><td>N_2O_5</td><td>solid</td><td>+5</td><td>acidic</td></tr>
<tr><td>dinitrogen hexoxide</td><td>N_2O_6</td><td>very unstable</td><td>+6</td><td>acidic</td></tr>
</table>
[1] [1]
</td><td>2</td></tr>
<tr><td>(b)</td><td>Oxidation number < +3 the oxides are neutral
Oxidation number >= +3 the oxides are acidic</td><td>1</td></tr>
<tr><td>(c)(i)</td><td>NO_2, N_2O_3, N_2O_5</td><td>1</td></tr>
<tr><td>(ii)</td><td>As the molecular size/mass increases, more energy has to be absorbed to overcome the stronger intermolecular forces of attraction</td><td>1</td></tr>
<tr><td>(d)</td><td>Oxides of nitrogen are mostly acidic gases [from Table 7.1]</td><td>1</td></tr>
<tr><td></td><td>which can diffuse across land before dissolving in rainwater forming acid rain, destroying crops, corroding marble and metal structures and lowering pH of water body, causing harm to the aquatic life.
discussion should focus on "environmental concern"</td><td>1</td></tr>
<tr><td>(e)</td><td>They have the same number of N and O atoms but the atoms are arranged/bonded differently.</td><td>1</td></tr>
<tr><td></td><td></td><td>1</td></tr>
</table>

Q/No.	Marking points/Marker's Report	Marks
(f)	Irreversible	1
	Concentration of C goes to 0 as time passes.	
g(i)	$2N_2O_5$ (s) → $4NO_2$ (g) + O_2 (g)	1
(ii)	C A B	1
	Total:	**12**
B8(a)	Crush the leaves [to speed up extraction]	2
	Add water [to dissolve the compound]	
	Filter [to remove the leaves]	
	Crystallise [to obtain the compound]	
	Every 2 correct steps = [1]	
(b)(i)	Compare his test results with the actual melting point of SG.	1
	If not contaminated, the mp should be the same, [else would be lower]	1
	[Max 1 mark for candidates stating the substance is pure if the melting pt. is fixed]	
	Idea of comparison must come in as 2 marks are given for this question	
(ii)	To make the colourless spot visible Accept if candidates indicated that SG is colourless [given in Qn].	1
(iii)	Student's SG contains both pure SG, salt and	1
	1 other unknown substance.	1
	2 spots on the chromatogram are aligned to SG and salt, but there is a 3rd spot that is not aligned to any known substance.	1
	Total:	**8**
either B9(a)	All contains the –COOH which can	1
	partially dissociate/ionise in water to form H^+ ions	1
(b)		1
(c)	Yes. Both alanine have the same type and number of bonds.	1
(d)		
(e)	These monomers can polymerise with itself and also with the other 2 polymers at random.	1
	Total:	**10**

Q/No.	Marking points/Marker's Report	Marks
Or B9(a)	Similarity: • same type of atoms, C, H and C*l* • covalent structure	1
	Difference: • PVDC have a lot more C, H and Cl atoms than $C_2H_2Cl_2$ • PVDC does not have C=C but $C_2H_2Cl_2$ have	1
(b)		1
(c)	Mr $C_2H_2Cl_2$ = 2(12) + 2(1) + 2(35.5) = 97	1
	No. of repeating units = 82450/97 = 850	1
(d)	Advantage: durable, long lasting, corrosion resistance	1
	Disadvantage: cannot decompose naturally. When dispose off will cause landfill problem.	1
(e)	Chlorine atoms provide a different reaction path with lower activation energy for the ozone molecules to breakdown.	1
	Hence more ozone molecules have energy equal to or more than the new Ea, thus increasing frequency of (effective) collision.	1
(f)	The ozone layer reduce the amount of the harmful UV light entering the earth, which can cause skin cancer.	1
	Total:	**10**