



CANDIDATE
NAME

CENTRE
NUMBER

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CANDIDATE
NUMBER

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0620/43

May/June 2020

1 hour 15 minutes

No additional materials are needed.

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

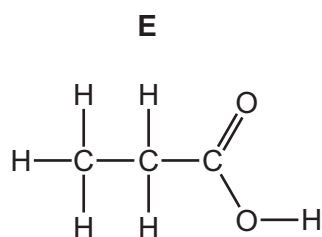
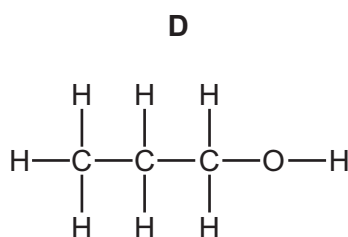
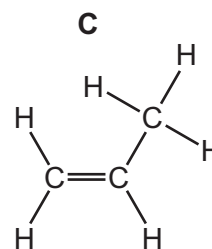
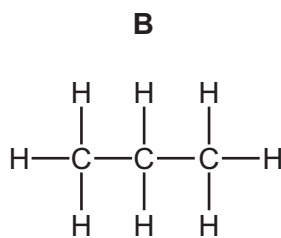
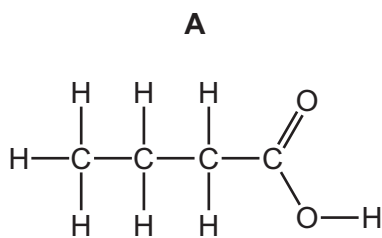
- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].
- The Periodic Table is printed in the question paper.

This document has **16** pages. Blank pages are indicated.

- 1 (a) The structures of five organic compounds, **A**, **B**, **C**, **D** and **E**, are shown.

Answer the questions that follow.

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



- (i) Give the letter of the compound that is propan-1-ol.

..... [1]

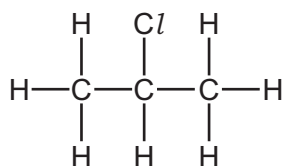
- (ii) Give the letter of the compound that has the empirical formula CH_2 .

..... [1]

- (iii) Give the letter of **one** compound that reacts with bromine in an addition reaction.

..... [1]

- (iv) Give the letter of **one** compound that reacts with chlorine to form the compound shown.



..... [1]

- (v) Give the letters of **two** compounds that can react with each other to form an ester.

..... and [1]

- (vi) Give the letter of the compound that is in the same homologous series as hex-1-ene.

..... [1]

- (vii) Give the letter of **one** compound that is an acid.

..... [1]

(viii) Draw a structural isomer of compound **D**.

Show all of the atoms and all of the bonds.

[1]

(b) Some acids are described as weak acids.

State the meaning of the term *weak acid*.

weak

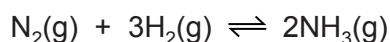
acid

[2]

[Total: 10]

2 Ammonia is manufactured by the Haber process.

(a) The equation for the reaction is shown.



(i) State what is meant by the symbol $\rightleftharpoons$.

..... [1]

(ii) State **one** source of hydrogen used in the manufacture of ammonia.

..... [1]

(b) The table shows some data for the production of ammonia.

pressure / atm	temperature / °C	percentage yield of ammonia
250	350	58
100	450	28
400	450	42
250	550	20

Deduce the effect on the percentage yield of ammonia of:

- increasing the pressure of the reaction

.....

- increasing the temperature of the reaction.

.....

[2]

(c) Explain, in terms of particles, what happens to the rate of this reaction when the temperature is increased.

.....

.....

.....

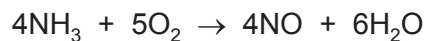
.....

.....

..... [3]

- (d) Ammonia, NH_3 , is used to produce nitric acid, HNO_3 . This happens in a three-stage process.

Stage 1 is a redox reaction.



- (i) Identify what is oxidised in **stage 1**.

Give a reason for your answer.

substance oxidised

reason

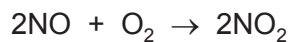
[2]

- (ii) In this reaction the predicted yield of NO is 512g. The actual yield is 384g.

Calculate the percentage yield of NO in this reaction.

percentage yield of NO = [1]

- (iii) The equation for the reaction in **stage 2** is shown.

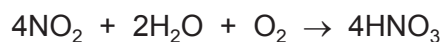


Which major environmental problem does NO_2 cause if it is released into the atmosphere?

.....

..... [1]

(iv) The equation for the reaction in **stage 3** is shown.



Calculate the volume of O_2 gas, at room temperature and pressure (r.t.p.), needed to produce 1260 g of HNO_3 .

Use the following steps.

- Calculate the number of moles of HNO_3 .

moles of HNO_3 =

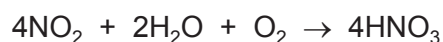
- Deduce the number of moles of O_2 that reacted.

moles of O_2 =

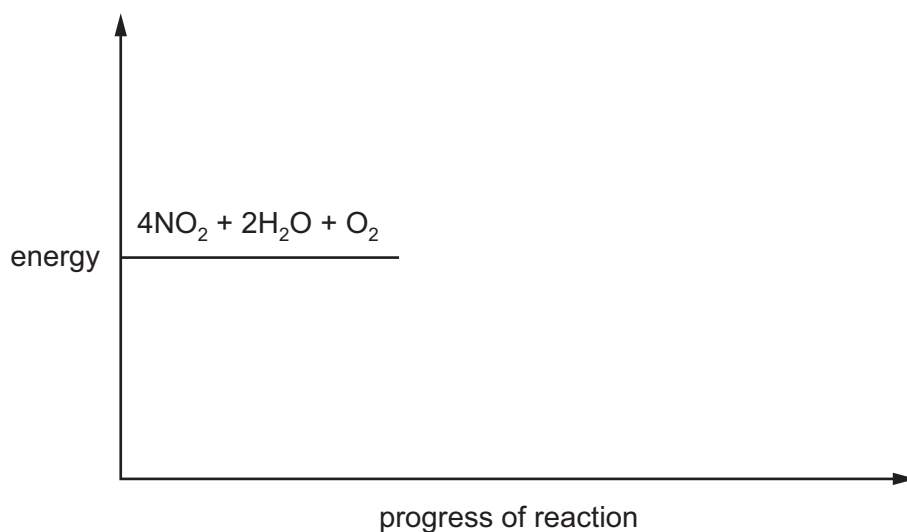
- Calculate the volume of O_2 gas that reacts at room temperature and pressure (r.t.p.).

volume of O_2 gas = dm^3
[4]

(e) The reaction in **stage 3** is exothermic.



Complete the energy level diagram for this reaction. Include an arrow that clearly shows the energy change during the reaction.



[3]

[Total: 18]

3 Chlorine is in Group VII of the Periodic Table.

(a) Two isotopes of chlorine are chlorine-35 and chlorine-37.

(i) State why these two isotopes of chlorine have the same chemical properties.

.....

 [2]

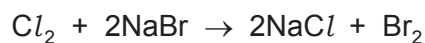
(ii) Complete the table to show the number of electrons, neutrons and protons in each atom and ion.

	number of electrons	number of neutrons	number of protons
$^{35}_{17}\text{Cl}$			
$^{37}_{17}\text{Cl}^-$			

[3]

(b) (i) Chlorine reacts with aqueous sodium bromide.

The equation for the reaction is shown.



State the type of reaction shown.

..... [1]

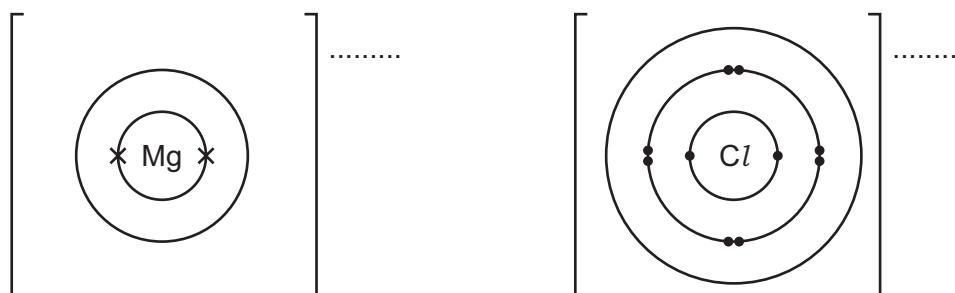
(ii) Why is there **no** reaction between iodine and aqueous sodium bromide?

..... [1]

(c) Magnesium reacts with chlorine to form magnesium chloride.

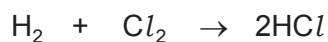
Complete the dot-and-cross diagram to show the electron arrangement of the ions in magnesium chloride. Give the charges on the ions.

The inner shells have been completed.



[3]

(d) Hydrogen and chlorine react to form hydrogen chloride gas, as shown in the equation.



This equation can be represented as shown.



Some bond energies are shown in the table.

bond	bond energy in kJ/mol
H-H	436
Cl-Cl	243
H-Cl	432

Calculate the energy change for the reaction between hydrogen and chlorine, using the following steps.

- Calculate the energy needed to break the bonds.

..... kJ

- Calculate the energy released when bonds are formed.

..... kJ

- Calculate the energy change for the reaction.

..... kJ/mol
[3]

[Total: 13]

- 4 (a) Filtration and chlorination are two stages in water treatment.

State the purpose of each stage.

filtration

.....

chlorination

.....

[2]

- (b) A student uses anhydrous copper(II) sulfate to test for the presence of water.

- (i) What colour change is seen if water is present?

from to [2]

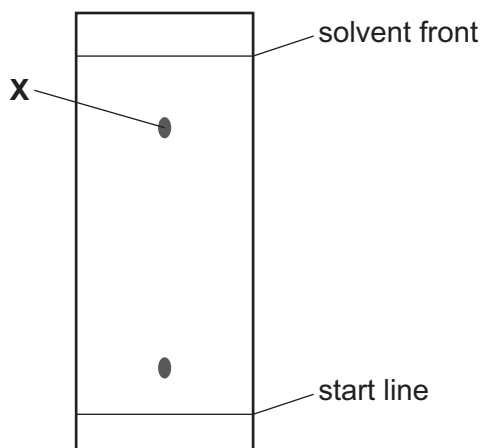
- (ii) The purity of a sample of water can be assessed by measuring its boiling point.

How is the boiling point of water affected by impurities?

..... [1]

- (c) Chromatography can be used to test the purity of substances.

The diagram shows the chromatogram of a coloured substance.



- (i) How does this chromatogram show that this substance is **not** pure?

..... [1]

- (ii) Draw a circle round the correct R_f value for the spot labelled **X**.

0.2 0.4 0.8 1.2 [1]

- (iii) State how a colourless substance can be made visible on a chromatogram.

..... [1]

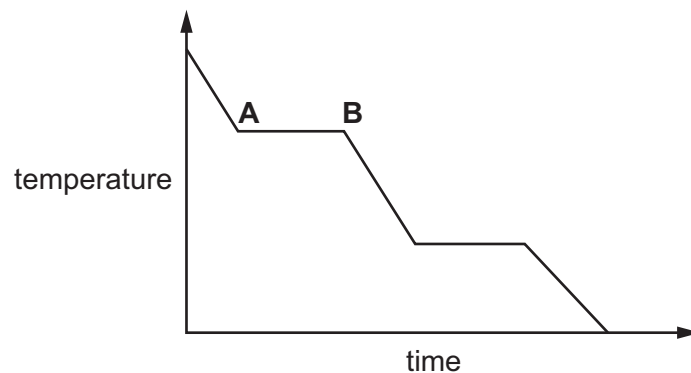
[Total: 8]

5 (a) Complete the table about solids, liquids and gases.

	particle separation	particle arrangement	type of motion
solid		regular	vibrate only
liquid	touching		random
gas	apart	random	

[3]

(b) The graph shows the change in temperature as a sample of a gas is cooled.



Name the change of state taking place between **A** and **B**.

..... [1]

(c) A bottle of liquid perfume is left open at the front of a room.

After some time, the perfume is smelt at the back of the room.

Name the **two** physical processes taking place.

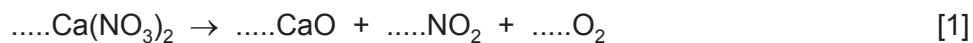
1

2 [2]

[Total: 6]

6 (a) An endothermic reaction occurs when calcium nitrate is heated.

(i) Balance the equation for this reaction.



(ii) State the type of reaction shown by the equation.

..... [1]

(b) Describe the test for a nitrate ion.

test

.....

result

.....

[3]

[Total: 5]

7 Aluminium is extracted by electrolysis. Iron is extracted from its ore by reduction with carbon.

(a) What is meant by the term *electrolysis*?

.....
..... [2]

(b) Name the main ore of aluminium.

..... [1]

(c) (i) Explain why aluminium **cannot** be extracted by reduction with carbon.

..... [1]

(ii) Describe the role of cryolite in the extraction of aluminium by electrolysis.

..... [1]

(iii) Name the product formed at the positive electrode.

..... [1]

(iv) Write the ionic half-equation for the reaction at the negative electrode.

..... [2]

(d) Aluminium is used in overhead electricity cables.

Give **two** properties of aluminium that make it suitable for use in overhead electricity cables.

1

2

[2]

(e) Iron is a transition element.

(i) Iron forms hydrated iron(III) oxide when it rusts.

Write a word equation to represent the formation of rust.

..... [2]

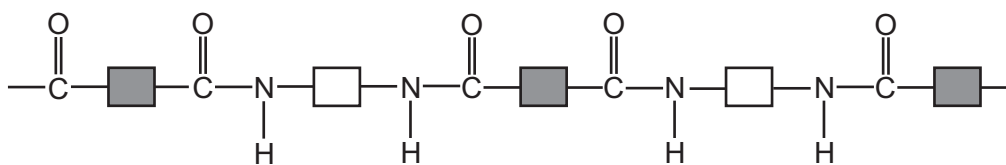
(ii) Give **two** ways in which the properties of transition elements differ from the properties of Group I metals.

1

2 [2]

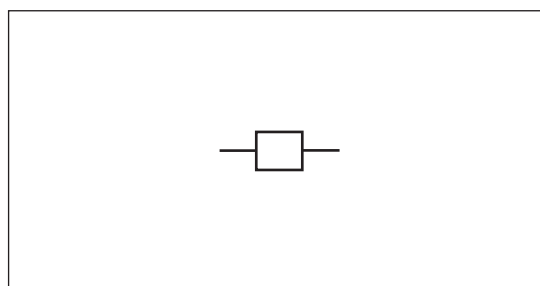
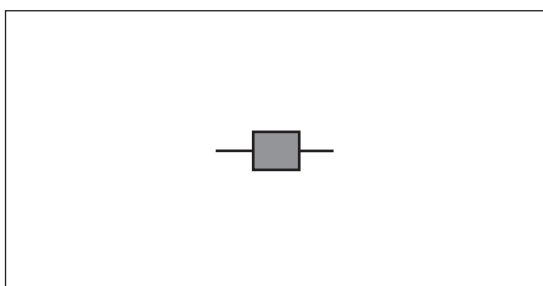
[Total: 14]

- 8 (a) Part of the synthetic polymer, nylon, is shown in the diagram.



- (i) Circle **one** amide linkage **on the diagram**. [1]

- (ii) Complete the structures of the **two** monomers that react to form nylon.



[2]

- (iii) Name the other product formed when nylon is produced.

..... [1]

- (b) Items made from nylon are often disposed of by burying them in the ground. This is called landfill.

Why is the disposal of nylon using landfill a problem?

.....
 [1]

- (c) Give the name of a natural polymer.

..... [1]

[Total: 6]

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The Periodic Table of Elements

Group

I	II	Group										III	IV	V	VI	VII	VIII	
		1Hhydrogen1																
		atomic number atomic symbol name relative atomic mass																
3Li lithium 7	4Be beryllium 9											5B boron 11	6C carbon 12	7N nitrogen 14	8O oxygen 16	9F fluorine 19	10Ne neon 20	
11Na sodium 23	12Mg magnesium 24											13Al aluminium 27	14Si silicon 28	15P phosphorus 31	16S sulfur 32	17Cl chlorine 35.5	18Ar argon 40	
19K potassium 39	20Ca calcium 40	21Sc scandium 45	22Ti titanium 48	23V vanadium 51	24Cr chromium 52	25Mn manganese 55	26Fe iron 56	27Co cobalt 59	28Ni nickel 59	29Cu copper 64	30Zn zinc 65	31Ga gallium 70	32Ge germanium 73	33As arsenic 75	34Se selenium 79	35Br bromine 80	36Kr krypton 84	
37Rb rubidium 85	38Sr strontium 88	39Y yttrium 89	40Zr zirconium 91	41Nb niobium 93	42Mo molybdenum 96	43Tc technetium —	44Ru ruthenium 101	45Rh rhodium 103	46Pd palladium 106	47Ag silver 108	48Cd cadmium 112	49In indium 115	50Sn tin 119	51Sb antimony 122	52Te tellurium 128	53I iodine 127	54Xe xenon 131	
55Cs caesium 133	56Ba barium 137	57–71 lanthanoids		72Hf hafnium 178	73Ta tantalum 181	74W tungsten 184	75Re rhenium 186	76Os osmium 190	77Ir iridium 192	78Pt platinum 195	79Au gold 197	80Hg mercury 201	81Tl thallium 204	82Pb lead 207	83Bi bismuth 209	84Po polonium —	85At astatine —	86Rn radon —
87Fr francium —	88Ra radium —	89–103 actinoids		104Rf rutherfordium —	105Db dubnium —	106Sg seaborgium —	107Bh bohrium —	108Hs hassium —	109Mt meitnerium —	110Ds darmstadtium —	111Rg roentgenium —	112Cn copernicium —	114Fl flerovium —	116Lv livermorium —				

lanthanoids

57La lanthanum 139	58Ce cerium 140	59Pr praseodymium 141	60Nd neodymium 144	61Pm promethium —	62Sm samarium 150	63Eu europium 152	64Gd gadolinium 157	65Tb terbium 159	66Dy dysprosium 163	67Ho holmium 165	68Er erbium 167	69Tm thulium 169	70Yb ytterbium 173	71Lu lutetium 175
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actinoids

89Ac actinium —	90Th thorium 232	91Pa protactinium 231	92U uranium 238	93Np neptunium —	94Pu plutonium —	95Am americium —	96Cm curium —	97Bk berkelium —	98Cf californium —	99Es einsteinium —	100Fm fermium —	101Md mendelevium —	102No nobelium —	103Lr lawrencium —
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The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).