



聖嬰中學

HOLY INNOCENTS' HIGH SCHOOL

Name of Student

Class

Index Number

40

**PRELIMINARY EXAMINATION 2020
SECONDARY 4 EXPRESS
CHEMISTRY PAPER 1**

6092/01

Date: 2 Sep 2020

Duration: 1 hour

Time: 0945 – 1045

Additional Materials: 1 Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction tape/fluid.

Write your name, class and index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers, **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the answer sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done on this question paper.

A copy of the Periodic Table is printed on page 2.

The use of an approved scientific calculator is expected, where appropriate.

Set by: Mr Daniel Lau

Vetted by: Mrs Sheryl Mok

The Periodic Table of the Elements

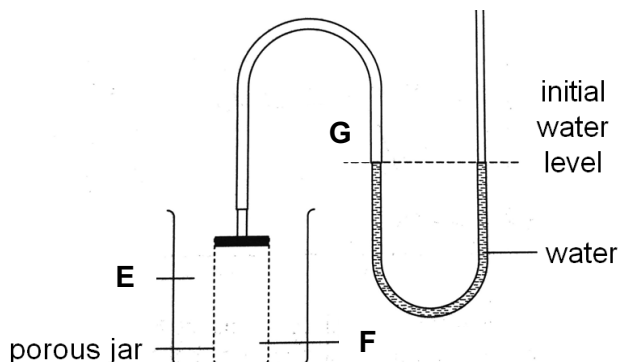
Group																	
I	II											III	IV	V	VI	VII	0
key proton (atomic) number atomic symbol name relative atomic mass						1 H hydrogen 1											2 He helium 4
						3 Li lithium 7	4 Be beryllium 9					5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
						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
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 dm³ at room temperature and pressure (r.t.p.)

- 1 The diagram below is a set up involving two gases **E** and **F**.



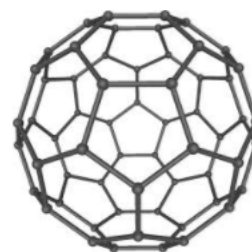
If the water level at **G** decreases, what could be the identities of gases **E** and **F**?

	gas E	gas F
A	carbon dioxide	nitrogen monoxide
B	fluorine	neon
C	methane	nitrogen
D	oxygen	ammonia

- 2 Solid samples of ammonium chloride, lead(II) chloride and sodium chloride were accidentally mixed together. Which of the following outlines the best method to obtain a pure dry sample of each substance?

- A** dissolving, filtration, sublimation, crystallisation
- B** dissolving, fractional distillation, filtration, evaporation
- C** sublimation, dissolving, filtration, evaporation
- D** sublimation, filtration, evaporation, distillation

- 3 Bucky balls are structures of carbon used in nanotechnology. One type of bucky ball has the chemical formula C_{60} and is shown in the diagram on the right.



Which of the following can be used to classify a bucky ball?

- A** an atom of a compound
- B** an atom of an element
- C** a molecule of a compound
- D** a molecule of an element

- 4 An inflated balloon shrinks if placed in a refrigerator.

Which of the following explanations is correct?

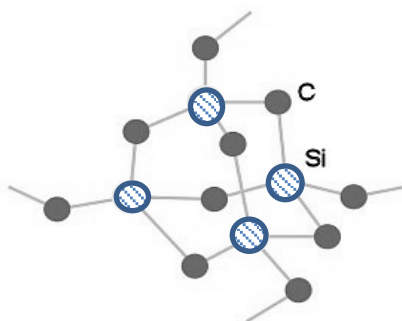
- A Particles move faster and become further apart.
- B Particles move slower and become further apart.
- C Particles move faster and become closer together.
- D Particles move slower and become closer together.

- 5 An element **J**, has p protons and n neutrons in its nucleus.

Which row gives a possible correct number of protons, neutrons and electrons in a negative ion of an isotope of **J**?

	protons	neutrons	electrons
A	p	$n+1$	$p+1$
B	p	$n+1$	$p-1$
C	$p+1$	n	$p+1$
D	$p+1$	n	$p-1$

- 6 Silicon carbide (SiC) has a similar molecular structure as diamond. This makes SiC a more suitable material to make knives than steel.



Which of the following is an advantage of using silicon carbide compared with steel?

- A SiC has a higher melting point due to stronger electrostatic forces between ions present in SiC.
- B SiC is more resistant to corrosion as Si and C are non-metallic elements.
- C SiC is less likely to deform under compression due to its atoms held in fixed positions by strong covalent bonds.
- D SiC is shinier than steel.

- 7 When a covalent liquid boils, its molecules become more widely spaced.

Which property of the molecules has the most influence on the energy required to boil a covalent liquid?

- A** The reactivity of the molecules.
B The shape of the molecules.
C The strength of the covalent bonds in the molecules.
D The strength of the forces of attraction between the molecules.

- 8 Phosgene (COCl_2) is a colourless gas which was used as a chemical weapon during World War I.

How many valence electrons in the phosgene molecules are involved in bonding?

- A** 4 **B** 8 **C** 12 **D** 16

- 9 A sample of 4000 cm^3 of polluted air is passed through limewater so that all the carbon dioxide present is precipitated as calcium carbonate. The mass of calcium carbonate formed is 0.010 g.

What is the percentage, by volume, of carbon dioxide in the air sample?

- A** 0.0003 % **B** 0.0006 % **C** 0.03 % **D** 0.06 %

- 10 A compound contains carbon, hydrogen, magnesium, oxygen. The table below shows the percentage composition of the various elements.

element	percentage composition by mass
carbon	42.4
hydrogen	5.9
oxygen	37.6
magnesium	14.1

What is the empirical formula of the compound?

- A** $\text{C}_4\text{H}_6\text{O}_2\text{Mg}$
B $\text{C}_6\text{H}_5\text{OMg}_2$
C $\text{C}_6\text{H}_{10}\text{O}_4\text{Mg}$
D $\text{C}_7\text{H}_{12}\text{O}_5\text{Mg}$

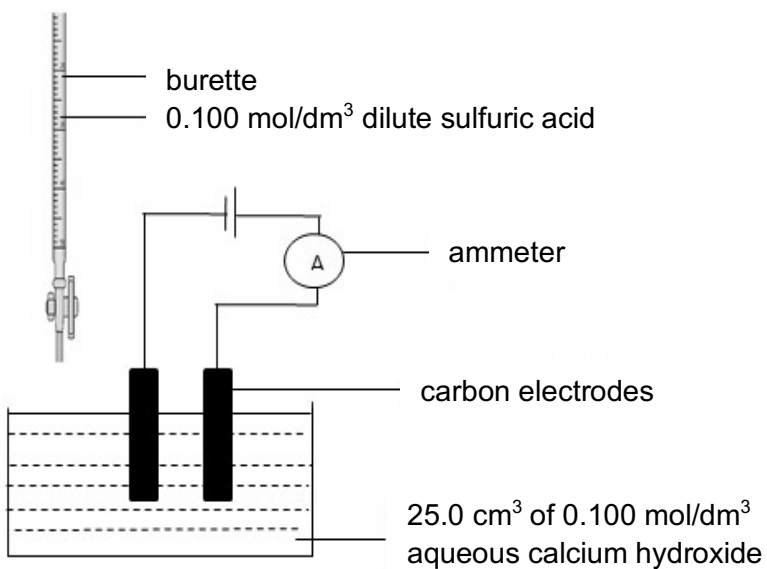
- 11 Dilute hydrochloric acid has a pH of 2. Which of the following substances will **not** affect the pH of the acid when it is added into dilute hydrochloric acid?
- A sodium nitrate
 - B sodium metal
 - C sodium hydroxide
 - D sodium carbonate

- 12 Four students each dissolved an indigestion tablet in 100 cm³ of water. They titrated 25.0 cm³ of their tablet solutions with dilute hydrochloric acid using the same indicator. The results are shown in the table below.

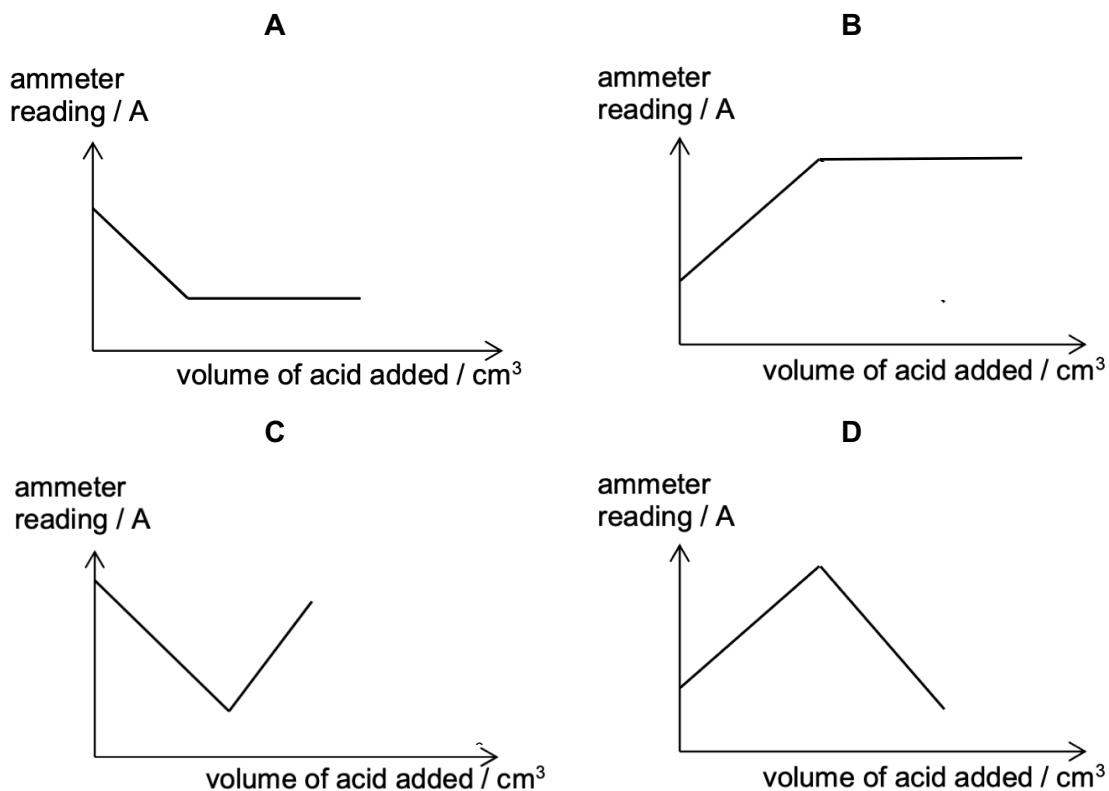
student	1	2	3	4
volume of HCl used / cm ³	19.90	20.10	19.95	20.90

- Which of the following statements could explain the anomalous result obtained by student 4?
- A The burette was rinsed with water immediately before use.
 - B The pipette was rinsed with water immediately before use.
 - C The burette was rinsed with dilute acid immediately before use.
 - D The pipette was rinsed with tablet solution immediately before use.
- 13 Which of the following salts can be prepared using the same salt preparation method?
- A ammonium sulfate and lead(II) chloride
 - B aluminium nitrate and iron(II) sulfate
 - C barium chloride and lead(II) sulfate
 - D sodium chloride and zinc nitrate
- 14 Which of the following is an observed trend from left to right across the third period of elements in the Periodic Table?
- A The number of valence electrons decreases.
 - B The metallic character of the elements increases.
 - C The melting points of the elements decreases steadily.
 - D The oxides of the elements change from basic to acidic.

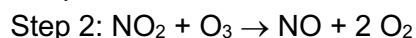
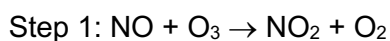
- 15 In an experiment, an excess of dilute sulfuric acid was added to aqueous calcium hydroxide. The acid was added from the burette in portions of 5.0 cm^3 until the acid was in excess. After each addition, the solution was stirred and the ammeter reading was noted.



Which graph correctly represents the relationship between the ammeter reading and the volume of acid added?



- 16 Which of the following is an endothermic reaction?
- A The formation of a carbohydrate and oxygen from carbon dioxide and water.
 - B The formation of a salt and water from an acid and an alkali.
 - C The formation of carbon dioxide from carbon and oxygen.
 - D The formation of water from hydrogen and oxygen.
- 17 Nitrogen monoxide, NO, damages the ozone layer by reacting with ozone in a two-step reaction.



Which of the following is true for the reaction?

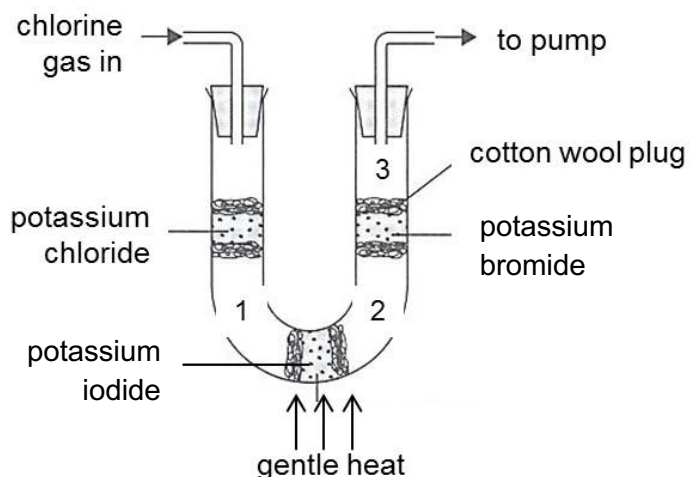
- A The reaction is reversible.
 - B Nitrogen monoxide act as a catalyst in the reaction.
 - C Nitrogen in nitrogen monoxide is reduced in step 1.
 - D Each nitrogen monoxide molecule causes 2 ozone molecules to decompose only.
- 18 Which of the following could **not** be a product of a redox reaction in which potassium manganate(VII) acts as an oxidising agent?
- A K_2MnO_4
 - B Mn^{2+}
 - C MnO_2
 - D Mn_2O_7
- 19 Which pair of elements, when reacted together, would give the most violent reaction?
- A caesium and fluorine
 - B lithium and iodine
 - C potassium and bromine
 - D sodium and chlorine

- 20 Element L has the following properties:
- I. Forms LCl_3 when heated with chlorine.
 - II. Forms LSO_4 when heated with dilute sulfuric acid.

Where can element L likely be found in the Periodic table?

- A group II
- B transition elements
- C group III
- D group V

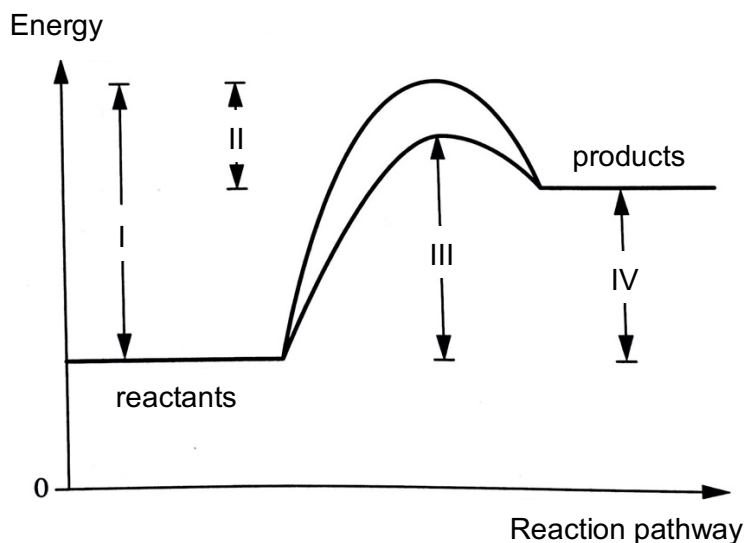
- 21 Gaseous chlorine was passed through the following apparatus. The apparatus was continuously heated throughout with a Bunsen flame and the observations for regions 1, 2 and 3 were recorded.



Which of the following correctly describes the observations at regions 1, 2 and 3?

	region 1	region 2	region 3
A	yellowish-green gas	yellowish-green gas	reddish-brown gas
B	yellowish-green gas	reddish-brown gas	violet gas
C	yellowish-green gas	violet gas	reddish-brown gas
D	yellowish-green gas	violet gas	violet gas

- 22 The energy profile diagram of a catalysed and uncatalysed chemical reaction is shown below.



Which of the following energy changes indicates the activation energy for the catalysed reaction?

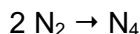
- A** I **B** II **C** III **D** IV

- 23 The table below shows the enthalpy change for the complete combustion of some compounds used as fuels.

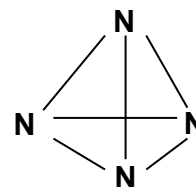
compound	formula	M_r	enthalpy change / kJ/mol
methane	CH_4	16	-880
ethanol	$\text{C}_2\text{H}_5\text{OH}$	46	-1380
propane	C_3H_8	44	-2200
heptane	C_7H_{16}	100	-4800

Which fuel produces the most energy when 1 kg of the compound is completely burned?

- A methane B ethanol C propane D heptane
- 24 Nitrogen exists as the molecule $\text{N}\equiv\text{N}$. Chemists once proposed that this nitrogen molecule can combine to form a larger molecule N_4 as shown below.



By considering the bonds formed and the bonds broken, what would be the value of the energy change for the above reaction?



(Bond energies: $\text{N}-\text{N}$, 160 kJ/mol; $\text{N}\equiv\text{N}$, 994 kJ/mol)

- A +1348 kJ/mol
 B +1028 kJ/mol
 C +514 kJ/mol
 D -34 kJ/mol
- 25 A newly discovered element **M** has a high melting point and a high boiling point. What other properties could element **M** have if it is a metal?

- I. **M** conducts electricity when solid.
 II. **M** forms an acidic oxide MO_2 .
 III. **M** is malleable.

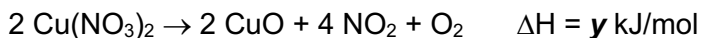
- A I & II B I & III C II & III D I, II & III
- 26 Steel is an alloy of iron with a very small percentage of carbon. Which of the following statements is correct?
- A Carbon atoms disrupt the metallic structure of iron.
 B Carbon atoms are the same size as iron atoms.
 C A decrease in the percentage of carbon makes the steel more brittle.
 D An increase in the percentage of carbon makes the steel softer.

- 27 In an experiment, 112 g of cadmium displaces 216 g of silver metal from aqueous silver nitrate.

Which of the following equations represents this results?

- A $\text{Cd}^{2+}(\text{aq}) + 2 \text{Ag}(\text{s}) \rightarrow \text{Cd}(\text{s}) + 2 \text{Ag}^+(\text{aq})$
 B $\text{Cd}^+(\text{aq}) + \text{Ag}(\text{s}) \rightarrow \text{Cd}(\text{s}) + \text{Ag}^+(\text{aq})$
 C $\text{Cd}(\text{s}) + 2 \text{Ag}^+(\text{aq}) \rightarrow \text{Cd}^{2+}(\text{aq}) + 2 \text{Ag}(\text{s})$
 D $\text{Cd}(\text{s}) + \text{Ag}^+(\text{aq}) \rightarrow \text{Cd}^+(\text{aq}) + \text{Ag}(\text{s})$

- 28 The enthalpy change of reaction for the action of heat on four nitrates are given below.



Predict which of the enthalpy change of reaction values is the largest.

- A **w** B **x** C **y** D **z**

- 29 Which of the following statements about the production of iron from iron(III) oxide are correct?

- I. Iron(III) oxide is reduced by carbon monoxide.
 II. Calcium silicate is formed by the reaction of limestone with sand.
 III. Molten iron formed is denser than molten slag.
 IV. Carbon dioxide reacts with coke to form carbon monoxide.

- A I & IV B I, II & IV C I, III & IV D All of the above

- 30 Approximately 40% of all iron and steel is produced by recycling.

Which of the following is **not** an advantage of recycling scrap steel?

- A Iron, when obtained by a recycling process, produces less carbon dioxide than the blast furnace process.
 B Extraction of iron from iron ore is less costly than recycling iron from scrap steel.
 C Extraction of iron from iron ore uses more natural resources which are finite.
 D Scrap metal, if not recycled, would cause environmental problems due to its disposal by landfill.

- 31 A student tested a solution by adding aqueous sodium hydroxide. A precipitate was not seen because the reagent was added too quickly.

Which of the following cations could **not** have been present in the solution?

- A Ca^{2+} B NH_4^+ C Pb^{2+} D Zn^{2+}

- 32 Two aqueous solutions of ionic compounds were mixed at a time and the observations were recorded as follows:

solution 1	solution 2	observation
$\text{Mg}(\text{IO}_3)_2$	$\text{Ni}(\text{C/O}_3)_2$	A precipitate is observed.
$\text{Mg}(\text{IO}_3)_2$	$\text{Sr}(\text{C/O}_3)_2$	A precipitate is observed.
MgCrO_4	$\text{Ca}(\text{C/O}_3)_2$	No visible reaction.
MgCrO_4	$\text{Pb}(\text{C/O}_3)_2$	A precipitate is observed.

Based on these observations, which of the following compound(s) is/are **insoluble**?

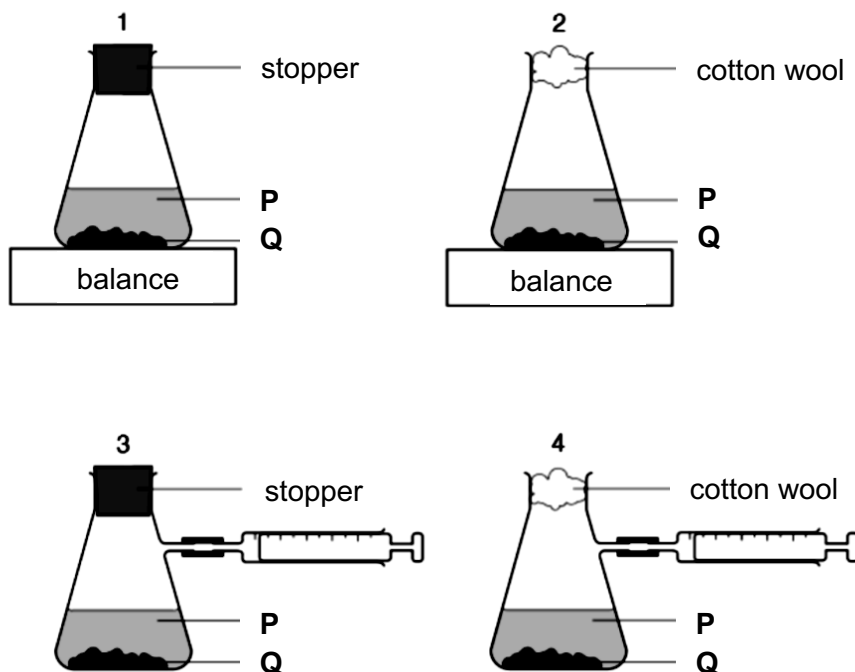
- A $\text{Mg}(\text{C/O}_3)_2$ only
 B $\text{Ni}(\text{IO}_3)_2$, $\text{Sr}(\text{IO}_3)_2$, and PbCrO_4
 C $\text{Mg}(\text{C/O}_3)_2$, $\text{Ni}(\text{IO}_3)_2$, $\text{Sr}(\text{IO}_3)_2$, and PbCrO_4
 D $\text{Mg}(\text{C/O}_3)_2$, $\text{Ni}(\text{IO}_3)_2$, $\text{Sr}(\text{IO}_3)_2$, CaCrO_4 and PbCrO_4
- 33 A student carried out the following series of tests on an aqueous solution of sodium carbonate and recorded his results as shown in the table below.

Which of the following tests shows an **incorrect** observation?

	test	observation
A	add silver nitrate solution	white precipitate formed
B	add copper(II) sulfate solution	green precipitate formed
C	add dilute sulfuric acid	effervescence observed
D	add sodium hydroxide solution	white precipitate formed

- 34 Solution **P** reacts with solid **Q** to form a gas.

Which two diagrams show suitable methods for investigating the rate of reaction?

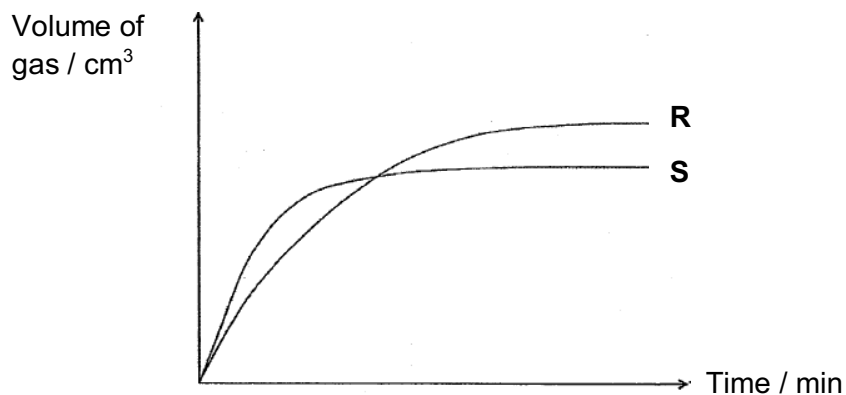


- A** 1 & 3 **B** 1 & 4 **C** 2 & 3 **D** 2 & 4

- 35 Hydrogen peroxide decomposes according to the following equation:



200 cm³ of 0.10 mol/dm³ hydrogen peroxide was allowed to decompose until there was no change in the volume of oxygen gas collected. The graph **R** below shows the volume of oxygen produced during the decomposition.



Which of the following changes to the experiment would produce the result in graph **S**?

- A** using 120 cm³ of 0.15 mol/dm³ hydrogen peroxide
B using 180 cm³ of 0.10 mol/dm³ hydrogen peroxide
C using 220 cm³ of 0.15 mol/dm³ hydrogen peroxide
D using 360 cm³ of 0.05 mol/dm³ hydrogen peroxide

- 36** A student conducted four experiments using the same mass of magnesium to react with excess acid.

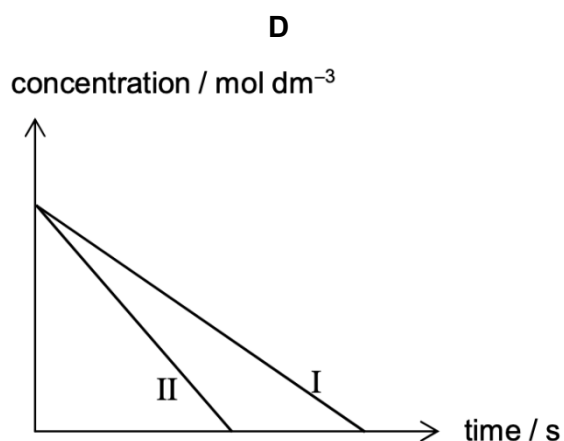
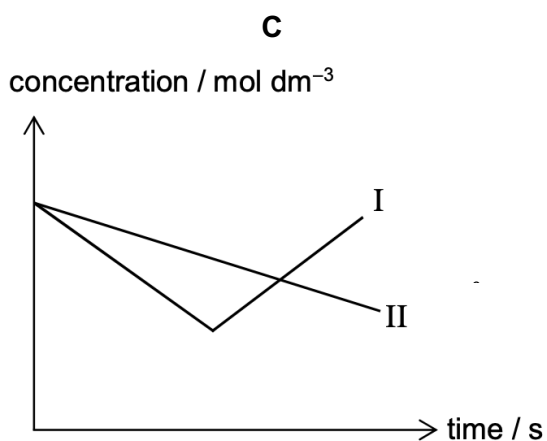
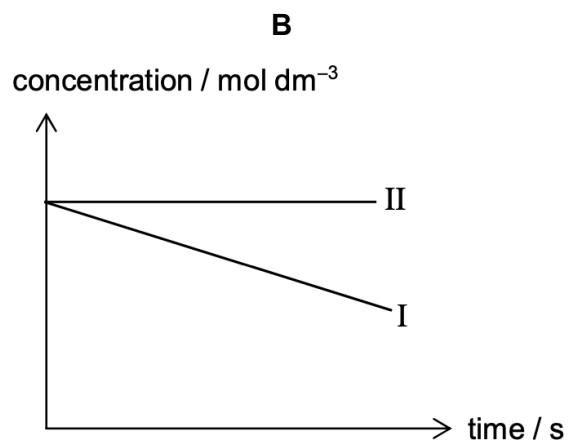
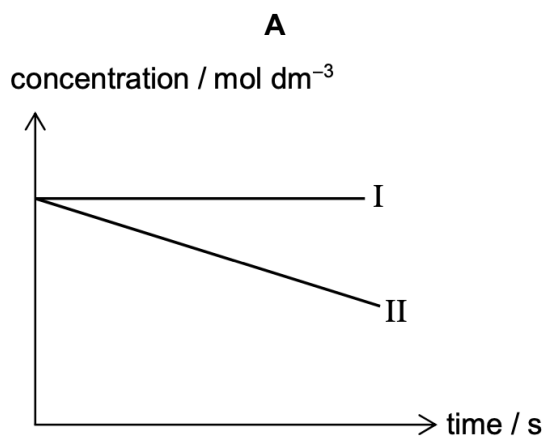
Which set of conditions will result in the magnesium being used up the fastest?

	magnesium type	concentration of acid	temperature / °C
A	ribbon	0.5 mol of HCl in 2 dm ³ of water	30
B	ribbon	0.2 mol of H ₂ SO ₄ in 1 dm ³ of water	30
C	powdered	0.2 mol of HCl in 500 cm ³ of water	60
D	powdered	0.2 mol of H ₂ SO ₄ in 500 cm ³ of water	60

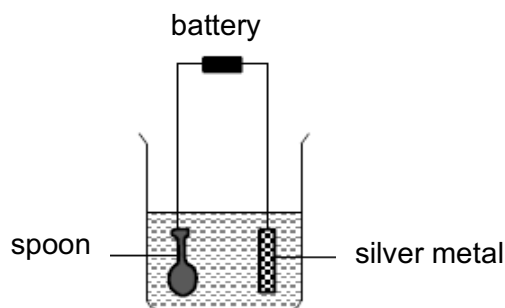
- 37** Two experiments were conducted on the electrolysis of aqueous copper(II) sulfate.

experiment	electrodes
I	copper
II	platinum

Which graph below shows the change in the concentration of the copper(II) ions in the electrolyte in both experiments?

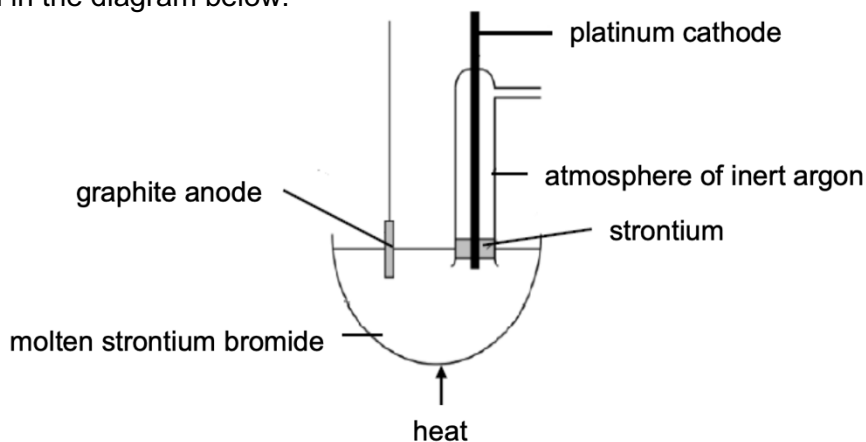


- 38 A spoon is silver-plated using the set-up shown below.



Which of the following statements is correct?

- A** The spoon is the anode and is connected to the positive terminal of the battery.
B The spoon is the anode and is connected to the negative terminal of the battery.
C The spoon is the cathode and is connected to the positive terminal of the battery.
D The spoon is the cathode and is connected to the negative terminal of the battery.
- 39 In an electrolysis, the same amount of charge deposited 16.0 g of copper and 14.9 g of tin. If the charge of copper ion is +2, what was the most likely charge of the tin ion?
- A** +1 **B** +2 **C** +3 **D** +4
- 40 Strontium metal can be obtained by the electrolysis of molten strontium bromide, SrBr_2 as shown in the diagram below.



Why is an atmosphere of argon used around the cathode?

- A** A compound of strontium and argon formed on the surface protects the metal.
B Presence of argon ensures strontium formed remains in molten form.
C Presence of argon prevents the formation of strontium oxide.
D Presence of argon stops the strontium formed from moving up the tube.

The Periodic Table of the Elements

Group																	
I	II											III	IV	V	VI	VII	0
key proton (atomic) number atomic symbol name relative atomic mass						1 H hydrogen 1											2 He helium 4
												5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
												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
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 dm³ at room temperature and pressure (r.t.p.)