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CONVENT OF THE HOLY INFANT JESUS SECONDARY
Preliminary Examination in preparation for
the General Certificate of Education Ordinary Level 2022

CANDIDATE NAME

CLASS

REGISTER NUMBER

CHEMISTRY

6092/01

Paper 1 Multiple Choice

14 September 2022

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and register number on the Multiple Choice Answer Sheet 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 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 the question paper.
A copy of the Periodic Table is printed on page 16.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **15** printed pages and **1** blank page.

1 One of the instructions for an experiment reads as follows.

Quickly add 50 cm^3 of acid.

What is the best piece of apparatus to use?

A a burette **B** a conical flask

C a measuring cylinder **D** a pipette

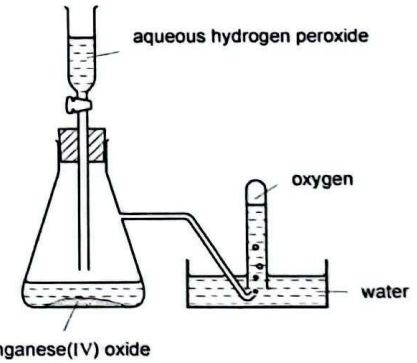
2 You have been given a liquid mixture of benzene (C_6H_6) and a dilute solution of sodium chloride in water. Benzene boils at 80 °C.

Which method should be used in the respective sequence to obtain samples of benzene and sodium chloride crystals?

	first method	second method
A	filtration	crystallisation
B	use a separating funnel	evaporation
C	distillation	filtration
D	evaporation	sublimation

3 Oxygen was prepared from hydrogen peroxide and collected as shown in the diagram.

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



The first few tubes of gas were rejected because the gas was contaminated by

A water vapour. **B** hydrogen peroxide.

C hydrogen. **D** nitrogen.

4 What is the best method to separate a mixture of sodium chloride crystals and iodine crystals?

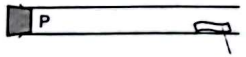
A sublimation
B fractional distillation
C filtration
D crystallisation

5 An aqueous solution of zinc sulfate is tested by adding reagents.

Which observation is correct?

	reagent added to zinc sulfate	observations
A	acidified aqueous barium nitrate	forms a yellow precipitate
B	aqueous ammonia	forms white precipitate, insoluble in excess of the reagent
C	aqueous sodium hydroxide	forms a white precipitate, soluble in excess of the reagent
D	powdered copper	forms a grey precipitate

6 A gas is released at point P in the apparatus shown.



damp universal indicator paper

Which gas turns the damp universal indicator paper red **most** quickly?

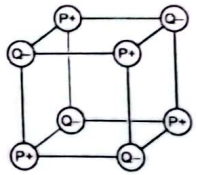
A ammonia
B methane
C hydrogen chloride
D sulfur dioxide

7 Which statement about the atoms of all isotopes of chlorine is correct?

A They have different number of electrons in the outer shell.
B They have the same mass.
C They have the same number of neutrons.
D They gain one electron to form ions.

8 Two elements, P and Q, are in the same period of the Periodic Table.

P and Q react together to form an ionic compound. Part of the lattice of this compound is shown.



Which statement is correct?

A An ion of P has more electrons than an ion of Q.
B An ion of P and ion of Q has different number of electron shells.
C An ion of Q has more protons than electrons.
D Element P is non-metallic.

9 Students are asked to state

- the number of electrons used to form covalent bonds in a molecule of methanoic acid,
- the electrical conductivity when the acid is dissolved in water.

Which row is correct?

	number of electrons	electrical conductivity in water
A	5	poor
B	6	good
C	8	poor
D	10	good

10 Which pair of statements about diamond and graphite is correct?

A They are allotropes of carbon. They are both macromolecules.

B They each conduct electricity. They can both be used as electrode.

C Diamond has covalent bonds. Graphite has ionic bonds.

D Diamond is hard with high melting point. Graphite is soft with low melting point.

11 These two statements are about metals, their properties and bonding.

statement 1 Metal conduct electricity when solid.

statement 2 In metals, a lattice of positive ions exists in a 'sea of electrons' which can move throughout the metal.

Which answer is correct?

A Both statements are correct and statement 2 explains statement 1.

B Both statements are correct but statement 2 does not explain statement 1.

C Statement 1 is correct but statement 2 is incorrect.

D Statement 2 is correct but statement 1 is incorrect.

12 40 cm^3 of the gaseous oxide of element Y requires 60 cm^3 of oxygen for complete combustion to produce 80 cm^3 of the gaseous oxide YO_2.

What is the molecular formula of the original oxide given that all gas volumes are measured at room temperature and pressure?

A YO **B** Y_2O **C** Y_2O_3 **D** Y_2O_5

13 N_2O_4 is a poisonous gas. It can be removed safely by reaction with aqueous sodium hydroxide.

$$N_2O_4(g) + 2NaOH(aq) \rightarrow NaNO_3(aq) + NaNO_2(aq) + H_2O(l)$$

What is the minimum volume of 0.8 mol/dm^3 aqueous sodium hydroxide needed remove 0.02 mol of N_2O_4?

A 12.5 cm^3 **B** 25.0 cm^3 **C** 50.0 cm^3 **D** 100.0 cm^3

14 Iron(II) oxide is produced by heating iron(II) carbonate.

$$FeCO_3(s) \rightarrow FeO(s) + CO_2(g)$$

What is the percentage yield of iron(II) oxide if 150 g of iron(II) carbonate produces 50 g of iron(II) oxide?

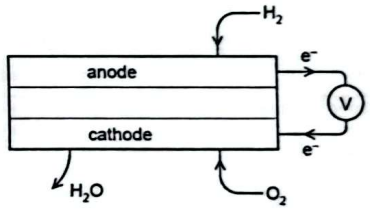
A $\frac{50 \times 116 \times 100}{150 \times 72}$

B $\frac{50 \times 150 \times 72}{116}$

C $\frac{50 \times 150 \times 72 \times 100}{116}$

D $\frac{50 \times 116}{150 \times 72}$

15 An alternative fuel for cars is hydrogen. Hydrogen can be used in a fuel cell as shown.



Which statement about the fuel cell is correct?

A Hydrogen gas is oxidised at the negative electrode to form water.

B Hydrogen gas is reduced at the positive electrode to form water.

C Oxygen gas is oxidised at the positive electrode to form water.

D Oxygen gas is reduced at the negative electrode to form water.

16 What is the ionic half-equation for the reaction that occurs at the cathode when molten lead(II) chloride is electrolysed?

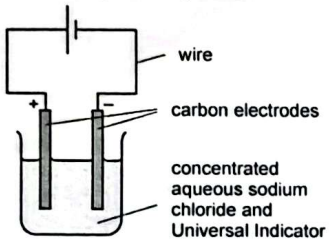
A $Pb^{2+} + 2e^- \rightarrow Pb$

B $2Cl^- \rightarrow Cl_2 + 2e^-$

C $Cl_2 + 2e^- \rightarrow 2Cl^-$

D $Pb \rightarrow Pb^{2+} + 2e^-$

17 A few drops of Universal Indicator were added to a beaker of concentrated aqueous sodium chloride and the solution was electrolysed using carbon electrodes.



What statement is correct?

A A grey solid is deposited at the anode.

B A yellowish-green gas is evolved at the cathode.

C The colour of Universal Indicator at the anode is colourless.

D The colour of Universal Indicator at the cathode is red.

18 A student wishes to use bond energies to calculate the enthalpy change for the reaction shown below.

$$(CH_3)_3CCl + (CH_3)_2NH \rightarrow (CH_3)_3CN(CH_3)_2 + HCl$$

Which inventory shows the most efficient means of doing the calculation to compute energies of bonds broken and formed?

A bonds broken: 15 C—H, 3 C—C, 2 C—N, 1 C—Cl, 1 N—H;
bonds formed: 15 C—H, 3 C—C, 2 C—N

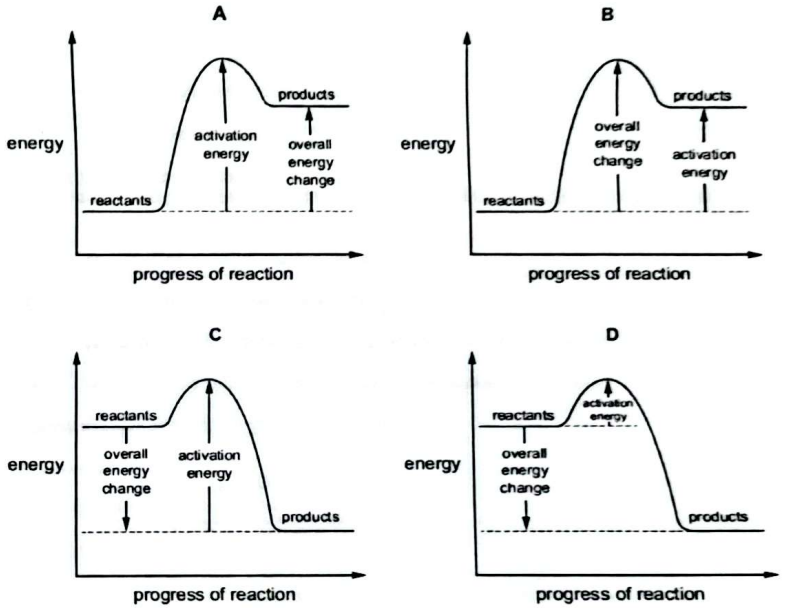
B bonds broken: 1 C—Cl, 1 N—H;
bonds formed: 1 C—N, 1 H—Cl

C bonds broken: 14 C—H, 3 C—C, 2 C—N;
bonds formed: 14 C—H, 3 C—C, 2 C—N, 1 C—Cl, 1 N—H

D bonds broken: 1 C—N, 1 H—Cl;
bonds formed: 1 C—Cl, 1 N—H

[Turn over

19 Which diagram is a correctly labelled energy level diagram for an endothermic reaction?



20 Magnesium reacts with dilute hydrochloric acid.

Which statement about the particles in the reaction is correct?

A Increasing the concentration of acid increases the collision rate but has no effect on the activation energy.

B Increasing the concentration of acid increases the collision rate and the activation energy.

C Increasing the temperature of the reaction increases the activation energy.

D Increasing the temperature of the reaction decreases the collision rate.

21 Ethanoic acid, nitric acid, propanoic acid and sulfuric acid each dissolve in water to form an acidic solution.

If Universal Indicator is placed in a 0.1 mol/dm^3 solution of each acid, which solution will produce a colour indicating the lowest pH?

A ethanoic acid

B nitric acid

C propanoic acid

D sulfuric acid

22 Dilute hydrochloric acid was added to substance X. No visible change was observed. However, the temperature of the mixture increased by 5 °C.

What could be substance X?

A copper(II) oxide

B magnesium metal

C calcium carbonate

D sodium hydroxide

23 An excess of aqueous sodium chloride was added to aqueous lead(II) nitrate and the mixture was filtered.

Which row shows the identity of the residue and the substances present in the filtrate?

	residue	substances in filtrate
A	lead(II) chloride	sodium nitrate and lead(II) nitrate
B	lead(II) chloride	sodium nitrate and sodium chloride
C	sodium nitrate	lead(II) chloride and lead(II) nitrate
D	sodium nitrate	lead(II) chloride and sodium chloride

24 The element vanadium, V, forms several oxides.

In which change is oxidation taking place?

A $VO_2 \rightarrow V_2O_3$

B $V_2O_5 \rightarrow VO_2$

C $V_2O_3 \rightarrow VO$

D $V_2O_3 \rightarrow V_2O_5$

25 In the Periodic Table, how does the metallic character of the elements vary from left to right across a period?

A It decreases.

B It increases.

C It increases then decreases.

D It stays the same.

26 The elements in a Group of the Periodic Table show the following trends.

1 The element with the lowest proton number has the lowest reactivity.

2 All the elements in the group form basic oxides.

3 The density of the elements increases down the group.

4 The melting point of the elements decreases down the group.

What is this Group?

A I **B** IV **C** VI **D** VII

27 Element X is a solid at room temperature and pressure. It needs to lose one electron per atom to attain the electronic structure of argon.

What is element X?

A bromine

B chlorine

C potassium

D sodium

28 When aqueous iodine is added to a solution of vanadium ions, V^{2+}, the V^{2+} ions each lose one electron.

Which property of transition elements is shown by this reaction?

A Transition elements are oxidising agent.

B Transition elements form a stable ion with a charge of 1+.

C Transition elements have variable oxidation states.

D Transition elements can act as catalyst.

29 Which row shows the correct indication of halogen which will react with potassium bromide to form bromine?

	chlorine	iodine
A	✓	✓
B	✓	×
C	×	✓
D	×	×

✓ = will react

× = will not react

Questions **30** and **31** concern the extraction of titanium.

Titanium (Ti) is extracted from the ore called rutile. Rutile is mainly made up of titanium oxide (TiO_2). Titanium is not very reactive so it should be possible to displace titanium from its oxide with carbon. However carbon reacts with titanium, making it very brittle.

Therefore, titanium is extracted by reacting titanium chloride ($TiCl_4$) with sodium. The sodium used for the reaction is obtained by electrolysis.

30 Which row in the table is the correct order of reactivity for carbon, sodium and titanium?

	most reactive ⟶ least reactive		
A	sodium	carbon	titanium
B	carbon	titanium	sodium
C	titanium	carbon	sodium
D	sodium	titanium	carbon

31 The equation for the reaction of titanium chloride with sodium is shown below.

$$TiCl_4 + 4Na \rightarrow Ti + 4NaCl$$

When 190 g of titanium chloride reacted with sodium, 48 g of titanium and 234 g of sodium chloride were produced.

How much sodium is required to produce 48 g of titanium?

A 23 g **B** 92 g **C** 190 g **D** 234 g

32 As extraction of aluminium by electrolysis is expensive, an increasing amount of aluminium is being recycled.

Another important reason to recycle aluminium is that

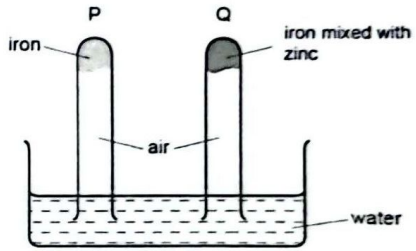
A it saves limited aluminium oxide reserves.

B the recycled aluminium is purer.

C aluminium scrap does not corrode easily.

D recycling aluminium does not use energy.

33 The diagram shows an experiment to investigate the rusting of iron.



What happens to the iron and water level in tube P and Q?

	P		Q	
	iron	water level	iron	water level
A	rusts	falls	rusts	no change
B	rusts	raises	does not rust	raises
C	rusts	no change	does not rust	falls
D	does not rust	raises	does not rust	no change

34 During the manufacture of iron by the blast furnace, which equation shows the reaction of an acidic substance with a basic substance?

A $C + O_2 \rightarrow CO_2$

B $CO_2 + C \rightarrow 2CO$

C $CaO + SiO_2 \rightarrow CaSiO_3$

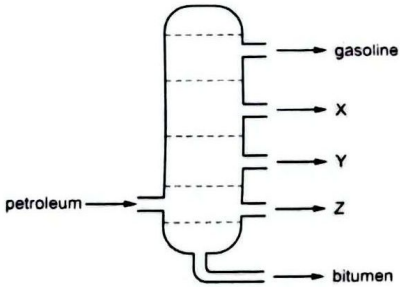
D $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

35 Pure air contains nitrogen, oxygen, and small amounts of other gases. The noble gases have been left out of the table.

Which row shows the composition of dry, unpolluted air?

	nitrogen / %	oxygen / %	other gases
A	21	78	small amount of carbon dioxide
B	21	78	small amount of carbon monoxide
C	78	21	small amount of carbon dioxide
D	78	21	small amount of carbon monoxide

36 The diagram shows the separation of petroleum into fractions.



Which statement about fraction X, Y and Z is correct?

A Fraction Y has the higher range of boiling points than Z.

B Fraction Y is less viscous than X.

C Fraction Z is less flammable than Y.

D Incomplete combustion of Z produces carbon dioxide and water.

37 The equation between a hydrocarbon, C_xH_8, and chlorine is shown.

$$C_xH_8 + 2Cl_2 \rightarrow C_xH_6Cl_2 + 2HCl$$

Which statement is correct?

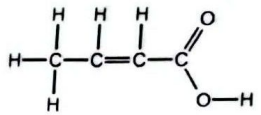
A The reaction is an addition reaction.

B UV light is required for the reaction to take place.

C High temperature and pressure is required for the reaction to take place.

D The molecular formula of the hydrocarbon is C_4H_8.

38 The structure of a compound is shown.



Which row shows the observation when the compound reacts with aqueous bromine, acidified potassium manganate(VII) and a piece of magnesium?

	aqueous bromine	warm with acidified potassium manganate(VII)	magnesium
A	colourless to brown	purple to colourless	no effervescence
B	brown to colourless	purple to colourless	effervescence
C	colourless to brown	remain purple	no effervescence
D	brown to colourless	remain purple	effervescence

39 What are formed when glucose is fermented?

A ethene and carbon dioxide

B ethene and oxygen

C ethanol and carbon dioxide

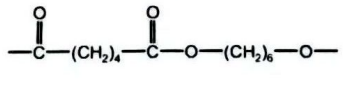
D ethanol and oxygen

40 Polymer Z

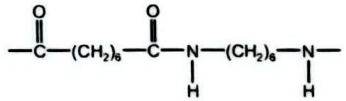
- has six carbon atoms in each of the monomers from which it is formed.
- is formed using condensation polymerisation.
- contains amide linkage.

Which is polymer Z?

A



B



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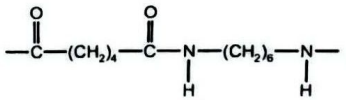
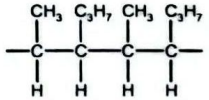


D



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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.).

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Preliminary Examination in preparation for
the General Certificate of Education Ordinary Level 2022

CANDIDATE NAME

CLASS

REGISTER NUMBER

CHEMISTRY

6092/02

Paper 2

31 August 2022

1 hour 45 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

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

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

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.
A copy of the Periodic Table is printed on page 22.

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

Section A

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

A1 The table shows some reactions.

	reaction	**decrease, increase or unchanged** in oxidation state
A	$CaCO_3 \rightarrow CO_2$	
B	$HNO_3 \rightarrow H_2$	
C	$KMnO_4 \rightarrow MnO$	
D	$NaOH \rightarrow NaCl$	

(a) Complete the table by stating if the oxidation state of the element underlined has decreased, increased or is unchanged after the reaction. [2]

(b) Use the letters **A**, **B**, **C**, and **D** to answer the following questions.

(i) Which reaction shows part of a neutralisation reaction?

..... [1]

(ii) In which **two** reactions do the products formed have particles that are very far apart and have high kinetic energy?

..... [1]

(iii) In which reaction would a colour change be observed?

..... [1]

[Total: 5]

A2 Amino acids may be separated by using two-dimensional paper chromatography. This involves putting a spot of the mixture on the corner of a piece of chromatography paper and allowing a solvent to soak up the paper. The paper is then dried, turned through 90° and placed in a second solvent. This method gives better separation than a one solvent method.

(a) Define the term 'Retention Factor' or the R_f value in chromatography.

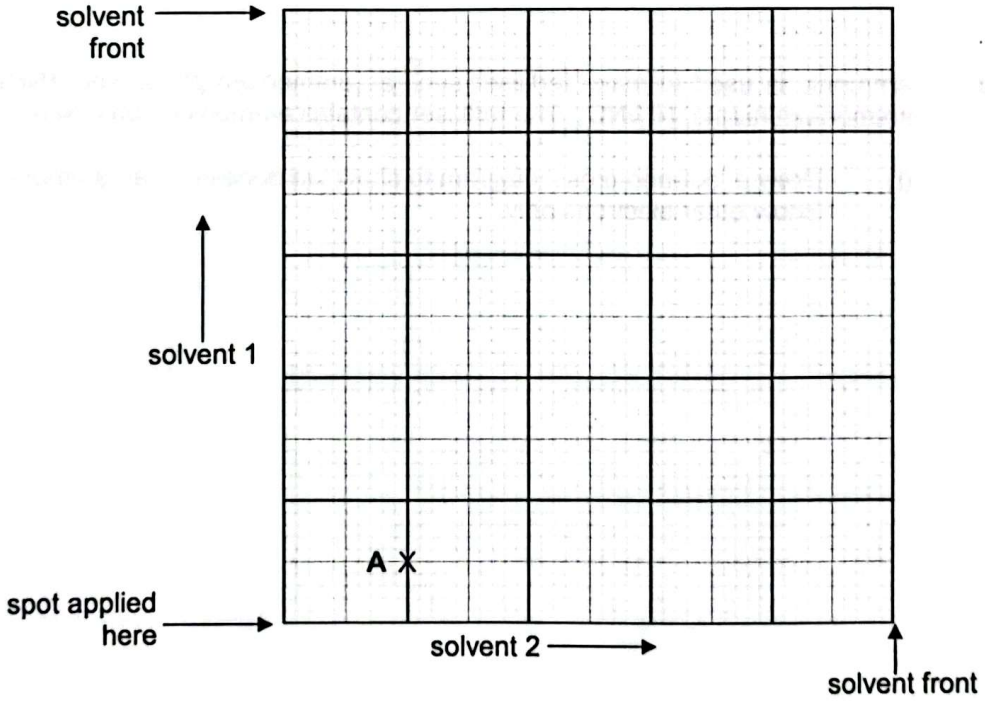
.....

..... [1]

(b) The table below shows the R_f values for some amino acids in two different solvents.

amino acid	R_f (solvent 1)	R_f (solvent 2)
A	0.1	0.2
B	0.0	0.4
C	0.3	0.0
D	0.8	0.9
E	0.6	0.5

Use the grid below to plot the positions of the amino acids **B**, **C**, **D** and **E** after the two-dimensional paper chromatography using solvent 1 followed by solvent 2. Label each point clearly. The amino acid **A** has been done for you.



[2]

(c) Which amino acid travelled fastest in both solvents? ..... [1]

(d) Which amino acid did **not** move at all in solvent 2? ..... [1]

[Total: 5]

A3 Ammonia is a compound of nitrogen and hydrogen.

(a) The table gives information about nitrogen and hydrogen atom.

	nitrogen atom	hydrogen atom
number of protons	7	
electronic structure		1

Complete the table for the number of protons in a hydrogen atom and the electronic structure in a nitrogen atom. [1]

(b) Using the electronic structure of a nitrogen atom, explain why the chemical formula of ammonia is NH_3 and not NH_4.

.....

.....

..... [2]

(c) What are the optimal conditions for making ammonia from nitrogen and hydrogen in the Haber process?

.....

..... [2]

(d) Ammonia is used to make fertiliser such as ammonium phosphate, $(NH_4)_3PO_4$ and ammonium nitrate, NH_4NO_3. The fertiliser contains ammonium ions, NH_4^+.

(i) Draw a 'dot-and-cross' diagram to show the bonding in an ammonium ion. Show outer electrons only.

[2]

(ii) Fertilisers that contain higher percentage of nitrogen by mass are more effective in promoting plant growth.

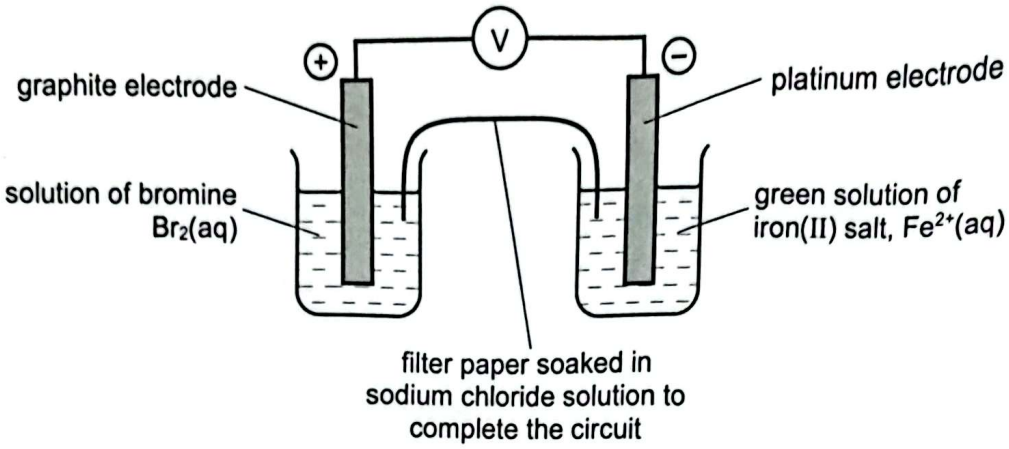
Use calculations to decide which fertiliser, ammonium phosphate, $(NH_4)_3PO_4$ and ammonium nitrate, NH_4NO_3 is more effective.

Show your working.

..... [3]

[Total: 10]

A4 The diagram shows a simple cell.



(a) In the left beaker, the colour changes from reddish-brown to colourless.

Write a half-equation, with state symbols, for the reaction that occurs in the left beaker.

..... [2]

(b) Is the change in **(a)** oxidation or reduction? Explain your reasoning in terms of oxidation state.

.....

..... [1]

(c) Hence, describe and explain what would be observed in the right beaker.

.....

.....

..... [2]

(d) When the solution of bromine is replaced by a solution of chlorine, the voltage increases. When the solution of bromine is replaced by a solution of iodine, the voltage decreases.

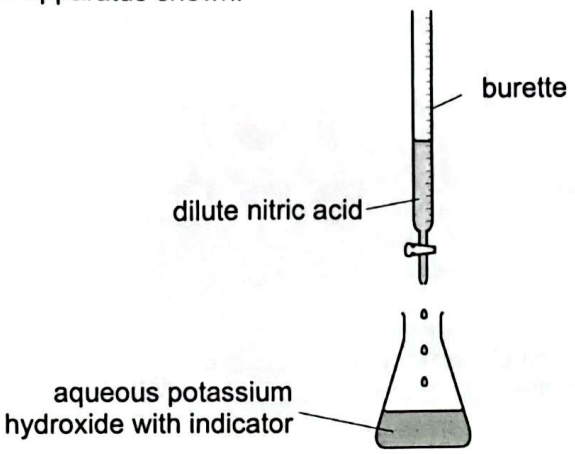
Suggest an explanation for this difference.

.....

..... [1]

[Total: 6]

A5 A student investigated the concentration of potassium hydroxide and dilute nitric acid by titration using the apparatus shown.



He used 25.0 cm^3 of aqueous potassium hydroxide. He did the titration three times and recorded the following results.

titration number	volume of dilute nitric acid / cm^3
1	18.10
2	18.90
3	18.20

(a) Which one of the results is anomalous?

Suggest what mistake the student made in washing of the apparatus to cause the anomalous result.

.....

..... [2]

(b) The equation for the reaction taking place in the titration is shown.

$$HNO_3 + KOH \rightarrow KNO_3 + H_2O$$

The student concluded that the aqueous potassium hydroxide was more concentrated than the dilute nitric acid.

Do the measurements obtained in the experiment support this conclusion?

Explain your reasoning.

.....

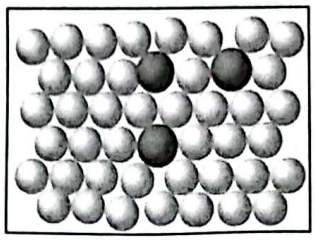
.....

..... [2]

[Total: 4]

A6 Nickel and nickel alloys are used in electronic components.

(a) The diagram below shows the arrangement of atoms in nickel alloy.



Nickel alloys are much harder than pure nickel.
Use ideas about the arrangement of atoms in nickel alloy to explain why.

.....

.....

..... [2]

(b) Nickel can be extracted in a three-step process.

The last step involves nickel carbonyl, $Ni(CO)_4$. The equation for the last step is

$$Ni(CO)_4(g) \rightarrow Ni(s) + 4CO(g)$$

Based on the information provided, discuss why the extraction of nickel is a concern to humans.

.....

..... [1]

(c) A student carried out some experiments to investigate the displacement reaction of nickel and three other metals, cobalt, magnesium and tin.

She added the metals into salt solutions. The table shows her observations.

	salt solution			
metal	cobalt(II) nitrate	magnesium nitrate	nickel(II) nitrate	silver nitrate
cobalt		no change, solution remains colourless	grey solid formed in pink solution	grey solid formed in pink solution
magnesium	grey solid formed in colourless solution		grey solid formed in colourless solution	grey solid formed in colourless solution
nickel	no change, solution remains pink	no change, solution remains colourless		
silver	no change, solution remains pink	no change, solution remains colourless	no change, solution remains green	

(i) The student accidentally left the observation for the experiment of nickel with silver nitrate blank.

Describe what the student would observe for the experiment of nickel with silver nitrate.

.....

..... [1]

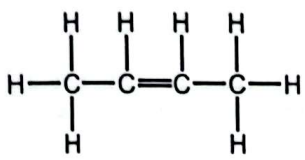
(ii) Write an equation for the reaction that happens between cobalt and silver nitrate.

..... [1]

[Total: 5]

A7 The structures of six organic compounds are shown.

A



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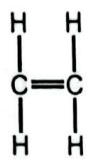

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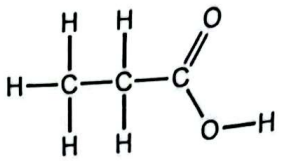
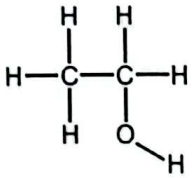


D



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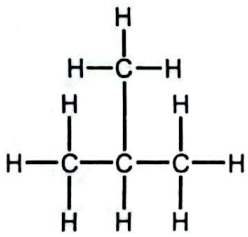

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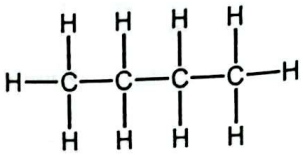


(a) State two compounds which are isomers of each other and explain why.

compounds .....

explanation .....

..... [2]

(b) Compound **D** is manufactured using one of the other compounds.

State which is the other compound, and the reagent and conditions required for the reaction. Write a balanced chemical equation for the reaction.

compound .....

reagent and conditions .....

equation ..... [3]

(c) Compound **A** forms an addition polymer.

Draw **two** repeat units of the addition polymer formed from **A**.

[1]

(d) Describe a chemical test to distinguish between compound **B** and compound **D**.

test .....

results for compound **B** .....

results for compound **D** ..... [2]

(e) Name the organic compound formed from the reaction between compound **C** and compound **D**.

..... [1]

[Total: 9]

A8 The exhaust gases from the internal combustion engines of motor cars and lorries contain pollutants.

The table shows the masses of pollutants formed when one kilogram of each fuel is burnt.

fuel	mass of pollutant / g				
	carbon monoxide	oxides of nitrogen	sulfur dioxide	volatile organic compounds eg. unburnt hydrocarbons	particulates
petrol	236	29	0.9	25	0.6
diesel	10	59	3.8	17	18.6

(a) Suggest and explain which fuel is a greater contributor to the production of acid rain.

.....

..... [2]

(b) Explain how oxides of nitrogen are formed in the internal combustion engines of motor cars and lorries.

.....

..... [2]

(c) Oxides of nitrogen and carbon monoxide from exhaust gases are removed by catalytic converters. In the catalytic converter, carbon monoxide reacts with nitrogen monoxide.

Construct the chemical equation for this reaction and explain why this reaction does not remove all the environmental problems caused by exhaust gases.

.....

.....

..... [2]

[Total: 6]

CANDIDATE NAME

CLASS

REGISTER NUMBER

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 Read the following article and answer the questions that follow.

Properties of Alkynes

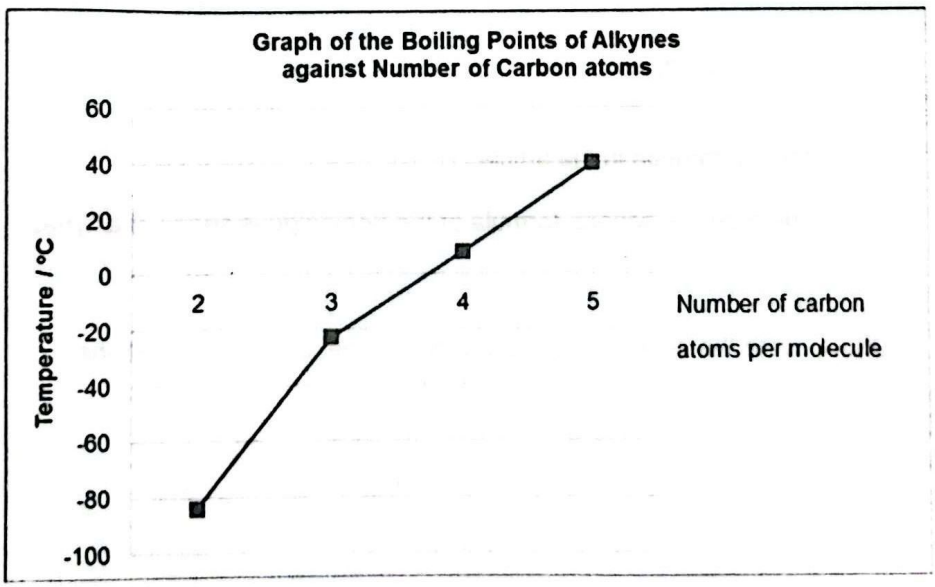
The alkynes are a homologous series of hydrocarbons. All alkynes contain a carbon to carbon triple bond (C ≡ C). **Table 1** below gives the structural formula and boiling points of some alkynes.

Table 1

name of alkyne	structural formula	molecular formula	M_r	boiling point / °C
ethyne	H – C ≡ C – H	C_2H_2	26	−84
propyne	H – C ≡ C – CH_3	C_3H_4	40	−23
butyne	H – C ≡ C – CH_2 – CH_3	C_4H_6	54	8
pent-1-tyne	H – C ≡ C – CH_2 – CH_2 – CH_3	C_5H_8	68	40

Graph 1 shows the boiling points of some alkynes plotted against the number of carbon atoms in each alkyne molecule.

Graph 1



Manufacture of Ethyne

For the past 50 years, ethyne was produced by the reaction of calcium carbide with water according to the equation below.

$$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$$

A modern method for producing a good yield of ethyne is by heating ethene above 1150 °C. The reaction is represented by the equation shown below.

$$CH_2 = CH_2(g) \rightarrow H - C \equiv C - H(g) + H_2(g)$$

Reaction of Alkynes

Alkynes are unsaturated compounds that react similarly to alkenes in many chemical reactions such as the addition reactions.

For example, like the alkenes, alkynes also undergo addition reaction with bromine water, However, unlike alkenes, alkynes react more slowly with bromine water.

(a) Describe and explain the trends shown by the data in **Table 1** and **Graph 1**.

.....

.....

..... [2]

(b) Draw a 'dot-and -cross' diagram to show the bonding found in ethyne.
Show outer electrons only.

[2]

(c) Using the information in the article,

(i) deduce the general formula of the homologous series of alkynes;

..... [1]

(ii) write the chemical formula of hex-1-yne, a six-carbon alkyne;

..... [1]

(iii) predict the boiling point of hex-1-yne.

..... [1]

(d) Chemical suppliers used to sell tins of 500 g calcium carbide.

Calculate the volume of ethyne that will be obtained at room temperature and pressure from 500 g of calcium carbide.

volume of ethyne = ... [2]

(e) From the article, suggest a test to distinguish an alkyne from an alkene. Include appropriate apparatus and chemicals to use in the test.

.....

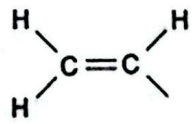
.....

..... [2]

(f) When ethyne reacts with carbon monoxide and water, in the presence of a catalyst, propenoic acid is formed.

Complete the structure of the propenoic acid in the equation shown below.

$$H-C\equiv C-H \;+\; CO \;+\; H_2O \;\rightarrow$$



(propenoic acid)

[1]

[Total: 12]

B10 **(a)** A student investigated the strength of sulfuric acid and hexanesulfonic acid.

$$H_2SO_4 \rightarrow 2H^+ + SO_4^{2-}$$

$$C_6H_{13}SO_3H \rightarrow H^+ + C_6H_{13}SO_3^-$$

The student is given 0.1 mol/dm^3 of aqueous sulfuric acid and 0.2 mol/dm^3 of aqueous hexanesulfonic acid.

(i) Describe how the student could prove that hexanesulfonic acid is also a strong acid.

.....

.....

..... [2]

(ii) Deduce why, for a fair comparison, the two acid solutions must have different concentration.

.....

..... [1]

(iii) Write the chemical equation for the reaction between aqueous hexanesulfonic acid and magnesium.

..... [1]

(b) Another student investigated the properties of a weak alkali, methylamine, which are similar to those of ammonia.

$$CH_3NH_2 + H_2O \rightleftharpoons CH_3NH_3^+ + OH^-$$

(i) Explain what is meant by the term weak alkali.

.....

..... [1]

(ii) When aqueous methylamine is added to aqueous iron(II) sulfate, a green precipitate is formed.

Write an ionic equation for the formation of the green precipitate.

..... [1]

(iii) What would the student sees if aqueous methylamine is added to aqueous iron(III) nitrate?

..... [1]

(iv) Suggest the name of a reagent that will displace methylamine from one of its salts, methylammonium sulfate, $(CH_3NH_3)_2SO_4$.

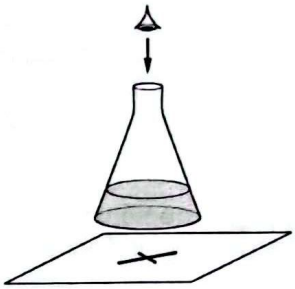
..... [1]

[Total: 8]

EITHER

B11 When aqueous sodium thiosulfate and dilute hydrochloric acid are mixed, a precipitate of insoluble sulfur is produced. This makes the mixture difficult to see through.

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



A student adds the following volumes of aqueous sodium thiosulfate, dilute hydrochloric acid and deionised water to the conical flask. The time taken for the formation of the precipitate of sulfur to make the cross disappear from view is recorded.

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

(a) In experiment 3, the student wanted the sodium thiosulfate to be double the concentration used in experiment 2.

(i) Complete the table to show the volumes which should be used and the expected time taken for the cross to disappear from view in experiment 3. [2]

(ii) Explain, in terms of collisions between reacting particles, how increasing the concentration of sodium thiosulfate would change the rate of reaction.

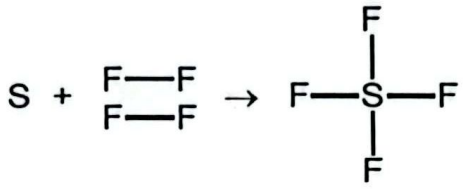
.....

.....

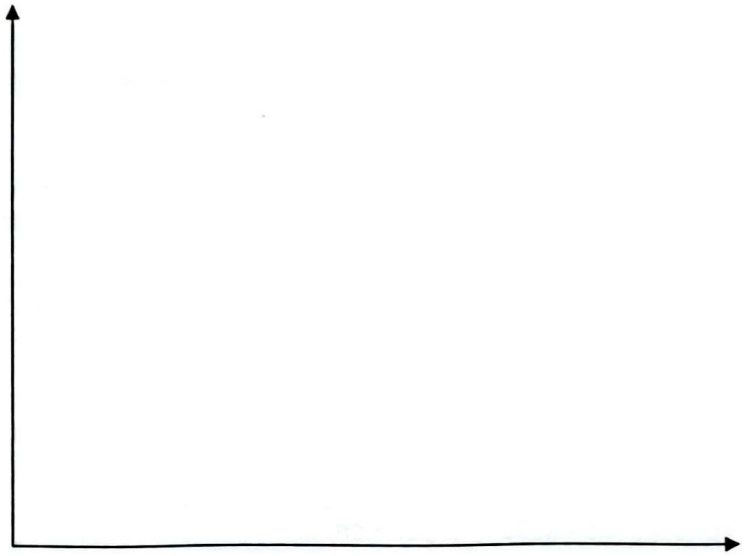
..... [2]

(b) Sulfur tetrafluoride, SF_4, can be made by combining gaseous sulfur with fluorine. The reaction is exothermic.

During the reaction, the amount of energy given out is 780 kJ/mol.



(i) Draw the energy profile diagram for this reaction. Label the 'activation energy' and 'enthalpy change' in your diagram.



[3]

(ii) The F — F bond energy is 160 kJ/mol.

Use this information to determine the bond energy, in kJ/mol, of one mole of S – F bond in SF_4.

[3]

[Total: 10]

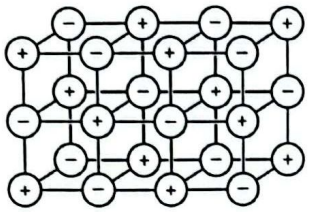
OR

B11 The boxes show the structure of three compounds, sodium chloride, silicon dioxide and cyclohexane.

sodium chloride

⊕ sodium ion

⊖ chloride ion

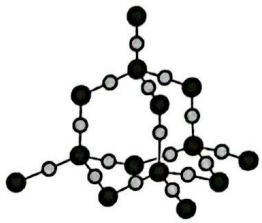


melting point: 801 °C

silicon dioxide

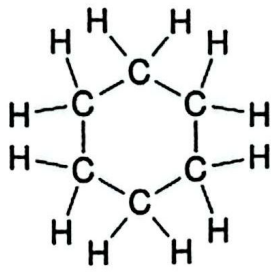
● silicon atom

● oxygen atom



melting point: 1600 °C

cyclohexane



melting point: 81 °C

(a) In the structure of sodium chloride, the ratio of positive ions to negative ions is 1:1. In the structure of a different ionic compound, the ratio of positive ions to negative ions is 1:2.

Suggest why this ratio varies in different ionic compounds.

.....

..... [2]

(b) Diamond has a similar structure and consequently similar properties as silicon dioxide.

State **two** physical properties common to both diamond and silicon dioxide.

.....

..... [2]

(c) Give the empirical formula of cyclohexane.

..... [1]

(d) Explain why the melting points of the three compounds differ from each other.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(e) When all three compounds are liquids, one of the compounds conducts electricity.

Name this compound. Explain why it conducts electricity when liquid.

compound .....

explanation .....

..... [2]

[Total: 10]

End of Paper