ZHONGHUA SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2020

SECONDARY 4E

Candidate's Name	Class	Register Number
	4E	

CHEMISTRY 6092/01

21 September 2020
1 hour

Additional Materials: OTAS

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, index number and class on the OTAS in the spaces provided.

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 OTAS.

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 in this booklet.

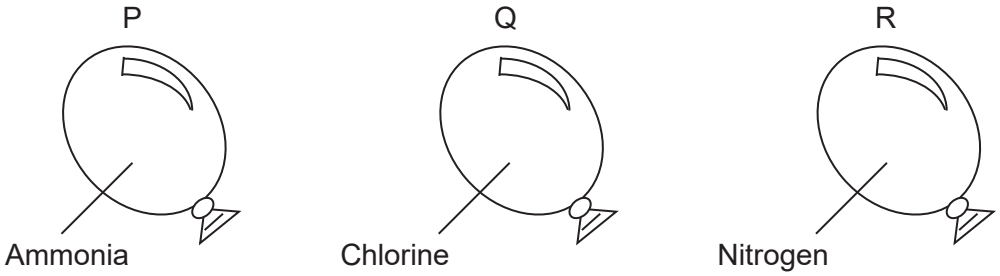
A copy of the Periodic Table is printed on page 15.

Setter: Ms Julia Yeo
Vetter: Ms Ong Lay Hong

This document consists of **15** printed pages, including this cover page.

[Turn over

1 Three balloons, P, Q and R, were inflated to the same size with three different gases, ammonia, chlorine and nitrogen.



Which is the correct order of the sizes of the balloons, starting with the biggest, after a period of 5 hours?

A P, Q, R **B** P, R, Q

C Q, R, P **D** Q, P, R

2 The table below shows the proton and nucleon numbers of atoms P, Q, R and S.

atom	proton number	nucleon number
P	6	14
Q	7	14
R	16	32
S	20	40

Which of the following statements are true?

1 Atom **P** and atom **Q** are isotopes.
2 Atom **P** and atom **R** will combine to form a covalent compound.
3 Atom **Q** and atom **S** will combine to form an ionic compound.
4 One mole of the compound formed between atom **R** and atom **S** has a mass of 72 g.

A 1 and 2 **B** 2 and 3

C 1, 3 and 4 **D** 2, 3 and 4

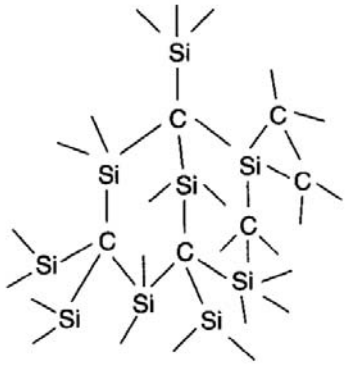
3 Phosphorus trichloride, PCl_3, is a molecule formed when the elements phosphorus and chlorine react together.

How many electrons in the outer shell of the phosphorus and chlorine atoms are not involved in bonding?

A 2 **B** 6

C 18 **D** 20

4 The diagram shows part of the structure of the compound silicon carbide. Which set of information about silicon carbide is correct?



	empirical formula	when strongly heated in oxygen
A	SiC	burns, giving a solid residue only
B	SiC	burns, giving a solid residue and a colourless gas
C	Si_2C	burns, leaving no solid residue
D	SiC_2	burns, giving a solid residue and a colourless gas

5 Which property of nitrogen is explained by the covalent bonds in its molecule?

A Its separation from liquid air by fractional distillation.

B The low reactivity of nitrogen.

C The acidity of nitrogen dioxide.

D The very low boiling point of nitrogen.

6 Cartoon hero, Steel Man, was famous for his shiny armour, a gold-titanium alloy, which allowed him to fly to Mars and back to Earth without melting.

Which of the following best describes the bonding which exists within the structure of his armour?

A Ions and atoms of gold and titanium are held by strong intermolecular forces.

B Ions and atoms of gold and titanium are held by strong attractive forces.

C Ions and electrons of gold and titanium are held by strong attractive forces.

D Ions, atoms and electrons of gold and titanium are held by strong attractive forces.

7 Ammonia burns in oxygen, forming nitrogen and water. The equation is shown below.

$$NH_3\ (g) + 3\ O_2\ (g) \rightarrow 2N_2\ (g) + 6\ H_2O\ (l)$$

If 40.0 cm^3 of ammonia is burnt in 60.0 cm^3 of oxygen, what will be the total volume of gases left after combustion at room temperature and pressure?

A 40.0 cm^3 **B** 60.0 cm^3

C 80.0 cm^3 **D** 100.0 cm^3

8 The fertiliser ammonium nitrate is manufactured from ammonia by a two-stage process.

stage 1 $NH_3 + 2O_2 \rightarrow HNO_3 + H_2O$

stage 2 $HNO_3 + NH_3 \rightarrow NH_4NO_3$

What is the maximum mass of fertiliser that can be made if 17 tonnes of ammonia is available?

A 34 tonnes **B** 40 tonnes

C 80 tonnes **D** 97 tonnes

9 In an experiment, 10.0 cm^3 of 0.01 mol/dm^3 copper(II) sulfate solution is mixed with 5.0 cm^3 of 0.01 mol/dm^3 sodium carbonate solution in a flask. The equation is shown below.

$$CuSO_4 + Na_2CO_3 \rightarrow Na_2SO_4 + CuCO_3$$

What is seen in the flask when the reaction was completed?

A A colourless solution only.

B A green precipitate and a blue solution.

C A green precipitate and a colourless solution.

D A white precipitate and a colourless solution.

10 When hydrogen peroxide is used as a bleaching agent, it decomposes to form water and oxygen.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

When 68 g of hydrogen peroxide decomposes, the volume of oxygen gas collected under room temperature and pressure is 1200 cm^3. What is the percentage purity of hydrogen peroxide?

A 2.5 %

B 5.0 %

C 10.0 %

D 15.0 %

11 A dilute aqueous solution of a strong acid, H**X**, contains molecules of water and the ions H^+ and $\mathbf{X}^-$. Which statement is correct?

A The pH value of the acid is above 7.

B The solution contains a high concentration of H**X** molecules.

C The solution also contains OH^- ions.

D The solution contains more H^+ ions than water molecules.

12 Some statements about acids are given.

1 a 1 mol/dm^3 solution of a strong acid will have a higher pH than a 1 mol/dm^3 solution of a weak acid.
2 pH gives a measure of the H^+ concentration in a solution.
3 universal indicator turns blue when placed in a solution of pH 5.
4 when acids react with metals, hydrogen ions gain electrons.

Which statements about acids are correct?

A 1 and 2

B 1 and 4

C 2 and 4

D 1, 2 and 3

13 Which of the following can be used to distinguish between aqueous zinc nitrate and aqueous calcium chloride?

1 aqueous sodium carbonate
2 aqueous lead(II) nitrate
3 dilute sulfuric acid

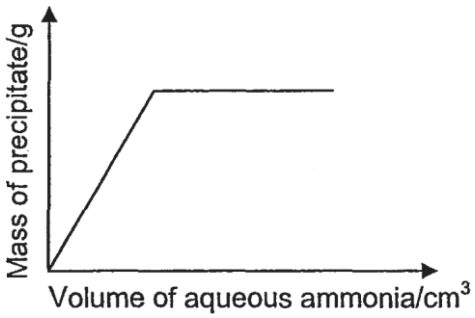
A 2 only

B 1 and 2

C 2 and 3

D 1, 2 and 3

14 An aqueous solution of a salt was placed in a test tube and aqueous ammonia was gradually added from a burette. The mass of the precipitate was obtained when various volumes of aqueous ammonia were added and a graph was obtained as shown.

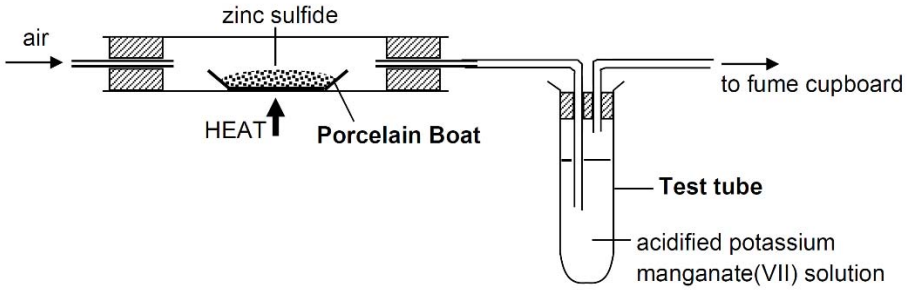


Which salt would show this behaviour?

A copper (II) nitrate **B** iron (II) sulfate

C sodium nitrate **D** zinc chloride

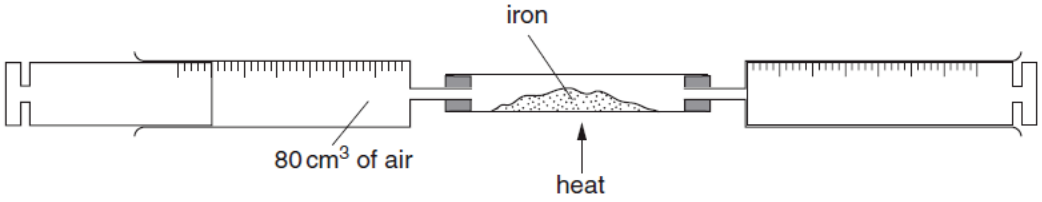
15 Zinc is extracted from its ore, zinc sulfide, which is heated in air to form zinc oxide. This was carried out in a laboratory using the apparatus shown.



What are the observations in the porcelain boat and test tube when zinc sulfide is heated?

	solid in porcelain boat	solution in test tube
A	turns yellow	turns colourless
B	turns yellow	remains purple
C	turns grey	remains purple
D	turns white	turns colourless

16 An 80 cm^3 sample of air is trapped in a syringe. The air is slowly passed over heated iron in a tube until there is no further decrease in volume.



When cooled to its original temperature, what is the volume of gas remaining in the syringe?

A 80 cm^3 **B** 64 cm^3

C 20 cm^3 **D** 16 cm^3

17 The statements below give some information about metals **R**, **S**, **T** and **U**.

- Carbonate of **U** does not decompose on heating.
- Only oxides of **R** and **T** can be reduced by heating with carbon.
- **R** and **S** react with dilute hydrochloric acid but not with cold water.
- **T** reacts with neither dilute hydrochloric acid nor water.

What is the order of increasing reactivity of the four metals?

A T < R < S < U

B T < S < R < U

C U < S < R < T

D U < T < R < S

18 Which pair of substance acts as reducing agents in the blast furnace?

A carbon and oxygen

B carbon monoxide and carbon dioxide

C carbon and carbon monoxide

D carbon dioxide and oxygen

19 Steel is an alloy with a very small percentage of carbon.

Which statement is correct?

A A decrease in the percentage of carbon makes the steel more brittle.

B An increase in the percentage of carbon makes the steel softer.

C Carbon disrupts the metallic structure of iron.

D Iron atoms are the same size as carbon atoms.

20 Metal **P** is more reactive than metal **Q** which is more reactive than metal **R**. The sulfates of **P** and **R** are colourless the sulfate of **Q** is blue.

Which observation is correct when a metal is added to a solution of sulfate?

	metal added	solution of sulfate	colour change
A	R	Q	blue to colourless
B	Q	P	colourless to blue
C	Q	R	blue to colourless
D	P	Q	blue to colourless

21 Which of the following statements regarding the element caesium (proton number 55) are correct?

1 It is a stronger reducing agent than potassium.
2 It reacts with chlorine to form an ionic compound.
3 It has a higher density than sodium.
4 It has a higher melting point than lithium.

A 1 and 2 **B** 1, 2 and 3

C 2 and 3 **D** 1, 2 and 4

22 Which of the following characteristics of elements in a period is incorrect?

A The elements on the left hand side of a period are metals.

B The reducing power of the elements decrease across the period.

C The elements on the right hand side of a period have the lowest melting point.

D When moving across a period, from left to right, the oxides change from acidic to basic.

23 In which of the following reactions does the oxidation state of nitrogen show the greatest increase?

A NH_3 (g) + HCl (g) → NH_4Cl (s)

B $2NH_3$ (g) + 3CuO (s) → N_2 (g) + 3Cu (s) + $3H_2O$ (l)

C $4NO_2$ (g) + O_2 (g) + $2H_2O$ (l) → $4HNO_3$ (l)

D $2NO_3^-$ (aq) + Cu (s) + $4H^+$ (aq) → $2NO_2$ (g) + Cu^{2+} (aq) + $2H_2O$ (l)

24 Which of the following are true for the reaction below?

$$2\ FeCl_3\ (aq) + H_2S\ (g) \rightarrow 2HCl\ (aq) + S\ (s) + 2FeCl_2\ (aq)$$

1 Hydrogen sulfide is reduced to hydrochloric acid.
2 Iron(III) ions gain electrons.
3 The solution changes in colour from yellow brown to pale green.
4 Oxidation state of sulfur decreases.

A 2 and 3 **B** 2 and 4

C 3 and 4 **D** 1, 2 and 3

25 The reaction in which the same reactant is both oxidised and reduced is called a *disproportionation* reaction.

Which equation is an example of a *disproportionation* reaction?

A $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

B $Cl_2 + 2NaOH \rightarrow NaCl + NaOCl + H_2O$

C $Fe_2(SO_4)_3 + 2KI \rightarrow 2FeSO_4 + K_2SO_4 + I_2$

D $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2$

26 When fossil fuels are burnt in a motor car the following gases are emitted from the car's exhaust. Which gases are the result of incomplete combustion?

1 C_8H_{18}
2 CO
3 NO_2
4 SO_2

A 2 only **B** 1 and 2

C 2 and 3 **D** 3 and 4

27 What modifications to a catalytic converter would result in lower concentrations of nitrogen oxides?

A Using smaller exhaust pipes.

B An increase in the surface area of the catalyst in the converter.

C A higher temperature of combustion in the engines.

D An increase in the rate of flow of gas through the converter.

28 The equation for combustion of hydrogen is shown below.

$$2H_2\,(g) + O_2\,(g) \rightarrow 2H_2O\,(g)$$

bond	H – H	O – H	O = O	O – O
Bond energy in KJ/mol	436	463	498	146

What is the enthalpy change of this reaction?

A - 482 KJ/mol **B** - 834 KJ/mol

C + 482 KJ/mol **D** + 834 KJ/mol

29 The formation of hydrogen chloride from the reaction between hydrogen and chlorine causes the temperature to decrease.

$$H{-}H + Cl{-}Cl \rightarrow 2\ H{-}Cl$$

Which of the following statements is correct?

A The breaking of Cl−Cl bonds releases more energy than the breaking of H−H bonds.

B The number of bonds broken is greater than the number of bonds formed.

C The reactants possess less energy than the products.

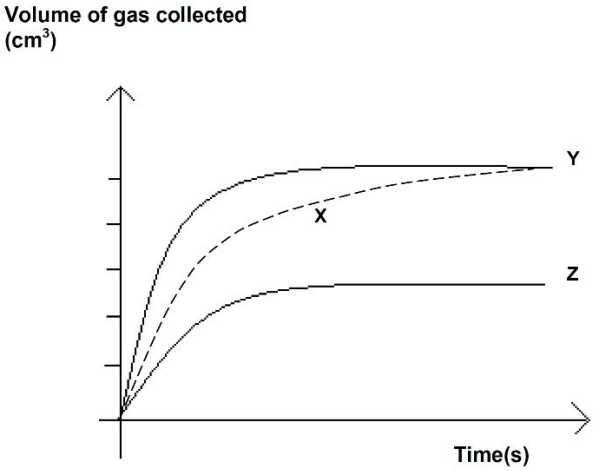
D The total energy change in bond breaking is less than that in bond formation.

30 In an experiment, a quantity of electricity plated 0.12 mol of copper metal onto an object, from Cu^{2+} (aq). The same quantity of electricity plated 0.08 mol of gold onto an object. What is the formula of the gold ions?

A Au^{+} **B** Au^{2+}

C Au^{3+} **D** Au^{4+}

31 In the graph, curve X represents the results of the reaction between 50 cm^3 of 0.10 mol/dm^3 dilute hydrochloric acid and excess calcium carbonate at 30 °C.



What are the changes that will produce curve Y and Z?

	curve Y	curve Z
A	50 cm^3 of 0.20 mol/dm^3 dilute HCl at 30 ºC	25 cm^3 of 0.10 mol/dm^3 dilute HCl at 30 ºC
B	50 cm^3 of 0.20 mol/dm^3 dilute HCl at 30 ºC	50 cm^3 of 0.05 mol/dm^3 dilute HCl at 30 ºC
C	50 cm^3 of 0.10 mol/dm^3 dilute HCl at 40 ºC	25 cm^3 of 0.10 mol/dm^3 dilute HCl at 30 ºC
D	50 cm^3 of 0.10 mol/dm^3 dilute HCl at 40 ºC	50 cm^3 of 0.05 mol/dm^3 dilute HCl at 30ºC

32 100 cm^3 of 1.0 mol/dm^3 hydrogen peroxide was left to decompose and the rate of decomposition and the volume of oxygen liberated were measured.

How would the rate of decomposition and the volume of oxygen produced be different if the experiment was repeated with some water added to it?

	rate of decomposition	volume of oxygen
A	decreased	unchanged
B	decreased	decreased
C	increased	increased
D	unchanged	decreased

33 Ammonia is manufactured by the Haber process. Which statement is incorrect?

A High pressure of 200 atm is used to increase yield.

B Each hydrogen molecule reacts with three nitrogen molecules to form two molecules of ammonia.

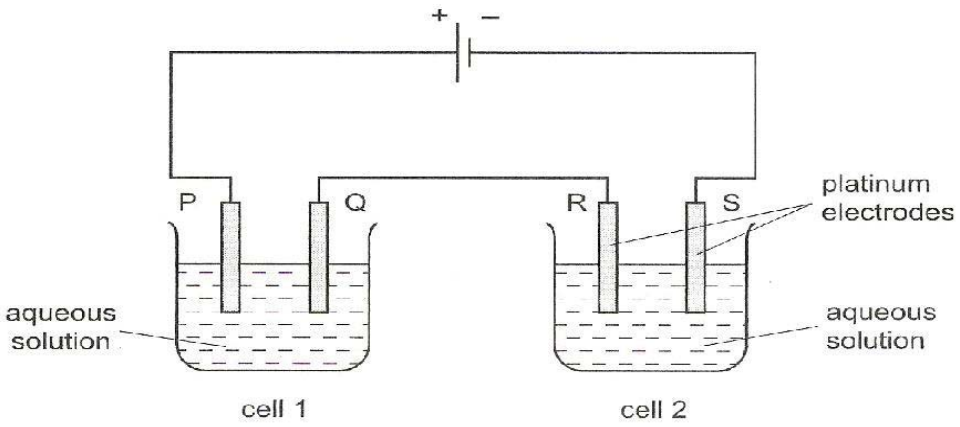
C A low temperature of 450 °C is used.

D The reaction is reversible.

34 A student tries to electroplate an iron ring with nickel. Which of the following combinations are correct?

	electrolyte	anode	cathode
A	iron(II) sulfate solution	iron ring	nickel rod
B	iron(II) sulfate solution	nickel rod	iron ring
C	nickel(II) sulfate solution	iron ring	nickel rod
D	nickel(II) sulfate solution	nickel rod	iron ring

35 In the diagram, each cell contains an aqueous solution of a single salt and all four electrodes are platinum. Electrodes **Q** and **S** increase in mass during the electrolysis but no gas is given off at **Q** or **S**.



If the increase in mass of electrode **Q** is greater than the increase in mass of electrode **S** at the same time, which of the following statements is true?

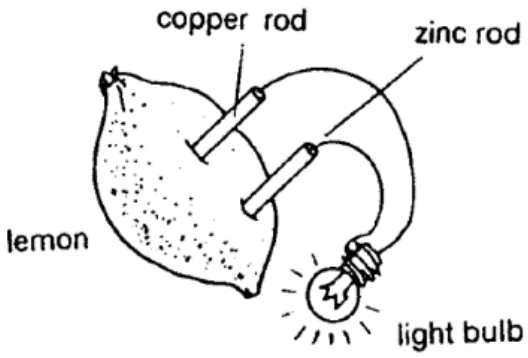
A The loss of mass of electrode **P** is less than the loss of mass of electrode **R**.

B The current flowing in cell 1 is greater than the current flowing in cell 2.

C The cation of the solution in cell 1 is different from the cation of the solution in cell 2.

D The cation in cell 1 is the same as in cell 2 but the solution in cell 1 is more concentrated than in cell 2.

36 The diagram below shows a 'lemon cell'. Which of the following statements concerning this lemon cell is not correct?



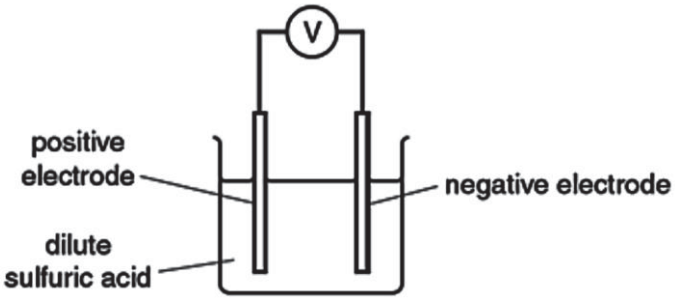
A Electrons flow from zinc rod to copper rod.

B The light bulb will not light up if the copper rod is replaced by a magnesium rod.

C The electrolyte in a lemon cell is the organic acid and mineral salts in the lemon.

D The light bulb will also light up if the lemon is replaced by an orange.

37 Four metals **W**, **X**, **Y** and **Z** were connected in pairs as shown in the diagram below and the voltage was recorded.



The results obtained are recorded in the table below.

cell	metals used	voltage/ V	positive terminal
1	**W** and **X**	1.10	**W**
2	**X** and **Y**	1.46	**Y**
3	**X** and **Z**	0.47	**X**

Which statement is correct?

A **Y** is the most reactive metal.

B The voltage obtained when **W** and **Y** are used is 0.36 V.

C The voltage obtained when **Z** and **Y** are used is 3.03 V.

D **W** can displace metal **Z** form a solution containing cations of **Z**.

38 In which instance is there no change in the concentration of the solution during electrolysis?

A Concentrated sodium chloride solution between carbon electrodes.

B Copper(II) sulfate solution between copper electrodes.

C Copper(II) sulfate solution between platinum electrodes.

D Dilute sodium chloride solution between platinum electrodes.

39 Which statement describes what happens when hydrogen and oxygen are used in a fuel cell?

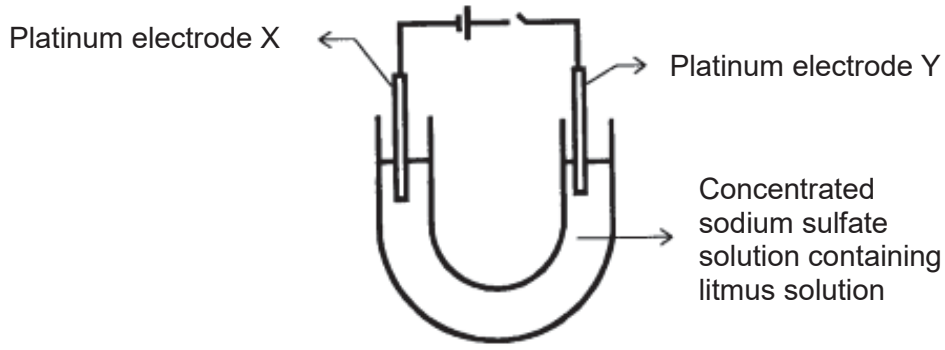
A Hydrogen is burned to form steam.

B Hydrogen is oxidised by losing electrons at the anode.

C Oxygen is oxidised by gaining electrons from hydrogen.

D Electricity is generated due to flow of electrons from cathode to anode.

40 The diagram below shows an electrolysis reaction with concentrated sodium sulfate solution as the electrolyte. Which of the following changes would occur when a current is passed through the solution for some time?



A Oxygen is given off at X and hydrogen is given off at Y.

B Sodium is formed at X and oxygen gas is given off at Y.

C The colour of the solution becomes red around X and blue around Y.

D The colour of the solution becomes blue around X and red around Y.

End of paper

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.).

ZHONGHUA SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2020

SECONDARY 4E

Candidate's Name	Class	Register Number

CHEMISTRY 6092 /02

14 September 2020
1 hour 45 minutes

Additional Materials: NIL

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces at the top of this page and on all separate answer paper used.

Write in dark blue or black pen.

You may use a pencil for any diagrams, graphs or rough working.

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

Section A

Answer **all** questions.

Write your answers in the spaces provided on the question paper

Section B

Answer all **three** questions, the last question is in the form either/or.

Write your answers in the spaces provided.

You are advised to spend no longer than one hour on **Section A** and no longer than 45 minutes on **Section B**.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [ ] at the end of each question or part question.

All essential working must be shown clearly.

A copy of the Periodic Table is printed on page 20.

For Examiner's Use	
Section A	/50
B9	/10
B10	/10
B11	/10
Total	/80

Setter: Mrs Maybrie Ang & Ms Julia Yeo
Vetter: Ms Ong Lay Hong

This document consists of **20** printed pages, including this cover page.

Section A

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

A1 Table 1.1 shows a list of substances.

Table 1.1

sodium	graphite	lead(II) hydroxide	calcium carbonate
lead(II)chloride	chlorine	iron(II) chloride	sulfur dioxide

Use the list of substances to answer the following questions. Each substance can be used once, more than once, or not at all.

Which substance

(a) can be decomposed by heat to give a gaseous product at room temperature and pressure?

……..... [1]

(b) dissolves in both acids and alkalis?

……..... [1]

(c) consists of particles that have the highest kinetic energy at room temperature and pressure?

……..... [1]

(d) is formed during electrolysis of concentrated aqueous sodium chloride.

……..... [1]

(e) has a giant covalent structure.

……..... [1]

[Total:5]

A2 Fig 2.1 shows an article from a textbook about elderberries.

Elderberries are widely used in wine making. Extract of elderberries is a useful pH indicator and it can be separated by chromatography.

As an indicator, the colour of the extract changes to pink at a pH of 2 – 3 and to blue at a pH of 11 – 12.

elderberries

Fig 2.1

(a) The chromatogram, Fig 2.2**,** was obtained when water was added to a drop of elderberries extract at the centre of a filter paper.

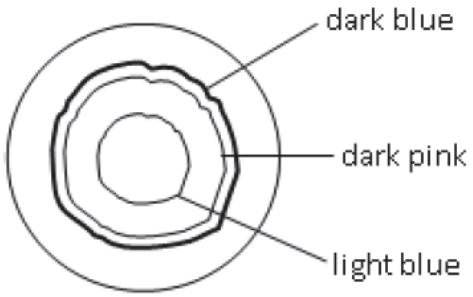


Fig 2.2

(i) Predict the colour of the elderberries extract at pH 7.

……..... [1]

(ii) An alternative set-up for the above experiment was shown in Fig 2.3 below.

dye	R_f value	distance travelled (cm)
light blue	0.2	
dark pink	0.4	1.00
dark blue	0.5	

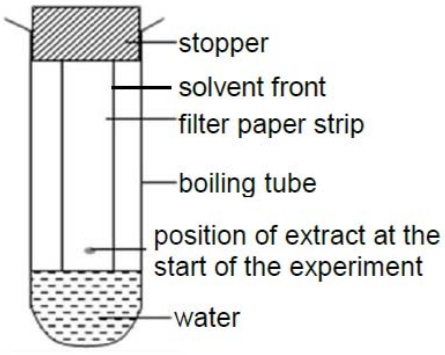


Fig 2.3

[1]

Given that the distance travelled by the dark pink dye is 1.00 cm, complete the table above by stating the distance travelled by the light blue and dark blue dyes.

(b) Fig 2.4 below shows how pH values changed during a titration when an acid was added from a burette into an alkali. A few drops of elderberries extract were added at the start of titration to monitor the pH of the solution.

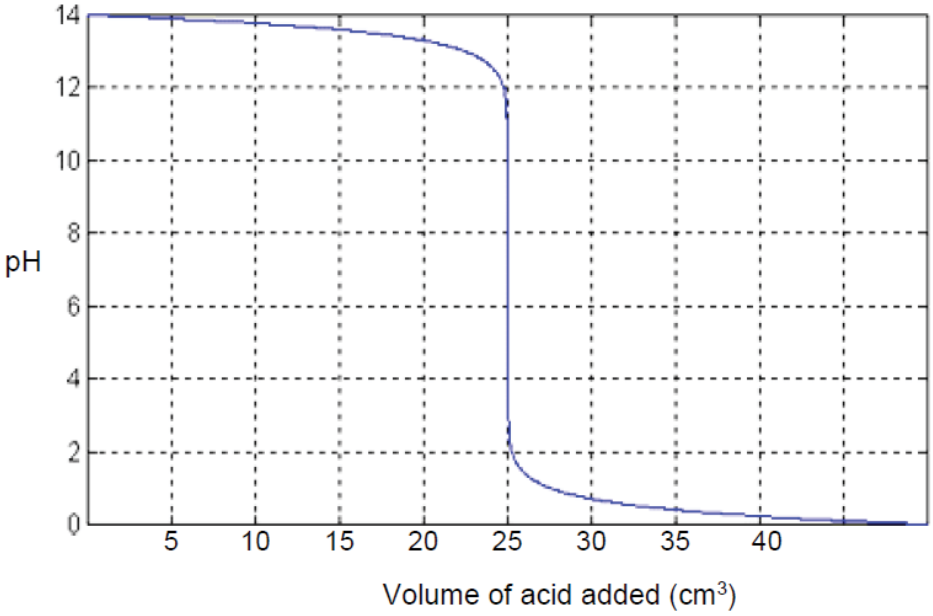


Fig 2.4

(i) State and explain what could be one possible chemical formula of the alkali used.

……

…… [2]

(ii) State the colour of the elderberries extract when the volume of acid added was

20 cm^3 ……

30 cm^3 …… [2]

[Total:6]

A3 An unknown colourless solution, **X**, was spotted in the laboratory.
Several tests were carried out as shown in Fig 3.1.

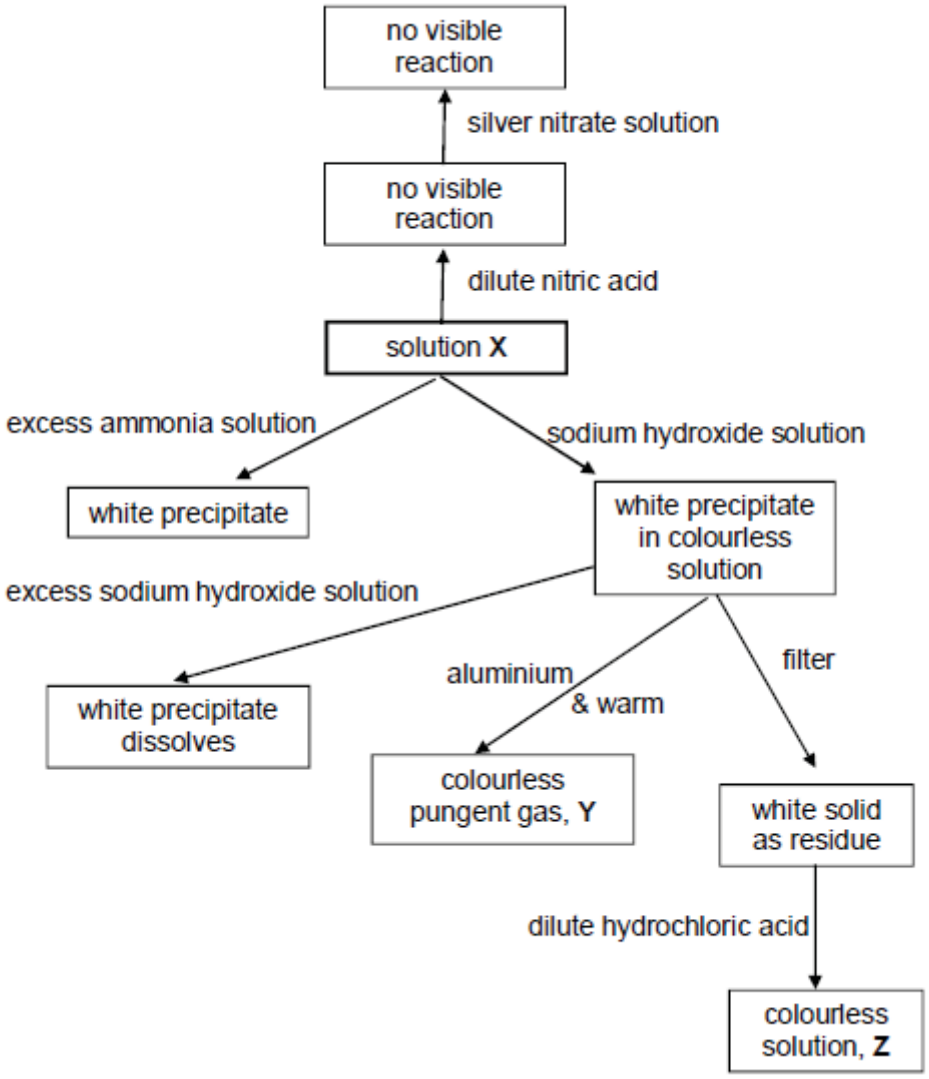


Fig 3.1

(a) Identify gas **Y** and describe a test to confirm the identity.

……

…… [2]

(b) Identify solution **Z** and write balanced equation with states symbols for the formation of solution **Z**.

……

…… [2]

(c) Prior to the addition of silver nitrate solution, dilute nitric acid was added to unknown solution **X**. Explain the purpose of adding dilute nitric acid and how does the observation made lead to the conclusion.

……

……

…… [2]

[Total:6]

A4 Fig 4.1 is a label found on a bottle of cleaning agent. It can be used to remove tarnish from steel pipes. Read the information on the label and answer the questions that follow.

TOTALSHINE

- Removes rust stains quickly and effectively.
- Removes tarnishes and restores original shine of surfaces without damaging them.

Directions:
1. Pour directly on surface or apply on cloth or sponge to use.
2. Leave it for 2 – 5 minutes and rinse with water.

CAUTION:
Not recommended for application on surfaces of marble.
Active ingredient: Phosphoric acid (H_3PO_4), a weak acid

Fig 4.1

(a) TOTALSHINE contains phosphoric acid. With the help of an ionic equation, explain why phosphoric acid is a tribasic acid and a weak acid?

……

……

…… [2]

(b) Explain why a steel pipe will tarnish after some time.

…… [1]

(c) Write a balanced chemical equation for the reaction that occurs when TOTALSHINE is applied to rust, Fe_2O_3.

…… [1]

(d) Why is it important to rinse the object with water after TOTALSHINE has been applied?

……..... [1]

(e) Why TOTALSHINE should not be used to clean a dirty marble table top?

……..

…….. [1]

[Total:6]

A5 The bond dissociation energies of some hydrogen halides are shown in Fig 5.1. Bond dissociation energy is the energy that must be provided to the molecule in order to break the bond.

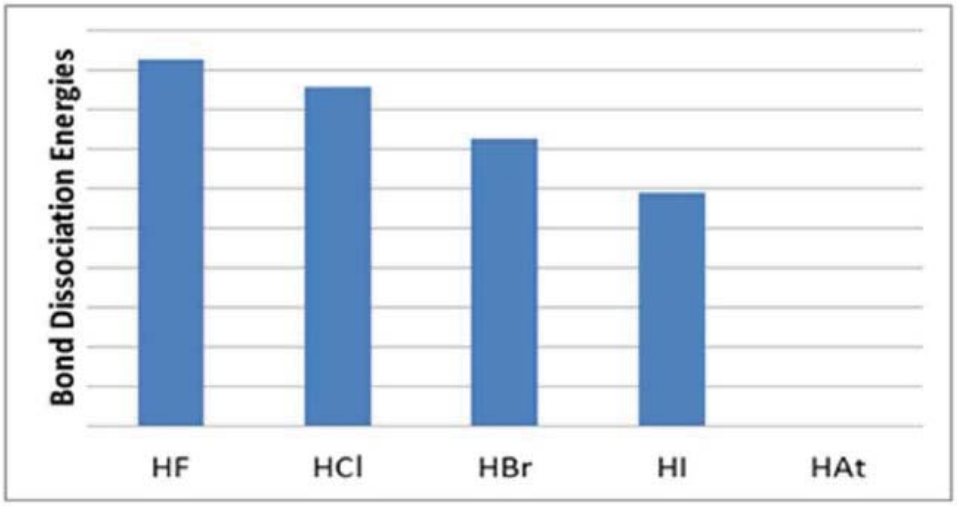


Fig 5.1

(a) Describe the trend shown in the above chart.

……..... [1]

(b) Predict the bond dissociation energy of hydrogen astatide, HAt, by drawing the rectangular bar in the chart above. [1]

(c) **(i)** Suggest which one of the hydrogen halides forms the strongest acid.

……..... [1]

(ii) Explain your answer to **(c)(i)**.

……

…… [1]

(d) Hydrogen bromide can be produced by reacting hydrogen and bromine according to the following reaction.

$$H_2\ (g) + Br_2\ (g) \rightarrow 2HBr\ (g)$$

The bond energies of some bonds are shown in Table 5.1 below.

Table 5.1

bond	H-H	H-Br	Br-Br
bond energy (kJ/mol)	432	363	193

Calculate the enthalpy change of this reaction and state whether it is exothermic or endothermic.

[2]

[Total:6]

A6 Fig 6.1 shows the results of experiments involving the reaction of calcium and excess water, carried out under different conditions.

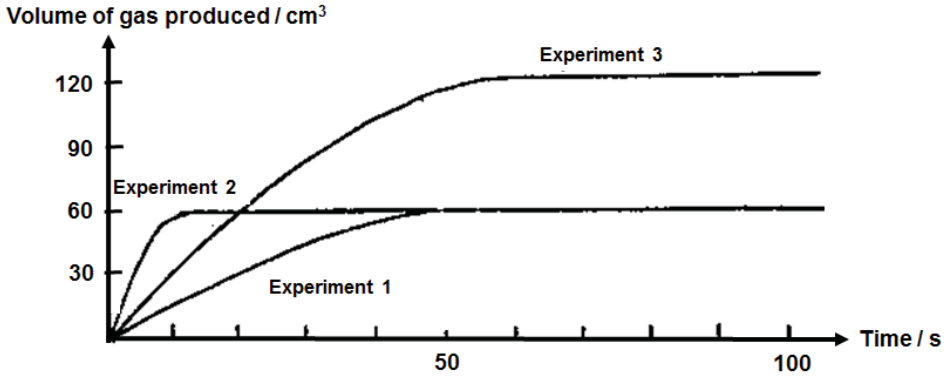


Fig 6.1

(a) Explain why

(i) the first part of each curve has a steep gradient.

……..... [1]

(ii) the last part of each curve is a horizontal line.

……..... [1]

(b) **(i)** Name two factors that can result in the difference in the experimental results of experiments 1 and 2.

……..... [1]

…….....

(ii) Use the ideas about collisions between particle to explain one of the factors identified in **b(i).**

…….....

…….....

……..... [2]

(c) Another experiment was carried out and the results are shown as experiment 3 in the Fig 6.1. Explain what is the likely experimental condition in experiment 3 as compared to experiment 1?

…….....

……..

……..... [2]

[Total:7]

A7 Pure titanium is extracted from its ore, rutile which has a chemical formula of TiO_2. Rutile is first reacted with chlorine gas at 1000^oC to produce titanium(IV) chloride and oxygen gas. The titanium(IV) chloride formed is then cooled and collected.

(a) **(i)** Construct the chemical equation for the reaction described above.

……..... [1]

(ii) Which is the oxidising agent in the reaction above? Explain your answer using oxidation states.

.....

……..... [2]

(b) Titanium (IV) chloride is then reacted with magnesium at 1100°C in a sealed reactor which is filled with argon gas. Titanium is then obtained at the end.

(i) Name the type of reaction described above. Explain why the reaction can take place.

……

…… [2]

(ii) Other than magnesium, name another metal and explain why it can be used in the above reaction.

…… [1]

(iii) Why is it necessary for the reactor be filled with argon gas?

…… [1]

[Total:7]

A8 Fig 8.1 shows an experimental set-up to coat an object with copper using electroplating.

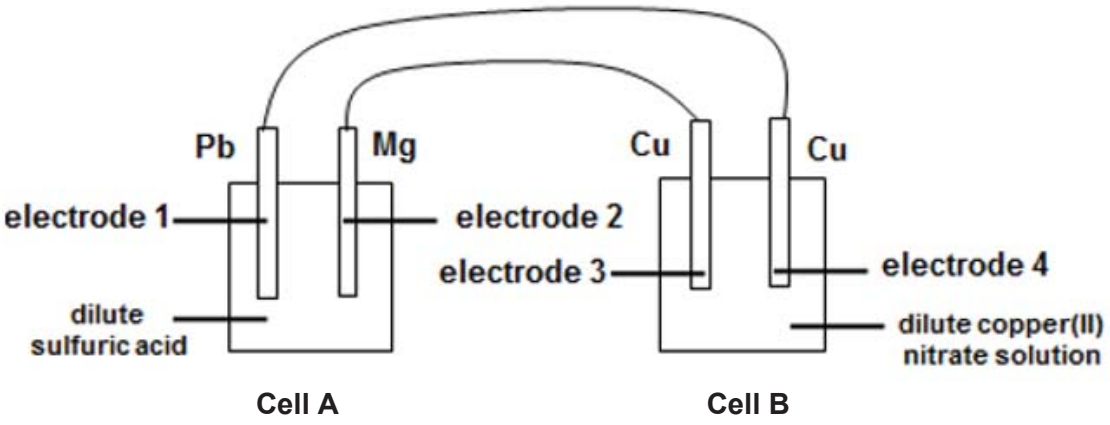


Fig 8.1

(a) On Fig 8.1, indicate the direction of electron flow. Explain your answer.

……

…… [2]

(b) A student would like to coat one of his metal toy object with copper. At which electrode (1, 2, 3, or 4) should the object be placed in order for it to be coated with copper?

…… [1]

(c) Write the half-equations with state symbols for the reactions occurring at electrodes 1 and 2.

electrode 1:

……

electrode 2:

…… [2]

(d) Use half equations to explain whether there will be a change in colour intensity of the blue copper (II) nitrate solution in cell B throughout the experiment.

……

……

……

…… [2]

[Total:7]

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.

B9 There are a range of atmospheric pollution problems currently threatening the Earth's general environment. The increased use of fossil fuels has a negative effect on the health of the environment in terms of air and water pollution.

Of all the fossil fuels, coal is the least expensive for its energy content. However, burning coal in electric power plants is a major source of carbon dioxide emissions. It also releases substantial amounts of methane. The U.S. Environmental Protection Agency's Clean Power Plan, as well as the low cost of natural gas, is leading older coal plants to close and reducing interest in new coal plants. Alternative sources of energy used as fuels are thus constantly sought after to meet the increasing demands of human activities.

Fig 9.1 below shows the changes in the type of fuel used between 1990 and 2002.

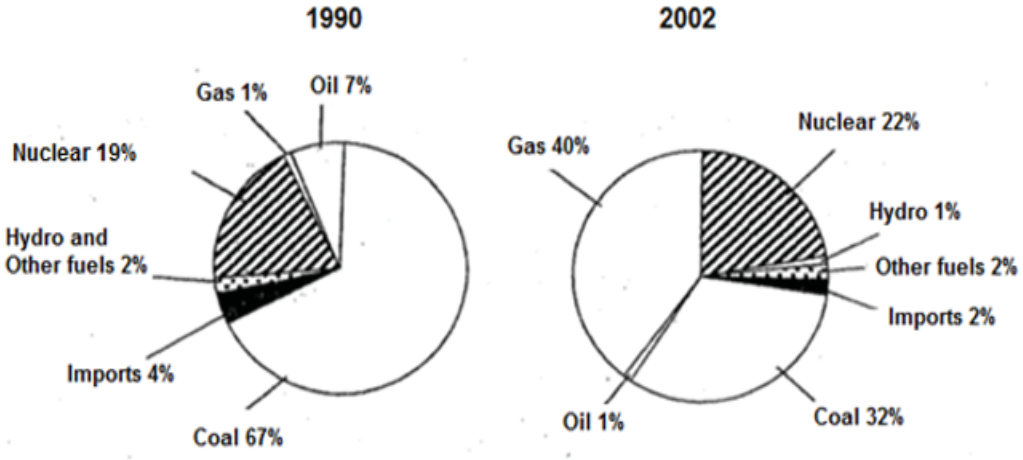


Fig 9.1

Air pollution is caused by solid particles and poisonous gases in the air. These substances are called air pollutants, which include carbon monoxide and unburnt hydrocarbons.

Fig 9.2 shows the relationship between the air : fuel ratio and the production of air pollutants by the vehicle engines.

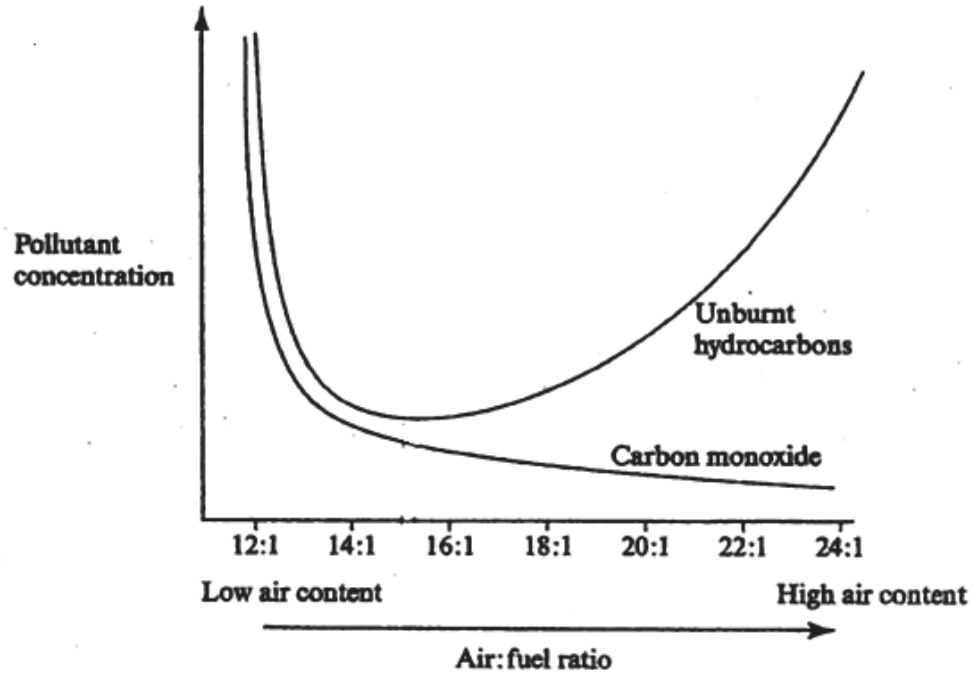


Fig 9.2

(a) Using information provided in Fig 9.1, give two main changes in the type of fuel used over 12 years from 1990 to 2002. Suggest an explanation for these changes and the effect on the environment.

……

……

……

……

……

……

……

…… [3]

(b) Using the information from Fig 9.2, describe and explain the trend for the carbon monoxide curve.

……

……

……

……

……

……

…… [3]

(c) Estimate the optimum air : fuel ratio to minimise pollution by carbon monoxide and unburnt hydrocarbons.

…… [1]

(d) **(i)** Suggest another air pollutant not mentioned in the graphs which is also produced by the vehicle engines.

…… [1]

(ii) Name the device fitted in cars which is used to remove both the emissions of carbon monoxide and the pollutant you named in **(d)(i)** from the car engine. Write a balanced equation for this reaction.

……

……

…… [2]

[Total:10]

B10 A student carries out a series of experiments. In each experiment, he electrolyses aqueous copper (II) sulfate solution using the apparatus shown in Fig 10.1.

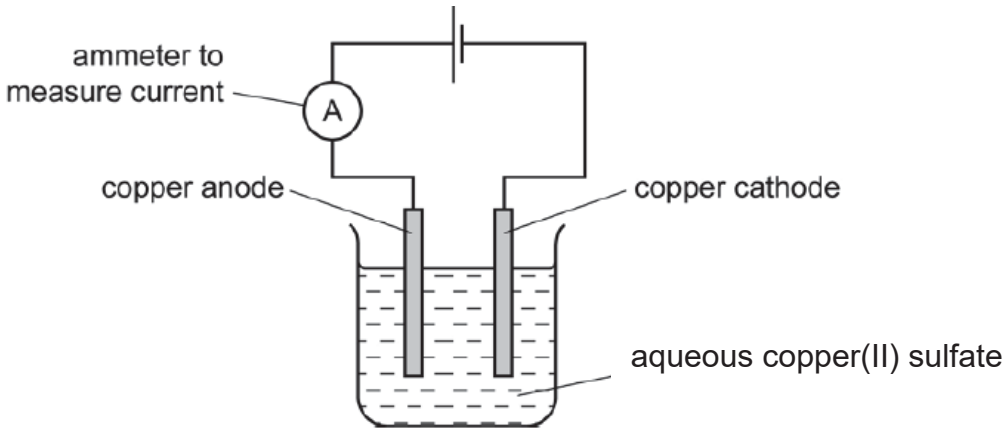


Fig 10.1

He uses the same concentration of aqueous copper (II) sulfate each time, but changes the current he passes through the solution. He runs each electrolysis for 10 minutes. The student weighs the negative electrode before and after each experiment and works out the mass of copper deposited.

Table 10.1 shows the results of his experiments.

Table 10.1

experiment	time / mins	current / A	mass of copper deposited / g
1	10	1.0	0.21
2	10	2.0	0.40
3	10	3.0	0.58
4	10	4.0	0.81

(a) **(i)** Use data from the Table 10.1 to describe the relationship between the current and the mass of copper deposited.

[1]

……..

(ii) Explain the trend observed in **(a)(i).**

…… [1]

(iii) Explain why the student ran the electrolysis for 10 min for all the experiments.

..... [1]

(b) The student carries out another experiment. He passes an electric current of 6.0 A through a solution of copper(II) sulfate for 5 minutes.
Use the information above to predict the mass of copper that would be formed in the experiment. Explain how you derived at your answer by showing your calculation.

[2]

(c) At the end of the electrolysis, the student removes a sample of the electrolyte and puts it in a test tube. He then adds aqueous ammonia dropwise to the sample until there is no further change.
Describe and explain what the student sees.

……

……

…… [2]

(d) The student carries out another electrolysis using aqueous silver nitrate and silver electrodes. His results are shown in Table 10.2.

Table 10.2

electrolyte	time / mins	current / Amps	mass of silver deposited / g
aqueous silver nitrate	10	4.0	2.7

(i) Write an ionic half equation with state symbols for the reaction that happens at the cathode.

…… [1]

(ii) Carry out calculations to compare the difference in the number of moles of copper and the number of moles of silver that are formed when a current of 4.0 A is used for 10 minutes.
Suggest an explanation for the difference in the number of moles of each metal formed.

[2]

[Total:10]

Either B11 This question describes how some substances that can be obtained from 2 different methods.

(a) Method 1 describes the extraction of zinc from its ore in the blast furnace

The temperature inside the blast furnace in which zinc is extracted is around 1000 °C.

Table 11.1 gives some information about substances in the blast furnace in which zinc is extracted.

Table 11.1

substance	melting point/ ^{o}C	boiling point/ ^{o}C
carbon	sublimes at 4330 ^{o}C	
silicon(IV) oxide	1610	2230
zinc	420	907

Use the data in the Table 11.1 to explain why the molten zinc obtained does not contain high levels of impurities such as silicon(IV) oxide and carbon.

……..

……..

……

……..

…….. [2]

(b) Method 2 describes the preparation of silver dichromate (VI) salt.
Silver dichromate (VI), $Ag_2Cr_2O_7$, is a red insoluble salt.
Silver dichromate (VI) can be made by reacting ammonium dichromate [$(NH_4)_2Cr_2O_7$] solution as one of the reactants.

(i) Suggest the other reactant and describe how it can be used to obtain pure dry solid silver dichromate.

……

……..

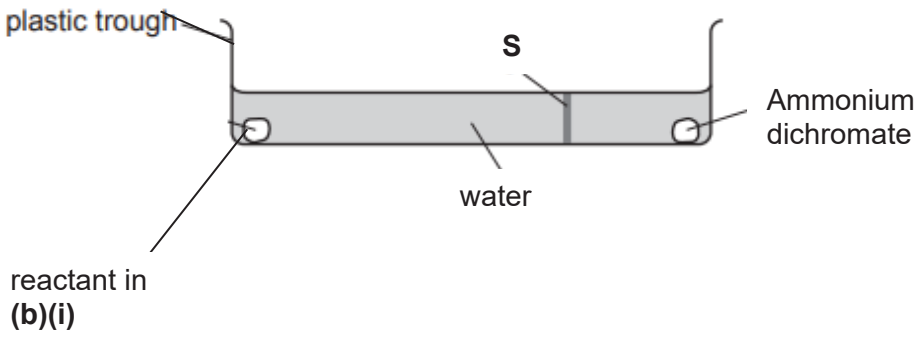
……..

……

……. [3]

(ii) Ammonium dichromate and the reactant in **(b)(i)** were poured into opposite ends of a trough. Upon reaction, a red solid appeared along the line marked **S** in Fig 11.1 after five minutes.

Fig 11.1



Explain the position of the red solid on the line marked **S**.

……

…… [2]

(iii) The experiment was repeated at a higher temperature.
What effect, if any, would this have on the time taken for the red solid to appear? Explain your answer.

……

…… [2]

(iv) Predict the change in colour of silver dichromate (VI) when it reacts with a reducing agent.

…… [1]

[Total:10]

Or B11 A laboratory assistant has six elements that are consecutively arranged in the Periodic Table. He randomly assigns each element a letter, **T, V, W, X, Y** and **Z.** The letters do not represent the atomic symbols and the order of the elements.
He carried out some experiments on the elements and found the following properties.

- $\mathbf{V}_2$ reacts with $\mathbf{X_2}$ to form a compound $\mathbf{VX_3}$.
- **Y** forms a carbonate that decomposes to carbon dioxide and an oxide on heating.
- **W** reacts with $\mathbf{T_2}$ to form $\mathbf{W_2T}$. $\mathbf{W_2T}$ dissolves in water to form a solution that turns purple with addition of Universal Indicator.
- **Z** is a gaseous element. It is used in advertising strip lights.

(a) Name the following elements

(i) T ……. **(ii) W** ……

(iii) Z …….. [3]

(b) Write a balance equation for the between

(i) Y and Cl_2

……..... [1]

(ii) $\mathbf{X}_2$ and NaCl.

..... [1]

(c) **(i)** State the industrial conditions required to produce $\mathbf{VH_3}$.
(H is hydrogen).

……..... [1]

(ii) Explain in terms of collision between reacting particles why one of the conditions named in **c(i)** is used.

…….....

……..

…….. [2]

(d) Explain in terms of structure and bonding why $\mathbf{VX_3}$ and $\mathbf{W_2T}$ have very different electrical conductivity.

…….....

……..... [2]

[Total:10]

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.).