

Section A [5 marks]

Answers to Section A

A1	A2	A3	A4	A5
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A1 Which one of the following elements, represented by Q, R, S and T is **least** likely to form a compound?

- A ${}^{11}_{23}\text{Q}$
 B ${}^{13}_{27}\text{R}$
 C ${}^4_2\text{S}$
 D ${}^{87}_{16}\text{T}$

A2 Some properties of four substances are given below. Which substance has a simple molecular structure?

Substance	Melting point (°C)	Boiling point (°C)	Physical state(s) in which substance conducts electricity
A	660	1110	solid and liquid
B	3500	3800	none
C	114	184	none
D	1240	1750	liquid only

A3 Which of these substances A to D is likely to be an element?

- A Substance A burns in air to form carbon dioxide and water.
 B When an electric current is passed through substance B, it does not decompose.
 C On heating substance C, a gas is evolved and a solid residue is left.
 D Substance D produces different fractions when distilled.

A4 Hydrochloric acid is added dropwise to a beaker of sodium hydroxide. Which of the following is taking place in the beaker *initially*?

- A The concentration of hydrogen ions decreases.
 B The concentration of hydroxide ions increases.
 C The pH of the solution decreases.
 D Sodium chloride crystals form in the beaker.

A5 The table below gives information about three indicators.

Indicator	pH at which colour change takes place	Colour change Low pH → high pH
Methyl orange	4	Red → yellow
Bromothymol blue	7	Yellow → blue
Phenolphthalein	9	Colourless → pink

A mixture formed with equal volumes of each indicator was added into a beaker of colourless solution with pH 5. What colour would be observed in the beaker?

- A Blue
 B Green
 C Orange
 D Yellow

Section A [5 marks]

Answers to this section are to be written in the blanks provided below.

1	2	3	4	5
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- 1 When solution X is added with a magnesium ribbon, effervescence is observed. On the other hand, when X is added with a few drops of barium nitrate, a white precipitate is formed.

What is X?

- A HCl
B H_2SO_4
C KCl
D K_2SO_4

- 2 An oxide of element Y has a low boiling point and dissolves easily in both dilute acids and alkalis. This oxide could be formed when air is subject to very high temperature or energy such as lightning or in combustion engines.

Which of the following could be element Y?

- A carbon
B lead
C magnesium
D nitrogen

- 3 A white powdery substance is often seen around the stoppers of bottles containing limewater.

Which substance has reacted with limewater to form the white substance?

- A carbon dioxide
B nitrogen monoxide
C oxygen
D water vapour

- 4 An aqueous solution has a pH value of 13.

What information does this fact give about the ions present in the solution?

	concentration of H^+ ions	concentration of OH^- ions
A	high	low
B	high	none
C	low	high
D	none	high

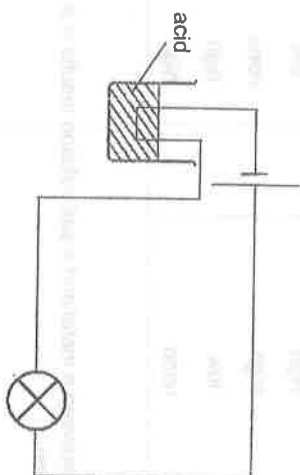
- 5 A reaction between a metal and a salt solution results in a change in the colour of the solution.

Which of the following ionic equations could describe this reaction?

- A $\text{Cu(s)} + \text{Mg}^{2+}(\text{aq}) \rightarrow \text{Mg(s)} + \text{Cu}^{2+}(\text{aq})$
B $\text{Cu(s)} + \text{Pb}^{2+}(\text{aq}) \rightarrow \text{Pb(s)} + \text{Cu}^{2+}(\text{aq})$
C $\text{Zn(s)} + 2\text{Ag}^+(\text{aq}) \rightarrow 2\text{Ag(s)} + \text{Zn}^{2+}(\text{aq})$
D $\text{Zn(s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Cu(s)} + \text{Zn}^{2+}(\text{aq})$

Section B [30 Marks]

- B1** An experiment is set up as illustrated below to determine the strength of an acid. Assume that the conductivity of an acid is dependent on the concentration of ions present in the solution which will affect the brightness of the light bulb.



- (a) Ethanoic acid and hydrochloric acid of the same concentration are being used in the experiment above. Predict and explain the results of the experiment.

.....

 [2]

- (b) Suggest a way, by using a chemical reaction, to test for the strength of an acid.

.....

 [2]

- (c) Given that ethanoic acid is a monobasic acid with the molecular formula, $C_2H_4O_2$, write the equation that describes how it will dissociate in water.

..... [2]

- B2** Magnesium chloride could be used as a mineral supplement to treat patients with magnesium deficiency in blood.

- (a) Describe how you will prepare a solution of magnesium chloride. Your answer should include the choice of reagents that will produce magnesium chloride.

.....

 [3]

- (b) The solution of magnesium chloride could be used to react with another reagent to prepare magnesium hydroxide.

- (i) With the suggestion of an appropriate reagent, write the chemical equation that describes this reaction. Include state symbols.

..... [2]
 (ii) Briefly describe how magnesium hydroxide should be extracted when the reaction is complete.

..... [1]

- B3** Rusting occurs when iron is exposed to oxygen and water. The hydrated iron(III) oxide formed, which is a reddish-brown solid, is rust.

It was found that a rust covered nail could be cleaned by immersing it in a can of soft drink, which contains phosphoric acid, such as Coca-Cola for around an hour before scrubbing off the rust easily.

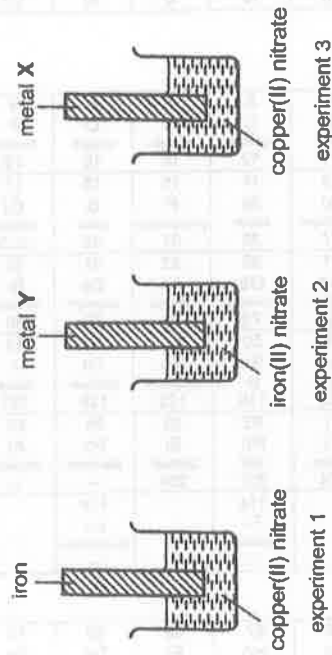
- (a) What can you deduce about the nature of iron(III) oxide from the above?

..... [1]

- (b) Write the ionic equation for the reaction between iron(III) oxide and phosphoric acid.

..... [2]

B4 A student investigated the reactivities of four metals, iron, copper, metal X and metal Y. He set up three experiments as shown in the diagram below.



(a) In experiment 1, the student sees changes happening to both the iron rod and the solution.

(i) Explain why there is a reaction in experiment 1.

[2]

(ii) Hence, describe the changes that the student would see.

[2]

(b) The student observes that reactions happen in only experiments 1 and 2.

In experiment 2, it is also observed that there is some effervescence.

Hence, by suggesting the identities of X and Y, place the four metals in increasing order of reactivity.

[2]

B5 The table below shows the difference in hardness of three materials.

The hardness of a material could be measured by the Brinell Hardness (HB) number. The HB number is determined by measuring the variables associated with the indentation caused by a force of a 10mm steel ball on the tested material.

Material	HB number
Copper	35
Brass	65
Mild steel	121

(a) What elements are present in brass?

[1]

(b) Give the reason for the difference in hardness between copper and brass with reference to their structures.

[3]

(c) Mild steel consists of less than 0.3% carbon. On the other hand, high carbon steel has approximately 0.6 to 1% of carbon content.

Suggest an application each for the use of mild steel and high carbon steel.

[2]

- B6** The burning of coal presents an environmental issue as coal contains sulfur impurities which will be oxidized to form sulfur dioxide gas. Sulfur dioxide is a pollutant gas that affects the environment and health as it forms acid rain. The equation for acid rain formation due to sulfur dioxide is:



Agricultural farms located near to coal-fired power stations have experienced devastating effects on their crop yield due to a fall in their soil's pH level.

A team of agronomists came up with a plan to help farmers manage the effects of acid rain on their soil. One way is to do periodic liming with the use of limestone.

- (a) Limestone consists of calcium carbonate. Explain how calcium carbonate can fix the soil's pH level.

[2]

- (b) What salt is formed as calcium carbonate reacts with acid rain?

[1]

END OF PAPER

The Periodic Table of Elements

I		II		Group																		III	IV	V	VI	VII	0										
																		1 H hydrogen 1																			2 He helium 4
Key proton (atomic) number atomic symbol name relative atomic mass																			5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20													
3 Li lithium 7	4 Be beryllium 9																		13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40													
11 Na sodium 23	12 Mg magnesium 24	19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84																		
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131																				
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium -	85 At astatine -	86 Rn radon -																				
87 Fr francium -	88 Ra radium -	89 – 103 actinoids	104 Rf rutherfordium -	105 Db dubnium -	106 Sg seaborgium -	107 Bh bohrium -	108 Hs hassium -	109 Mt meitnerium -	110 Ds darmstadtium -	111 Rg roentgenium -	112 Cn copernicium -	114 Fl flerovium -		116 Lv livermorium -																							
lanthanoids																																					
actinoids		57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium -	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175																					
		89 Ac actinium -	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium -	94 Pu plutonium -	95 Am americium -	96 Cm curium -	97 Bk berkelium -	98 Cf californium -	99 Es einsteinium -	100 Fm fermium -	101 Md mendelevium -	102 No nobelium -	103 Lr lawrencium -																					