Name: _____ ( ) Class:_____

PRELIMINARY EXAMINATION
GENERAL CERTIFICATION OF EDUCATION ORDINARY LEVEL

CHEMISTRY **6092/02**
Paper 2 **26 August 2020**
1hour 45minutes

READ THESE INSTRUCTIONS FIRST

Write your name, register number, and class clearly in the spaces provided at the top of this page.
Write in dark blue or black pen only.
You may use a soft pencil for any diagrams or graphs.
Do not use highlighters, glue, and correction fluid or correction tape.

Section A
Answer **all** questions in the spaces provided.

Section B
Answer all **three** questions, the last question is in the form of either/or.
Answer **all** questions in the spaces provided.

A copy of Periodic Table is provided on page 2.
The number of marks is given in brackets [ ] at the end of each question or part question.
The use of a scientific calculator is expected, where appropriate.

	Marks
Section A (50)	
Section B (30)	
Total (80)	

This document consists of **20** printed pages.

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		**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
11 Na sodium 23	12 Mg magnesium 24											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
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	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
actinoids	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 –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

Section A

Answer **all** the questions in this section in the space provided.
The total mark for this section is 50.

A1 The following substances are given:

aluminium	lithium oxide	water
air	zinc oxide	ammonium chloride
brass	silver carbonate	nitrogen monoxide

Each substance may be used once, more than once or not at all.

(a) **(i)** Which substance is a mixture of elements only?

……..[1]

(ii) Which substance contains a non-metallic element with an oxidation state of +2?

……..[1]

(iii) Which substance reacts with hot alkaline sodium nitrate to form an alkaline gas?

……..[1]

(iv) Which substance can be obtained by sublimation when mixed with sodium chloride?

……..[1]

(v) Which substance is best obtained by simple distillation when mixed with ammonium chloride?

……..[1]

(b) Briefly describe how a sample of pure and dry silver carbonate can be produced in the laboratory.

……

……

……

……[3]

[Total: 8 marks]

A2 Elements R and Q react with chlorine readily to form chlorides. The table below below shows some of the properties of the two chlorides, RCl_2 and QCl_2.

	RCl_2	QCl_2
melting point/^oC	874	-120
boiling point /^oC	1250	59
electrical conductivity of liquid	good	poor
solubility in water	dissolves to form a neutral solution	reacts to form a solution of pH 1

(a) Describe the arrangement and movement of particles in QCl_2 at 30^oC.

……[1]

(b) Which groups of the Periodic Table do R and Q belong to?

……

……[2]

(c) Explain in terms of bonding and structure the difference in electrical conductivity of liquid RCl_2 and liquid QCl_2.

……

……

……

……

……[4]

(d) When QCl_2 is added to water, the resulting mixture has pH 1. Suggest the name of a compound formed during the reaction.

……[1]

(e) Suggest the formula of a covalent compound which has a boiling point of 2230^{o}C.

……[1]

[Total: 9 marks]

A3 This question is about the halogens.

(a) The table shows data about the melting and boiling points of three halogens, chlorine, bromine and iodine.

Complete the table by filling in the name of each halogen.

name of halogen	Melting point /^{o}C	Boiling point /^{o}C
	-7.2	58.8
	-100.9	-34.7
	113.8	184.5

[1]

(b) Describe the trend in the reactivity of the elements down Group VII. Explain your answer based on their atomic structures.

……

……

……

……[2]

(c) Seawater contains potassium bromide.

(i) What would be observed when aqueous chlorine is added to seawater? Explain your answer.

……

……[2]

(ii) Describe a chemical test to show that seawater also contains sulfate ions.

……

……[2]

(d) Chlorine and fluorine react vigorously to form chlorine trifluoride, ClF_3. Explain using oxidation numbers, whether chlorine is an oxidising or a reducing agent in this reaction.

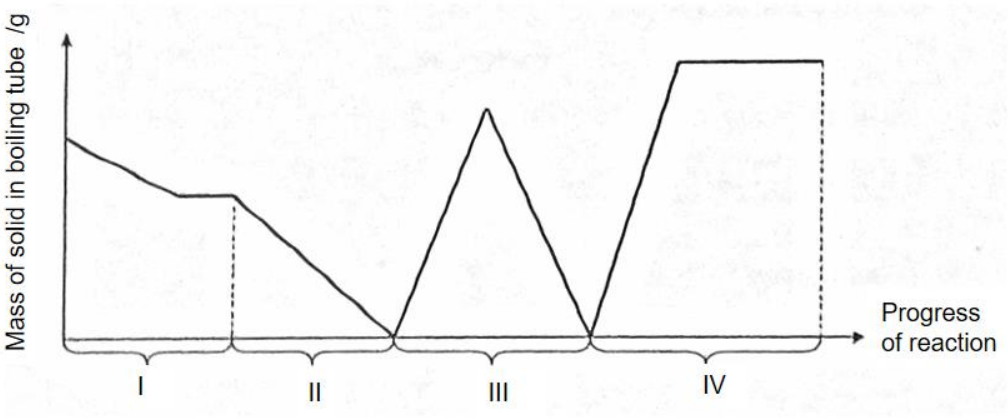
……

……

……[2]

[Total: 9 marks]

A4 The graph below shows how the mass of a solid in a boiling tube changes as the reaction progresses.



stages	description
I	Solid P is heated strongly to form solid Q. A gas is evolved producing white precipitate with limewater.
II	Excess dilute hydrochloric acid is added to solid Q.
III	Aqueous ammonia is added to the reaction mixture obtained from stage II.
IV	Dilute nitric acid and aqueous silver nitrate are added to the reaction mixture obtained from stage III.

(a) State the identity of gas produced in stage I.

……[1]

(b) Suggest two possible identities of the cations present in solid P. Explain your answer.

……

……

……[2]

(c) Write a chemical equation for the reaction in stage I.

……[1]

(d) Write an ionic equation for the formation of the solid in stage IV.

…….....[1]

(e) Explain why the mass of the soild reaches a constant in stage IV.

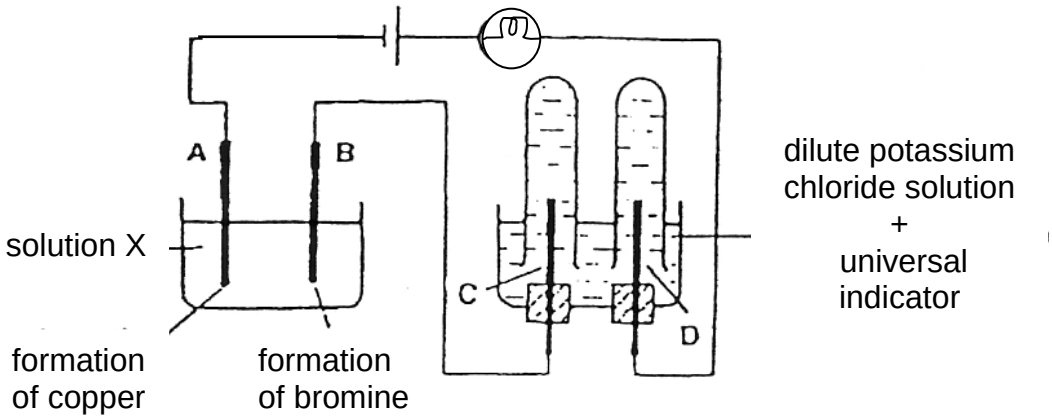
…….....

…….....

…….....[1]

[Total: 6 marks]

A5 The diagram below shows the set-up used for the electrolysis of solution X and dilute potassium chloride solution using graphite electrodes. Dilute potassium chloride solution has a pH of 7.



(a) Suggest an identity for solution X.

……[1]

(b) **(i)** Write ionic equations for the reactions occuring at electrodes C and D.

Electrode C: ……..

Electrode D: …….. [2]

(ii) Suggest one industrial use of the product formed at electrode C.

……[1]

(c) After electrolysing for 20 minutes, 84 cm^3 of gas is collected in the test tube at electrode C at room temperature and pressure.

Calculate the mass of copper formed at electrode A.

[2]

(d) The experiment is repeated by replacing dilute potassium chloride with concentrated potassium chloride. State the colour changes of the universal indicator. Explain your answer.

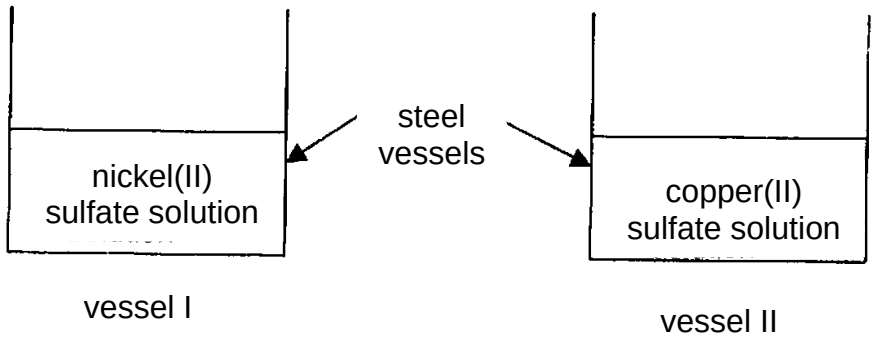
……

……

……[2]

[Total: 8 marks]

A6 A fixed volume of 1.0 mol/dm^3 green nickel(II) sulfate solution and copper(II) sulfate were placed in separate steel vessels and left to stand. After a short while, a solid residue was formed in both vessels. Nickel reacts with dilute acid but not with water.



(a) Explain why steel is harder and stronger than pure iron.

……

……

……[2]

(b) Explain the formation of the solid residue in vessel II.

……

……[2]

(c) Describe what would be observed when nickel is added to aqueous copper(II) sulfate.

……

……[2]

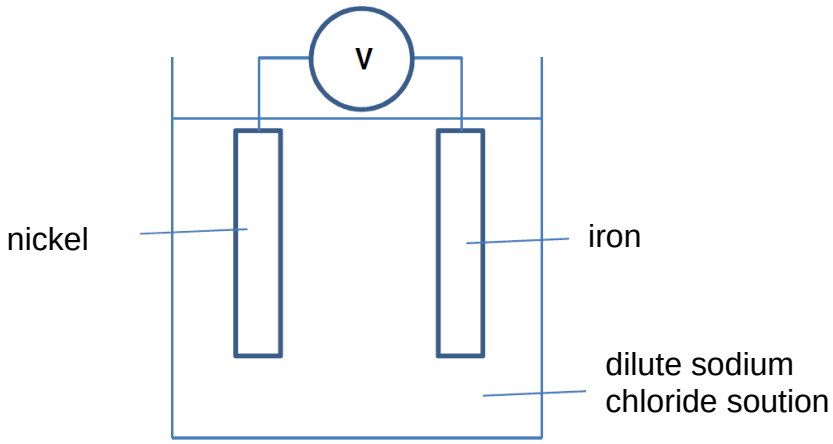
(d) A piece of calcium is placed in vessel II containing aqueous copper(II) sulfate. Bubbles are observed around the calcium. Explain the formation of the bubbles with the aid of a chemical equation.

……

……

……[2]

(e) The following diagram shows the set-up of an electric cell.



Write the ionic equations for the reactions that occur at the anode and cathode.

Anode: ……..

Cathode: …….. [2]

[Total: 10 marks]

Section B

Answer all **three** questions in this section.

The last question is in the form of an either/or and only **one** of the alternatives should be attempted. The total mark for this section is 30.

B7 Galvanisation is the process of coating the entire surface of a piece of iron with zinc to prevent it from rusting. The information below shows two common ways of galvanising iron – hot dip galvanisation and electro-galvanisation.

Hot dip galvanisation

The piece of iron is dipped into molten zinc at 460 ^{o}C and held there until the temperature of the iron equilibrates with that of the bath. The iron is then slowly withdrawn from the molten zinc while it is still liquid. This is done to remove excess zinc. It is then air cooled to solidify the zinc. The outermost layer of zinc then reacts with oxygen and carbon dioxide in air in the following reactions:

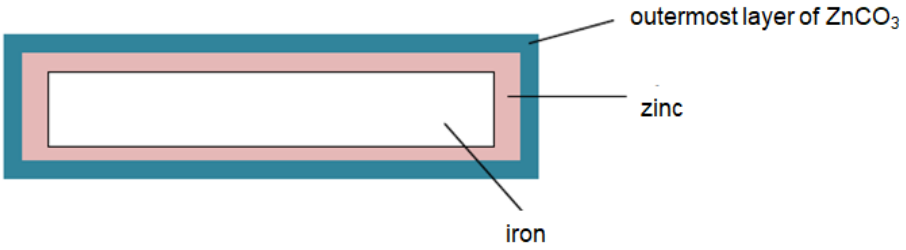
Reaction 1: Zinc reacts with oxygen to form zinc oxide.

$$2Zn + O_2 \rightarrow 2ZnO$$

Reaction 2: Zinc oxide then reacts with carbon dioxide to form zinc carbonate.

$$ZnO + CO_2 \rightarrow ZnCO_3$$

The resulting iron piece will appear as follows:



The resultant coating is coarse and thick and the process is used to make alloy sheets for roofs.

Electro-galvanisation.

The piece of iron to be galvanized and a piece of zinc are used as electrodes and dipped into an electrolyte containing a mixture of aqueous zinc cyanide, $Zn(CN)_2$ and aqueous sodium hydroxide.
Zinc cyanide is highly toxic and must be handled with care.
An external electrical supply is used.

Zinc ions are discharged to form zinc atoms, which are coated onto the piece of iron.
The resultant coating is smooth and thin and the process is used to make bolts and nuts.

(a) Explain how galvanisation prevents the rusting of a steel roof or bolts.

……..

……..

……..[2]

(b) In hot dip galvanisation, explain how zinc oxide displays basic properties in reaction 2.

……..[1]

(c) State two disadvantages of electro-galvanisation method.

……..

……..[2]

(d) Draw a clearly-labelled diagram of the experimental set-up used in electro-galvanisation.

[2]

(e) Explain why reactions 1 and 2 for hot dip galvanisation do not occur for electro-galvanisation.

……..

……..[2]

(f) Suggest a method to extract zinc from its oxide.

……..[1]

[Total: 10 marks]

B8 A car manufacturer wants to fit the most environmentally friendly engine into their new car model. They considered two different types of engines, one normal and one known as a "lean burn" engine which has a lower working temperature. They also made modifications to both types of engines, thus coming up with four different types of engines and tested all four of them out. The table below shows the percentage composition of exhaust gases emitted from cars fitted with the four different engines.

	Normal engine	Normal engine with "modification"	"Lean burn" engine	"Lean burn" engine with "modification"
Carbon dioxide	14	15	16	18
Oxygen	0.7	0	0.5	0
Carbon monoxide	4.5	0.3	0.2	0.03
Nitrogen oxides	0.3	0.04	0.05	0.01
Hydrocarbons	0.12	0.03	0.09	0.01

(a) Name the major component of the exhaust gas that is not listed in the table above.

……[1]

(b) Using the data given, suggest what "modification" has been made to both the normal and "lean burn" engines.

……[1]

(c) Suggest why there is a drop in the percentages of nitrogen oxides from the normal engine to the "lean burn" engine.

……..

……[1]

(d) Describe one harmful effect of carbon monoxide gas on human health.

……..

……..

……[2]

(e) Give one natural source of nitrogen oxides in the atmosphere.

……..[1]

(f) A petrol car needs 137500 kJ of energy to travel 100km.

(i) Assuming petrol is made up of octane, C_8H_{18}, calculate the volume of carbon dioxide produced for this journey using the equation below.

$$C_8H_{18} + 25/2O_2 \rightarrow 8CO_2 + 9H_2O \quad \Delta H = -5500 \text{ kJ/mol}$$

[2]

(ii) Draw a labelled energy profile diagram to show the reaction between octane, C_8H_{18} and oxygen.

[2]

[Total: 10 marks]

EITHER

B9 Three experiments were carried out using lead(II) carbonate. In experiment I, W g of lead(II) carbonate was added to 50 cm^3 of 0.2 mol/dm^3 dilute nitric acid in a flask. The results of the reaction are tabulated below. The volume of carbon dioxide gas was recorded every 15s for a duration of 120s.

time from start of experiment /s	total volume of carbon dioxide collected /cm^3
0	0
15	52
30	81
45	97
60	100
75	100
120	100

The experiment was repeated using dilute sulfuric acid and ethanoic acid in experiments II and III respectively. All other conditions were kept the same as experiment I.

(a) Construct a balanced chemical equation for the reaction between lead(II) carbonate and dilute nitric acid.

……..[1]

(b) Calculate the value of W in grams.

[2]

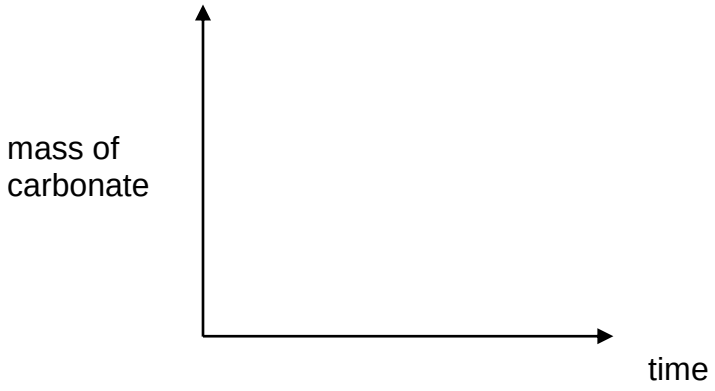
(c) Explain why the reaction in Experiment II stopped suddenly after only a small amount of gas had been given off.

……..

……..

……..[2]

(d) On the diagram below, sketch two graphs to show how the mass of carbonate changes as reaction progresses in experiment I and III. Explain your answer in terms of collision theory of particles, given that lead(II) ethanoate is soluble in water.



……..

……..

……..

……..

……..

……..[4]

(e) Another experiment is carried out to investigate the thermal stability of lead(II) carbonate and iron(II) carbonate.

The same number of moles of both metal carbonates are heated in separate test tubes and the gas given off is bubbled through limewater. The table below shows the time taken for the white precipitate to form in limewater.

carbonate used	time taken for the white precipitate to form in limewater /s
	50
	30

Fill up the table with the correct carbonates. [1]

[Total: 10 marks]

OR

B9 The equation for the reaction between sodium thiosulfate and dilute hydrochloric acid is given below.

$$Na_2S_2O_3\,(aq) + 2HCl\,(aq) \rightarrow 2NaCl\,(aq) + S(s) + SO_2(g) + H_2O(l)$$

The speed of this reaction was investigated using the following experiment. A beaker containing 50 cm^3 of 0.2 mol /dm^3 sodium thiosulfate was placed on a piece of paper marked with a 'X'. 10.0 cm^3 of 2.0 mol /dm^3 hydrochloric acid was added and the stopwatch was started.

Initially the cross was clearly visible. When the solution became cloudy and the cross could no longer be seen, the stopwatch was stopped and the time recorded.

The experiment was repeated with different volumes of sodium thiosulfate and water. The results for this experiment are given in the table.

experiment number	volume of sodium thiosulfate /cm^3	volume of hydrochloric acid /cm^3	volume of distilled water /cm^3	time taken for cross to disappear from view /s
1	10	10	40	56
2	20	10	30	28
3				

(a) Explain why it is necessary to keep the total volume constant in all the experiments.

……..

……..[1]

(b) In experiment 3, the student wanted the concentration of sodium thiosulfate in the mixture to be double of that used in experiment 2.

(i) Complete the table above to show the volumes used of each solution and water and the expected time taken for the cross to disappear from view in experiment 3. [2]

(ii) How and why does the speed of the reaction change from experiment 1 to 3? Explain in terms of collision of particles

……

…….....[2]

(c) Experiment 1 was repeated using a beaker with a smaller base. If all the other conditions were kept the same, would you expect the time taken for the cross to disappear from view to be shorter, longer or same? Explain your answer.

……..

……..[2]

(d) Explain in terms of collision theory, how an increase in temperature would affect the initial rate of reaction in experiment 1.

……..

……..

……..

……..[2]

(e) Describe the changes observed when sulfur dioxide produced during experiment 1 is bubbled through aqueous acidified potassium manganate(VII).

…….....

…….....[1]

[Total: 10 marks]

-- End of Paper --