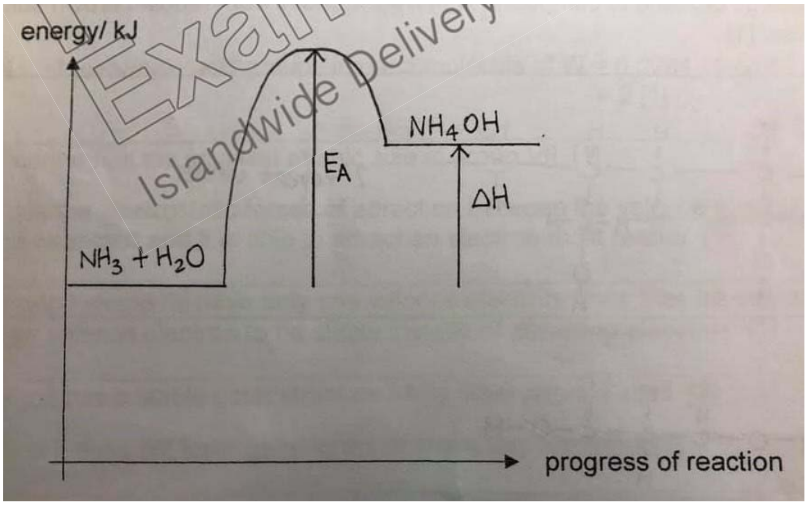
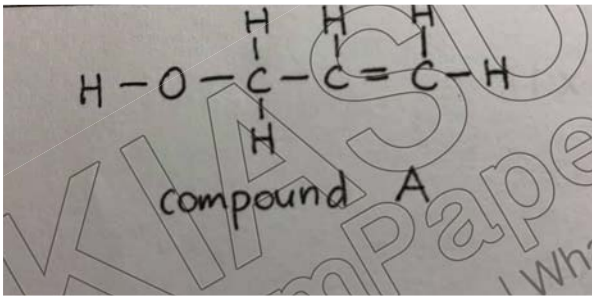
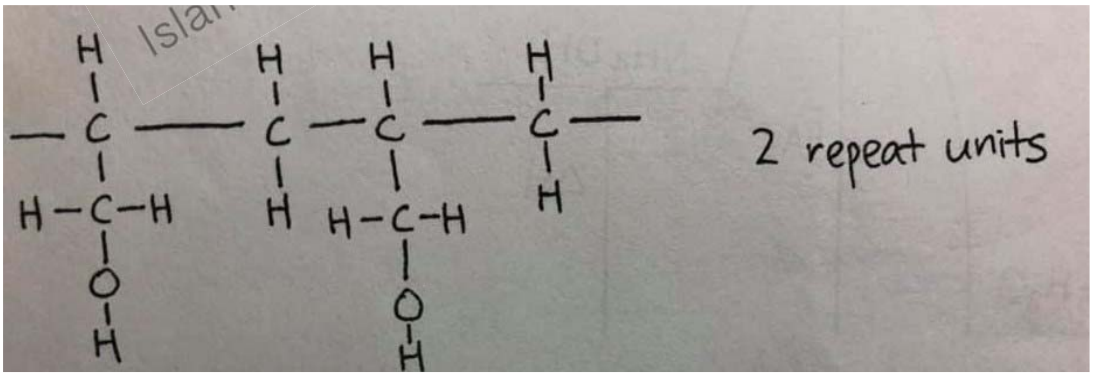
Zhonghua Secondary School

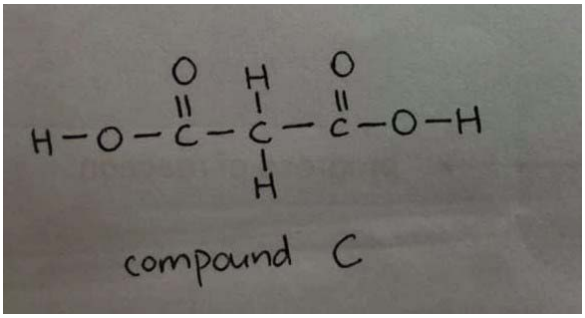
2019 Prelim 6092 Examination- Chemistry

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

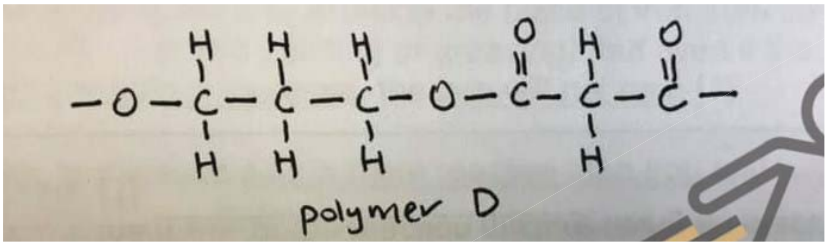
A1(a)	NH_3 [1]
(b)	$KMnO_4$ [1]
(c)	KI [1]
(d)	$CuSO_4$ [1]
(e)	$ZnSO_4$ [1]
(f)	KI [1]
A2 (a)	$CO(NH_2)_2 + H_2O \rightarrow 2NH_3 + CO_2$ [1]
(b)	Ammonia is oxidized to form nitrogen gas. Oxidation state of nitrogen increases from -3 in NH_3 to 0 in N_2. [1] Oxygen gas is reduced to form steam. Oxidation state of oxygen decreases from 0 in O_2 to -2 in H_2O. [1] Since oxidation and reduction take place, it is a redox reaction.
(c)	$N_2 + 3H_2 \rightleftharpoons 2NH_3$ No of moles of N_2: H_2 1 : 3 2 : 6 Nitrogen is in excess, hydrogen is the limiting reactant. [1] Theoretical mass of ammonia = 6/24 x 2/3 x 17 = 2.83 g [1] Maximum mass of ammonia = 2.83 x 88% = 2.49 g [1] (3sf)
(d)	 [1] for E_A [1] for ΔH [1] for reactants and products

A3(a)	Reddish brown solid will be formed on X. [1]
(b)	Student A is correct. Cu^{2+} ions will be <u>preferentially discharged</u> at the cathode and reduced to form Cu. [1] Cu^{2+} (aq) + 2e → Cu(s) [1] Blue colour intensity fades away due to Cu^{2+} ions being removed from the electrolyte. [1]
(c)(i)	Green to violet/blue [1]
(ii)	Initially concentrated potassium chloride solution is neutral and universal indicator is green. <u>Hydrogen ions</u> will be <u>preferentially discharged</u> at the cathode to form hydrogen gas. <u>Chloride ions</u> will be <u>preferentially discharged</u> at the anode to form chlorine gas. [1] Thus the remaining electrolyte is potassium hydroxide, which is alkaline. Universal indicatior turns violet in the presence of an alkaline solution. [1]
A4(a)	
(b)	Add <u>aqueous bromine</u> to compound **A**. It decolourises from <u>reddish brown</u> solution to <u>colourless</u>. [1]
(c)	

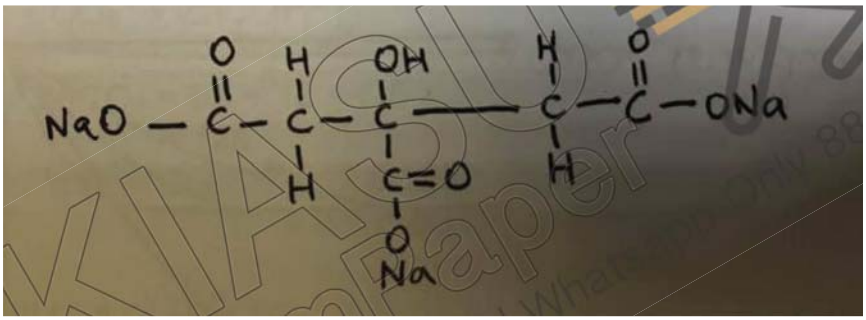
(d)



(e)



A5
(a)



(b)(i)

Element	C	H	O
Percentage	40.7	5.1	54.2
No. of moles	40.7/12 = 3.39	5.1/1 =5.1	54.2/16 = 3.39
Simplest ratio	3.39/3.39 =1	5.1/3.39 =1.5	3.39/3.39 =1
	2	3	2

Correct table with values [2] marks

Empirical formula is $C_2H_3O_2$. [1]

(ii)

No. of moles of NaOH = 1 x (29.40/1000)
= 0.0294 mol
No. of moles of **W** reacted = 1.73/118
= 0.0146 mol [1]

No. of carboxylic acid groups in each molecule of **W** = 0.0294 / 0.0146
= 2 [1]

<table>
<tr><td>A6
(a)</td><td>Fluorine has the smallest atomic size in group VII. [1]

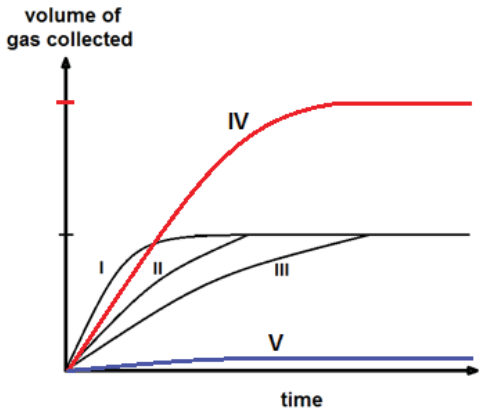
Thus the electrostatic forces of attraction between the valence electron and nucleus is the strongest and it is able to attract an electron most readily. [1]</td></tr>
<tr><td>(b)</td><td>Group I elements have only one valence electron. Thus they have tendency to lose their valence electron to be stable instead of attracting electrons. [1]</td></tr>
<tr><td>(c)</td><td>Argon has a stable octet structure / fully filled valence shell. [1]

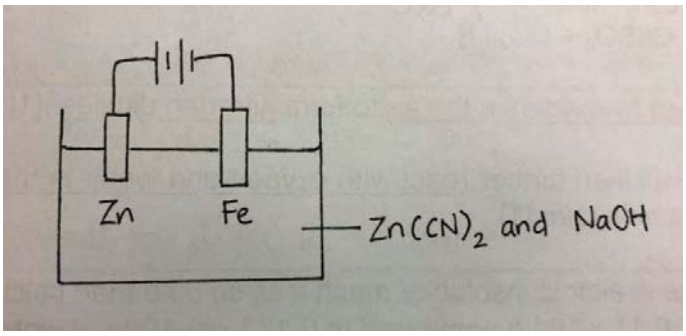
Thus it does not lose, gain/attract or share any electrons.[1]</td></tr>
<tr><td>(d)</td><td>Francium [1]

Range of value = 0.50 – 0.79 [1]</td></tr>
<tr><td>A7
(a)</td><td>Weak acids partially ionize to produce lower concentration of H^+ ions. [1]</td></tr>
<tr><td>(b)</td><td>H_3PO_4 (aq) ⇌ $3H^+$ (aq) + PO_4^{3-} (aq) /
H_3PO_4 (aq) ⇌ $2H^+$ (aq) + HPO_4^{2-} (aq)/
H_3PO_4 (aq) ⇌ H^+ (aq) + $H_2PO_4^-$ (aq) [1]</td></tr>
<tr><td>(c)</td><td>NaH_2PO_4 and Na_2HPO_4 [1]</td></tr>
<tr><td>(d)(i)</td><td>
<table>
<tr><th>Acid used</th><th>Curve</th></tr>
<tr><td>HCl</td><td>II</td></tr>
<tr><td>H_2SO_4</td><td>I</td></tr>
<tr><td>H_3PO_4</td><td>III</td></tr>
</table>
All correct for [1] mark
</td></tr>
<tr><td>(ii)</td><td>Both sulfuric acid and hydrochloric acid are strong acids. Sulfuric acid is a dibasic acid while hydrochloric acid is a monobasic acid. Thus, the experiment using sulfuric acid has a faster rate of reaction as compared to hydrochloric acid since the concentration of hydrogen ions is doubled compared to hydrochloric acid. [1]

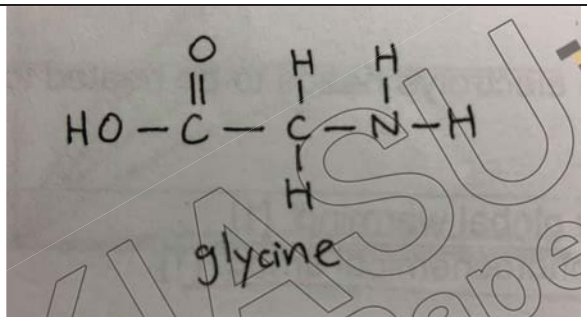
The experiment using phosphoric acid will have the lowest rate of reaction because the concentration of hydrogen ions in phosphoric acid is lowest among the three acids. [1]

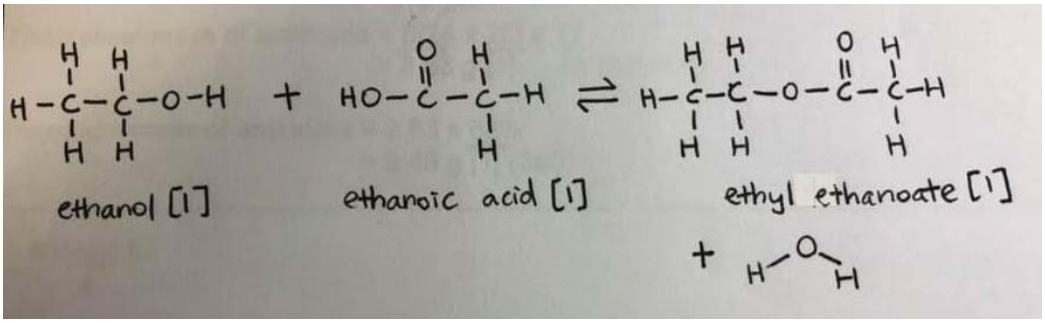
The higher the concentration of hydrogen ions per unit volume, the higher the frequency of effective collisions and the faster the rate of reaction. [1]</td></tr>
</table>

(e)	
(f)	Measure the mass of the reaction mixture using an electronic balance at fixed time intervals. [1]

B8 (a)	Galvanising not only protects the piece of iron from coming into contact with oxygen or water (just like painting or greasing), but even if the surface is scratched and the iron beneath is exposed, the iron will not rust. [1] This is because zinc is more reactive than iron and will corrode in place of iron. [1]
(b)(i)	$2Zn + O_2 \rightarrow 2ZnO$ [1] $ZnO + CO_2 \rightarrow ZnCO_3$ [1]
(ii)	Mr of $ZnCO_3$ = 65 + 12 + (16 x 3) = 125 No. of mol of $ZnCO_3$ = 12.5/125 = 0.1 mol [1] No. of mol of ZnO = 0.1 x 1 = 0.1 mol Mass of Zn = 0.1 x 65 = 6.5 g [1]
(c)(i)	

(ii)	The acids in the electrolyte may react with the iron and zinc electrodes. / H^+ ions from the electrolyte can be preferentially discharged to form H_2 gas. [1]
(d)	A piece of iron galvanised by hot-dip galvanisation is more durable / less likely to rust, as the layer of zinc is thicker. [1] However, it is more expensive/ more energy is needed as the electrolyte needs to be heated to 460°C to carry out galvanisation. [1]
B9 (a)	Methane is a greenhouse gas. It causes global warming. [1] Methane also leads to the formation of photochemical smog. [1]
(b)	$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ [1] Plants take in carbon dioxide and water in the presence of sunlight to manufacture glucose. [1]
(c)	Hydrogen is currently obtained from cracking of petroleum. [1] Petroleum is a non-renewable source / depleting finite resource. [1]
(d)	Any 2 answers: Burning hydrogen does not produce any pollutants, it produces only water. [1] The reaction between hydrogen and oxygen is more exothermic, thus producing more energy than that of gasoline. [1] Hydrogen is a renewable resource. [1]
(e) **B10**(a)(i) Either	Anode equation: $2H_2O(l) \rightarrow O_2(g) + 4H^+(aq) + 4e^-$ [1] Overall equation: $2H_2O(l) \rightarrow O_2(g) + 2H_2(g)$ [1] The amounts of CO, SO_2 and PM10 emissions are lower when using biodiesel than fossil diesel. [1] On the contrary, the amount of NO_x exhaust emission is higher when burning biodiesel than fossil diesel. [1]
(ii)	There is more amount of CO produced. CO is a pollutant which binds with haemoglobin in red blood cells, reducing its ability to transport oxygen. This causes breathing difficulties and may even result in death. [1] There is more SO_2 produced. SO_2 irritate the eyes and lungs and causes breathing difficulties [1]

(b)(i)	CaO/ calcium oxide [1] $CaO + SO_2 \rightarrow CaSO_3$ [1] OR $CaCO_3$/ calcium carbonate [1] $CaCO_3 + SO_2 \rightarrow CaSO_3 + CO_2$ [1]
(ii)	NO will be oxidised by oxygen in the air to form nitrogen dioxide. [1] Nitrogen dioxide will then further react with oxygen and water in the air to form nitric acid which causes acid rain. [1]
(iii)	Calcium carbonate is almost insoluble/ much less soluble than calcium hydroxide, with a solubility of 6.17×10^{-4} g compared to 0.173 per 100g of water. [1] Thus $CaCO_3$ reacts slowly with acid/effective only in reducing acidity on the surface of the soil/ cannot penetrate the soil to neutralise acid deeper down. [1]
B10 (a)(i) Or	
(ii)	Similarity: Both polymers only require one type of monomer / both polymers have giant molecular structures. [1] Difference: Polypropene is a hydrocarbon while polyglycine is a non-hydrocarbon / polyglycine has amide linkage while polypropene is held together by C-C single bonds. [1]
(iii)	No of monomers = 990/18 = 55 [1] Mr of polyglycine = 55 x [75 – 16 – 2(1)] = 3135 [1]

(b)(i)	Compound A is ethanol, B is ethanoic acid and C is ethyl ethanoate. 
(ii)	The amount of carbon dioxide emitted during the combustion of ethanol [1] is balanced by the taking in of carbon dioxide by sugar cane during photosynthesis [1]. As there is no net gain in carbon dioxide, the environmentalist is correct.