BK1 - TOV 2016
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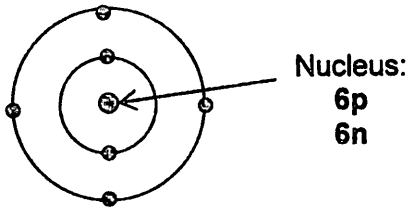
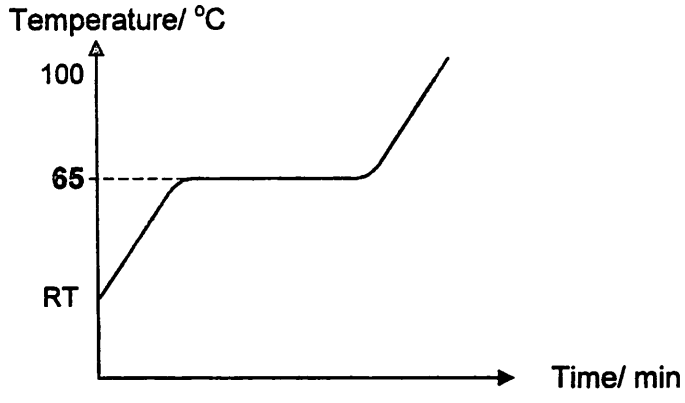
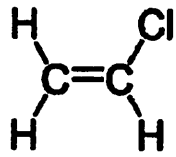
4541/2 CHEMISTRY
Paper 2

Section A

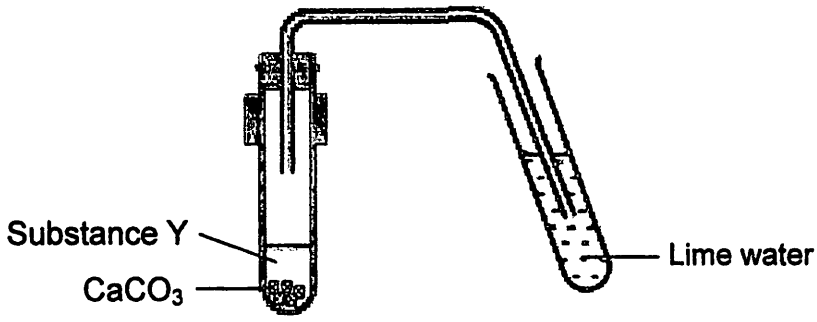
1	(a)		 [*Electron arrangement*] [*Number of proton & neutron*]	1 1	...2
	(b)	(i)	Isotopes are atoms (of the same element) with the **same *proton number*** but **different *nucleon number*** // Isotopes are atoms (of the same element) with the **same number of protons** but **different number of neutrons**.		1
		(ii)	[*Any example of isotope*] Sample answer : Carbon-14, Cobalt-60, Sodium-24, Iodine-131 *etc*		1
	(c)		12		1
	(d)	(i)	Liquid		1
		(ii)	Becomes faster		1
		(iii)	 [*Correct shape of the graph*] [*Indicate the boiling point at 65 °C*]	1 1	...2
			TOTAL		**9**

2	(a)	(i)	Polymer is a long chain molecules made up of a large number of small repeating identical units of monomer.		1
		(ii)			1
		(iii)	Can *Reason* : Cheap // Long lasting // Easy to found **OR** Cannot. *Reason* : Non-biodegradable // Produced toxic gases	1 1	...2
	(b)	(i)	Pure metal = P Alloy = Q	1 1	...2
		(ii)	Substance Q. Presence of foreign atom disrupts the orderly arrangement of atoms in pure metal. Layers of atom not easily slide.	1 1 1	...3
			TOTAL		**9**

3	(a)	(i)	1		1
		(ii)	Valence electron of T, Q and R = 1		1
		(iii)	2.8.1		1
	(b)		Atomic size of atom R is bigger Attraction force between nucleus and electron valence is weaker Atom R easier to release electron	1 1 1	...3
	(c)	(i)	$4T + O_2 \rightarrow 2T_2O$ [*Correct formulae of reactants and products*] [*Balanced equation*]	 1 1	2
		(ii)	Mole of T : Mol of T_2O 4 : 2 0.1 : 0.05 Mass T_2O = 0.05 x [2(7) + 16] g // 1.5 g	1 1	2
			TOTAL		**10**

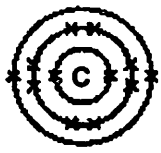
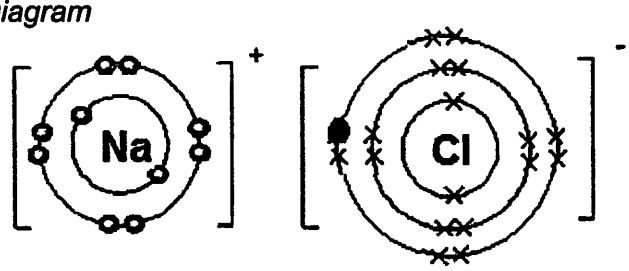
4	(a)		Change in quantity of reactants or product per time		1
	(b)		$Mg + 2HCl \rightarrow MgCl_2 + H_2$	1+1	...2
	(c)	(i)	Mol Mg = $\frac{0.3}{24}$ = 0.0125 mol		1
		(ii)	Mol HCl = $\frac{1 X 50}{1000}$ = 0.05 mol		1
	(d)		1 mol of magnesium produce 1 mol hydrogen // 0.0125 mol Mg produce 0.0125 mol hydrogen Volume of hydrogen = 0.0125 x 24 dm^3 = 0.3 dm^3 / 300 cm^3	1 1	...2
	(e)		**Set I** Rate of reaction = $\frac{0.3}{100}$ = 0.003 $dm^3 s^{-1}$ // $\frac{300}{100}$ = 3 $cm^3 s^{-1}$ **Set II** Rate of reaction = $\frac{0.3}{60}$ = 0.005 $dm^3 s^{-1}$ // $\frac{300}{60}$ = 5 $cm^3 s^{-1}$	1 1	...2
	(f)		Size of magnesium/reactant and catalyst		1
			TOTAL		**10**

5	(a)	(i)	Anode : X Cathode : Y		1
		(ii)	**Electrical** energy to **chemical** energy		1
	(b)	(i)	Copper(II) ion / Cu^{2+} ion, chloride ion / Cl^- ion, hydrogen ion / H^+ ion and hydroxide ion / OH^- ion.		1
		(ii)	X : Cl^-, OH^- Y : Cu^{2+}, H^+	1 1	...2
		(iii)	Brown solid is deposited		1
		(iv)	$Cu^{2+} + 2e \rightarrow Cu$		1
	(c)	(i)	Oxygen		1
		(ii)	Insert glowing splinter in the mouth of test tube. It will light-up / rekindles.	1 1	...2
	(d)		Concentration of copper(II) chloride.		1
			TOTAL		**11**

6	(a)		Chemical substance that ionises in water to produce hydrogen ion / H^+ ion.		1
	(b)		X : Weak acid Y : Strong acid	1 1	...2
	(c)		X : Ethanoic acid Y : Sulphuric acid	1 1	...2
	(d)	(i)	*Sample answer*: Add calcium carbonate granules into the acid and flow the gas into a test tube contains lime water. The lime water turns chalky / milky. **OR** Add magnesium ribbon into the acid. Gas bubbles released.	 1 1	...2
		(ii)	*Sample answer*:  [*Functional diagram*] [*Labelled*]	 1 1	...2
			$CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + CO_2 + H_2O$	1+1	...2
			TOTAL		**11**

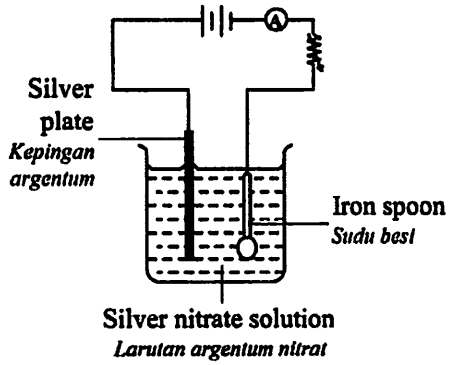
Section B

7	(a)	(i)	Molecular Formula = $C_6H_8O_6$ Empirical Formula = $C_3H_4O_3$	1 1	...2
		(ii)	<table><tr><th></th><th>Molecular Formula</th><th>Empirical Formula</th></tr><tr><td>Same type of elements present</td><td colspan="2">Carbon, Hydrogen, Oxygen</td></tr><tr><td>Number of atom element present</td><td>6 C atoms, 8 H atoms, 6 O atoms</td><td>3 C atoms, 4 H atoms, 3 O atoms</td></tr></table>	1 2	...3
	(b)		*Reactant* : Copper(II) carbonate *Products* : Copper(II) oxide **and** carbon dioxide *Observation* : 1. Black solid formed 2. Lime water turned cloudy *Equation* : $CuCO_3 \longrightarrow CuO + CO_2$ *Quantitative aspect* : 1 mol of $CuCO_3$ decomposed produce 1 mol of CuO and 1 mol of CO_2	1 1 1 1 1+1 1	...7
	(c)	(i)	<table><tr><th></th><th>Carbon</th><th>Hydrogen</th><th>Oxygen</th></tr><tr><td>Mass (g)</td><td>40</td><td>6.7</td><td>53.3</td></tr><tr><td>Number of mole (mol)</td><td>$\frac{40}{12}$ = 3.33</td><td>$\frac{6.7}{1}$ = 6.7</td><td>$\frac{53.3}{16}$ = 3.33</td></tr><tr><td>Ratio</td><td>1</td><td>2</td><td>1</td></tr></table> Empirical formula = CH_2O n (CH_2O) = 60 [12 +2 + 16] n = 60 n = 2 Molecular formula = $C_2H_4O_2$ // CH_3COOH	1 1 1 1 1	...5
		(ii)	Number of mole = $\frac{6}{24}$ // 0.25 mol 0.25 mol Mg produces 0.25 mol H2 gas Volume H_2 = 0.25 × 24 dm^3 // 6.0 dm^3	1 1 1	...3
				TOTAL	20

8	(a)	(i)	Compound X Sharing of electron	1 1	...2
		(ii)	 Group 2, Period 3	1 1	...2
		(iii)	*Sample answer* : **Compound X** / **Compound Y** Low melting / boiling point / High melting / boiling point Intermolecular forces are weak / Electrostatic Forces between ions are strong Less heat energy is needed to overcome the forces / More heat energy is needed to overcome the forces Do not conduct electricity / Conduct electricity in molten state / aqueous solution Does not have free moving ions / Have free moving ions The ion can carry charge to complete the circuit.	1 1 1 1 1 1	...6
	(b)		X *and* Y Ionic bond Electron arrangement of atom Na 2.8.1 Atom Na donate one electron to form Na^+ ion To archive octet electron arrangement $Na \rightarrow Na^+ + e$ Electron arrangement of atom Cl 2.8.7 Atom Cl gain one electron to form Cl^- ion To archive octet electron arrangement $Cl + e \rightarrow Cl^-$ ion Na^+ and Cl^- attract to each other by strong electrostatic force *Diagram*  	1 1 1 1 1 1 1 1 1 1 1 1	***Max*** ...10
			TOTAL		**20**

Section C

9	(a)		Gas Y : **Carbon dioxide** / CO_2 *Test* : 1. Bubble/flow the gas through lime water. 2. *Observation* : Lime water turns milky/chalky. *Test for NO_3^- ion* : 1. Add ***dilute sulphuric acid*** followed by ***iron(II) sulphate solution*** into the solution X in a test tube. 2. Slant the test tube and add concentrated sulphuric acid slowly/carefully. 3. *Observation* : A **brown ring** is formed.	1 1 1 1 1 1	
			$PbCO_3$ / **Solid X** **Colour of residue** : yellow when hot white when cold / yellow when hot white when cold **Gas** : Gas turns lime water milky / A brown gas released // The gas ignited the glowing wooden splinter	1+1 1+1	***Max*** ...8
	(b)		1. [*Material* : Sodium carbonate / potassium carbonate] 2. [*Apparatus* : beaker, filter funnel, filter paper] 3. Pour [20 -100] cm^3 of [0.1-2.0] mol dm^{-3} solution X into a beaker. 4. Add [20 -100] cm^3 of [0.1-2.0] mol dm^{-3} sodium carbonate solution. 5. Stir the mixture. 6. Filter. 7. Rinse the residue. $Zn(NO_3)_2 + Na_2CO_3 \rightarrow ZnCO_3 + 2NaNO_3$ 8. [*Formula of reactants*] 9. [*Formula of products*] 10. [*Balanced*]	1 1 1 1 1 1 1 1 1 1	...10
	(c)		Add baking powder/sodium bicarbonate/bicarbonate soda. Baking powder produce carbon dioxide gas	1 1	...2
			TOTAL		**20**

10	(a)	(i)	Z ,Cu, Y, X	1	
		(ii)	Negative terminal is Y Because Y is more electropositive than Z/ above Z in the electrochemical series. Voltage value is 2.00 V	1 1 1	...4
	(b)		U, T, S. U can displace T and S from its salt solution. U is the most electropositive /higher than T and S in the electrochemical series. T can displace S from its salt solution. T is more electropositive than S because /higher than S in the electrochemical series. S cannot displace U and T from its salt solution. S least electropositive /lowest in the electrochemical series.	1 1 1 1 1 1 1	***Max*** ...6
			Suitable metal and electrolyte : Silver plate, silver nitrate solution // Copper plate, copper(II) nitrate/sulphate/chloride solution *Procedure* : 1. Iron spoon is cleaned with sandpaper. 2. Iron spoon is then connected to the negative terminal of the battery and silver plate is connected to the positive terminal. 3. Both are immersed into silver nitrate solution. 4. Turn on the switch. *Diagram* :  [*Functional diagram*] [*Labelled*] *Half equation at anode* : $Ag \rightarrow Ag^+ + e$ *Half equation at cathode* : $Ag^+ + e \rightarrow Ag$ *Observations* : 1. At **anode** : Silver plate becomes thinner. 2. At **cathode** : Iron spoon is coated with shiny grey solid	1 1 1 1 1 1 1 1 1 1 1	***Max*** ...10
				TOTAL	**20**

END OF MARKING SCHEME