Pasir Ris Secondary School
Preliminary Examination (Aug 2020)
Sec 4E Chemistry 6092

6092 4E Chemistry Prelim Exam 2020 – Paper 1 Answer

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

Marking Scheme - Paper 2

<table>
<tr><th colspan="3">Question</th><th>Marking Scheme</th><th>Marks</th><th>Remarks</th></tr>
<tr><td colspan="6"></td></tr>
<tr><td>A1</td><td>(a)</td><td></td><td>
<table>
<tr><td></td><td>protons</td><td>electrons</td><td>neutrons</td></tr>
<tr><td>$^{33}_{16}S$</td><td>16</td><td>16</td><td>17</td></tr>
<tr><td>$^{25}_{12}Mg^{2+}$</td><td>12</td><td>10</td><td>13</td></tr>
</table>
</td><td>3</td><td>p -1m
n – 1m
e – 1m</td></tr>
<tr><td></td><td>(b)</td><td></td><td>2.8</td><td>1</td><td></td></tr>
<tr><td colspan="6"></td></tr>
<tr><td>A2</td><td>(a)</td><td></td><td>Silver chloride / barium carbonate</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td>Sodium hydroxide and iron(II) nitrate
Both must be correct.</td><td>1</td><td></td></tr>
<tr><td></td><td>(c)</td><td></td><td>Sodium hydroxide and ammonium sulfate
Both must be correct.</td><td>1</td><td></td></tr>
<tr><td></td><td>(d)</td><td></td><td>Magnesium oxide and dilute sulfuric acid
Both must be correct.</td><td>1</td><td></td></tr>
<tr><td></td><td>(e)</td><td></td><td>Sodium hydroxide and zinc sulfate
Both must be correct.</td><td>1</td><td></td></tr>
<tr><td colspan="6"></td></tr>
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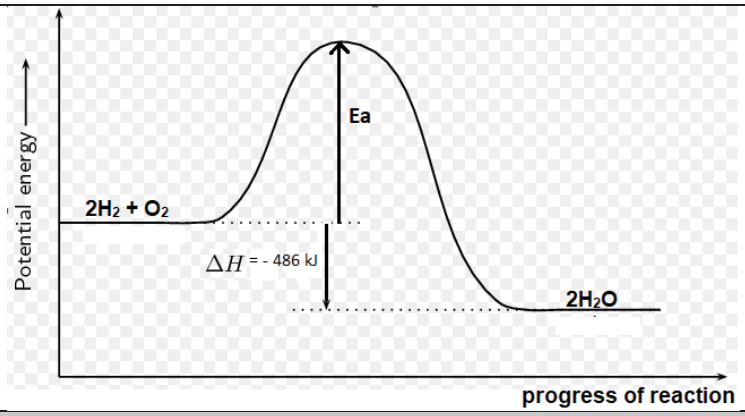
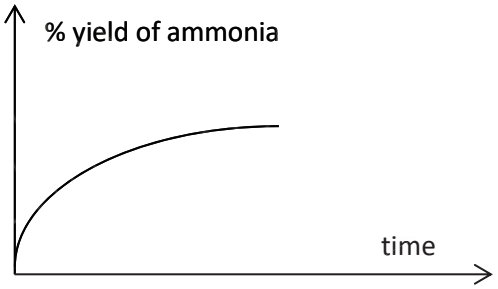
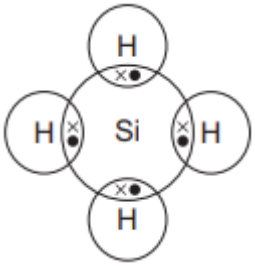
A3	**(a)**		No. of moles of HC*l* = 2.0 x (50/1000) = 0.100 mol No. of moles of Zn = 0.650/65 = 0.0100 mol Molar ratio of Zn : HC*l* = 1 mol : 2 mol 0.01 mol of Zn will react with only 0.02 mol of HCl Since 0.1 mol HC*l* was added for the reaction, it was the acid that was in excess.	1 1 1	BCA table accepted
	(b)		The rate of reaction is the fastest at initial time because the mass of zinc is the highest. The rate of reaction decreases because the mass of zinc decreases with time and the number of collision decreases, hence number of effective collision decreases with time. Reaction eventually stops at 7 minutes, when the zinc is completely used up.	1 1 1	
	(c)		Experiment 2: half the volume (120cm^3) & same rate as exp 1 Experiment 3: same volume (240cm^3) & twice/faster rate than exp 1	1 1	e.c.f. allowed
A4	**(a)**		$2H_2 + O_2 \rightarrow 2H_2O$	1	
	(b)		Energy absorbed for bond breaking = 2 x 436 + 498 = **1370 kJ** Energy released for bond forming = 4 x 464 = **1856 kJ** energy change = +1370 kJ + (-1856 kJ) = **- 486 kJ**	1 1	At least one calc correct
	(c)		O=O has a double (covalent) bond **or** Both O-H and H-H only have single (covalent) bonds/ More energy is needed to break the O=O bond than to break the O-H or H-H bond.	1	
	(d)		Hydrogen can be used as a fuel because when it reacts with oxygen, more energy is released during bond formation in water than energy absorbed during bond breaking in hydrogen and oxygen gas. [1] The reaction is exothermic. [1]	2	
	(e)		[1]: correct shape (exothermic) [1]: correct labelling of enthalpy change of reaction and E_a [1]: correct labelling of reactants and product	3	Penalise 1m for each wrong direction of arrows

					
A5	**(a)**		hydrogen – cracking of crude oil/(alkane) [1]; nitrogen – fractional distillation of (liquefied) air. [1]	1 1	
	(b)	**(i)**	No. of moles of N_2 = 140/28 = 5 mol No. of moles of H_2 = 30/2 = 15 mol [1] Since N_2:H_2 is 1:3, so none of them is in excess/limited; The theoretical (100%) mass of NH_3 formed = 10 x 17 = 170 g [1] At 450 °C & 200 atm, the mass of NH_3 formed = 170g x 27% = 45.9 g [1]	3	
		(ii)		1	
		(iii)	Too high a pressure will greatly increase the cost of operation; or using a higher pressure is more dangerous (safety risk).	1	
		(iv)	This is to ensure that the speed of reaction will not be too slow so as to stay economical.	1	
A6	**(a)**		Silicon dioxide loses oxygen atoms to form silicon and is reduced. Carbon gains an oxygen atom to form carbon monoxide and is oxidised. Since oxidation and reduction occurs simultaneously, this reaction is a redox reaction. (-0.5 m if this is not mentioned)	1 1	
	(b)		Any two from: high melting point / high boiling point (1) poor conductor of electricity (1) does not dissolve (in water) (1) (very) hard (1)	2	

	(c)	**(i)**	 1m – ratio of Si and H 1m – arrangement of electrons	2	
		(ii)	Silane has a simple (molecular or covalent) structure [1] with weak intermolecular forces / van der Waals' forces between molecules which are easy to overcome with little energy. [1]	2	
A7	**(a)**		$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$	1	
	(b)	**(i)**	Processes like combustion and respiration release CO_2 AND photosynthesis absorbs CO_2. The (rate of) CO_2 released into the atmosphere is (roughly) the same as the amount absorbed from the atmosphere.	1 1	
		(ii)	gas which absorbs infra-red radiation/gas which absorbs energy / gas which absorbs heat	1	
		(iii)	waste gas from animals / bacterial action etc.	1	
		(iv)	No. of moles of methane = 0.0014/ 24 = 5.833×10^{-5} mol Mass of methane = $5.833 \times 10^{-5} \times 16 = 9.33 \times 10^{-4}$ g	1 1	
	(c)		The oxygen in O_2 comes from the water/ the oxygen in the oxygen molecule comes from the water AND the oxygen in $C_6H_{12}O_6$ comes from CO_2.	1	Need to mention both origins.
B8	**(a)**		Chlorine is more reactive than bromine. [1] Hence, chlorine is able to displace bromine from its aqueous bromide solution. [1]	2	
	(b)		$Cl_2(aq) + 2Br^-(aq) \rightarrow 2Cl^-(aq) + Br_2(aq)$ Correct state symbols – [1] Balanced ionic equation – [1]	2	
	(c)	**(i)**	The solution changed from colourless to red-brown/brown / orange.	1	
		(ii)	More light is absorbed by bromine [1] as bromine has darker colour intensity as compared to chlorine [1].	2	
	(d)		The value of absorbance increases quickly during the first 1 / 1.5 minutes. [1] Between 1 / 1.5 minutes to 4.5 / 5 minutes, the value of absorbance increases more gradually. [1] After 4.5 / 5 minutes, the value of absorbance remains constant at a value of 0.7. [1]	3	

B9	**(a)**		% nitrogen in ammonium chloride, NH_4Cl = 14/53.5 x 100% = 26.2% % nitrogen in ammonium phosphate, $(NH_4)_3PO_4$ = 42/149 x 100% = 28.2% Hence, ammonium phosphate has a higher percentage mass of nitrogen than ammonium chloride. (deduct 0.5m if the student did not state a stand)	1 1	
	(b)		$OH^-(aq) + H^+(aq) \rightarrow H_2O(l)$	1	
	(c)	**(i)**	Strong acid dissociates/ionises completely/fully in water to form a high concentration of hydrogen ions. Weak acids dissociates/ionises partially in water to form a low concentration of hydrogen ions.	1 1	
		(ii)	Add metal/ metal carbonate to the acid. Measure the volume of gas produced at regular time intervals. The strong acid would have a faster rate of reaction compared to weak acid. [Reject: more gas would be produced with a strong acid, unless student mentioned "more gas produced per unit time interval"] OR Add universal indicator. The strong acid would indicate a red colour. Weak acid would indicate a orange or yellow colour.	2	1m – test 1m – observations
		(iii)	$NH_4H_2PO_4/(NH_4)_2HPO_4$	1	
	(d)		Calcium hydroxide is alkali and it **reacts** with ammonium salts to form salt, water and ammonia gas. The ammonia gas escapes and the soil does not have the nitrogen it needs $2NH_4Cl + Ca(OH)_2 \rightarrow CaCl_2 + 2NH_3 + 2H_2O$	1 1	
B10 Either					
	(a)	**(i)**	Slag and carbon dioxide (both must be written)	1	
			Carbon dioxide: $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ Slag: $CaO + SiO_2 \rightarrow CaSiO_3$	1 1	
		(ii)	• Method: Electrolysis • Calcium is a more reactive metal than iron and thus, forms compounds which are more difficult to decompose / more stable / has a greater tendency to remain as compounds.	1 1	

			• More energy is required to extract calcium from its ore.		
	(b)	**(i)**	conditions are oxygen and water	1	
		(ii)	Magnesium is above iron in the reactivity series (or is more reactive than iron) Hence sacrificial protection occurs and magnesium corrodes preferentially than iron.	1 1	
		(iii)	At a higher temperature, the reactants have a higher amount of energy and move faster. There are more particles with energy greater than or equals to the activation energy of the reaction. This leads to a greater frequency of effective collisions between the reacting particles.	1 1 -	1m penalised if the last statement is missing
B10 Or					
	(a)	**(i)**	Fractional distillation of liquid air (Electrolysis of water is not accepted as a source of either gas.)	1	
		(ii)	Aqueous sodium hydroxide (must mention 'aqueous' or 'solution')	1	
		(iii)	Reduction. Oxygen is reduced to form hydroxide ions as the oxidation state of oxygen decreases from 0 in O_2 to -2 in OH^-. (With just one mark available, only the reason for the selection of reduction gained credit.)	1	
		(iv)	**Advantage:** It is a renewable energy resource/it is also pollution-free because only water is produced when hydrogen reacts with oxygen/it is also an efficient source of energy as hydrogen releases more energy per gram of fuel compared to many other fuels. **Disadvantage:** Difficult to find an effective means of storing the gas/hydrogen is extremely flammable and explosive/expensive electrode (The question showed that the fuel cell was for use in a space shuttle. Difficulty in transporting the cell is not a disadvantage.)	1 1	
	(b)	**(i)**	It does not contain mobile ions to act as charge carrier.	1	
		(ii)	Magnesium > Y > Z > X	1	
		(iii)	The magnesium rod will decrease in size/mass/will dissolve. Silver solid will be formed. $Mg(s) + 2Ag^+(aq) \rightarrow Mg^{2+}(aq) + 2Ag(s)$	1 1 1	
Important note: When going through the paper with the class, extend part (a) to discuss the following. A fuel cell uses 240 dm^3 of hydrogen. Calculate the volume of oxygen needed, and the mass of water formed. All gas volumes measured at room temperature and pressure. [3]					