



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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0620/43

May/June 2020

1 hour 15 minutes

You must answer on the question paper.

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.

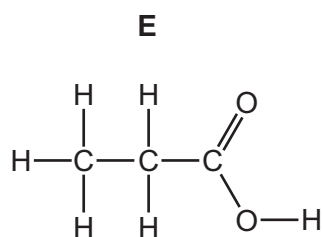
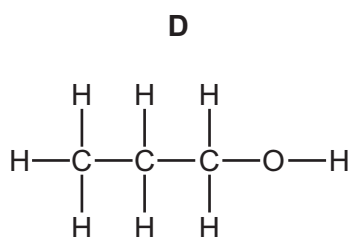
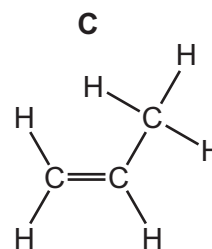
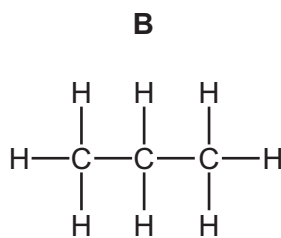
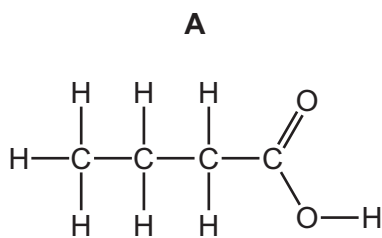
- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].
- The Periodic Table is printed in the question paper.

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]
- ```

 H Cl H
 | | |
H — C — C — C — H
 | | |
 H H H

```
- ..... [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 .....

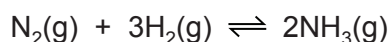
acid .....

[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<br>/ atm | temperature<br>/ °C | percentage yield<br>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.

.....

.....

.....

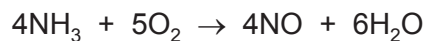
.....

.....

..... [3]

- (d) Ammonia,  $\text{NH}_3$ , is used to produce nitric acid,  $\text{HNO}_3$ . 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 .....

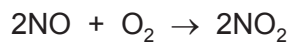
..... [2]

- (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.

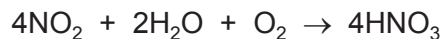


Which major environmental problem does  $\text{NO}_2$  cause if it is released into the atmosphere?

.....

..... [1]

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



Calculate the volume of  $\text{O}_2$  gas, at room temperature and pressure (r.t.p.), needed to produce 1260 g of  $\text{HNO}_3$ .

Use the following steps.

- Calculate the number of moles of  $\text{HNO}_3$ .

moles of  $\text{HNO}_3$  = .....

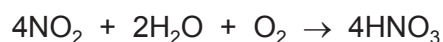
- Deduce the number of moles of  $\text{O}_2$  that reacted.

moles of  $\text{O}_2$  = .....

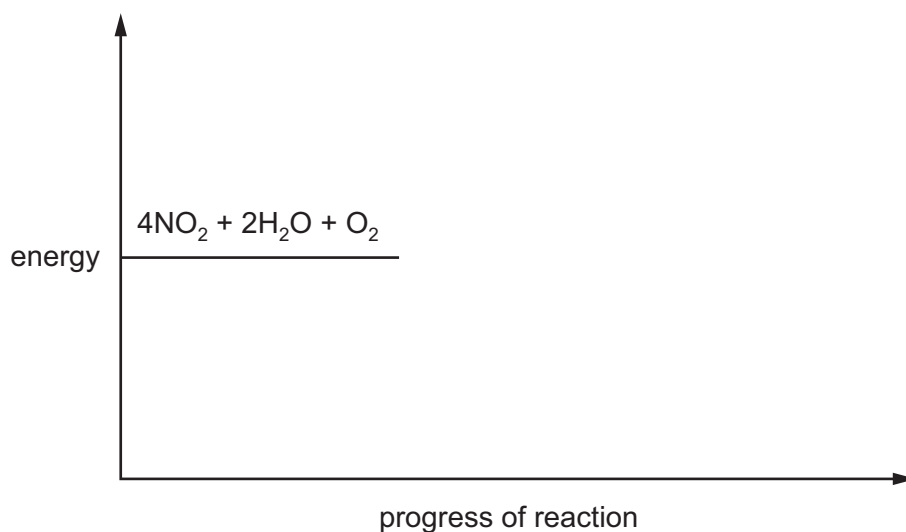
- Calculate the volume of  $\text{O}_2$  gas that reacts at room temperature and pressure (r.t.p.).

volume of  $\text{O}_2$  gas = .....  $\text{dm}^3$   
[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]

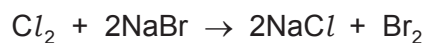
(ii) Complete the table to show the number of electrons, neutrons and protons in each atom and ion.

|                         | number of<br>electrons | number of<br>neutrons | number of<br>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]

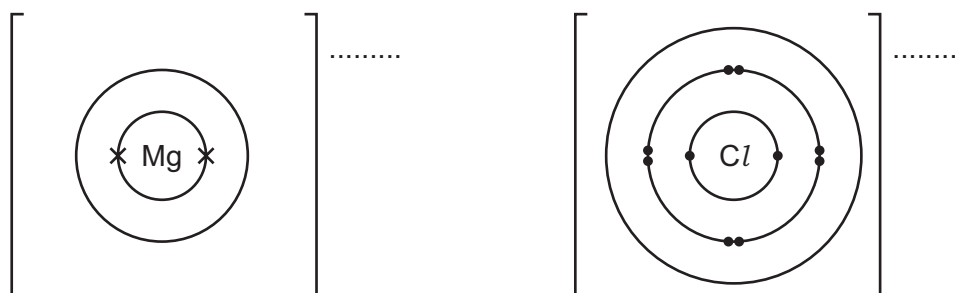
(ii) Why is there **no** reaction between iodine and aqueous sodium bromide?

..... [1]

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

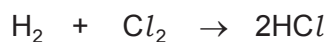
Complete the dot-and-cross diagram to show the electron arrangement of the ions in magnesium chloride. Give the charges on the ions.

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<br>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]

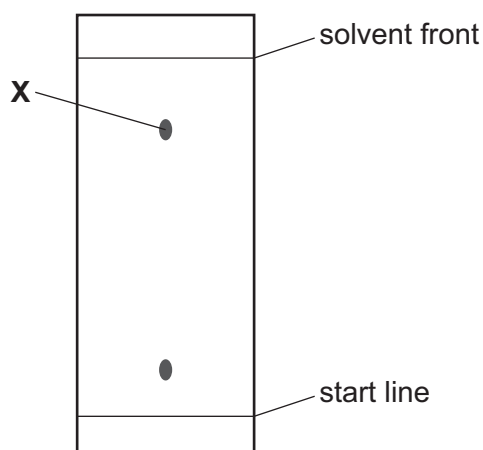
- (ii) The purity of a sample of water can be assessed by measuring its boiling point.

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]

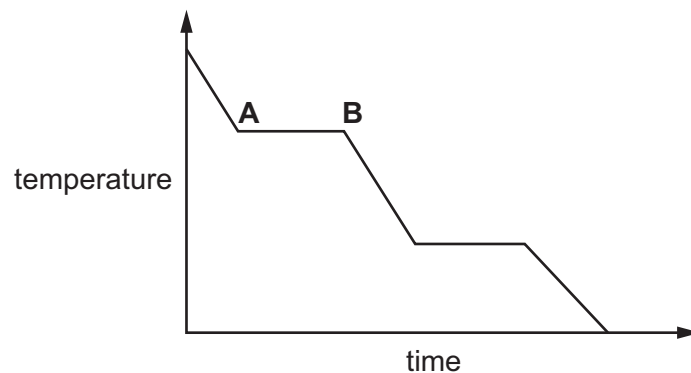
[Total: 8]

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 .....

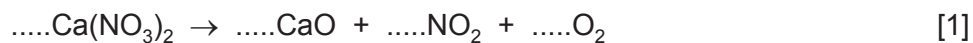
2 .....

[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]

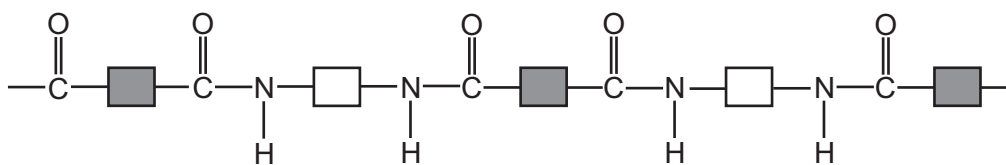
(ii) Give **two** ways in which the properties of transition elements differ from the properties of Group I metals.

1 .....

2 ..... [2]

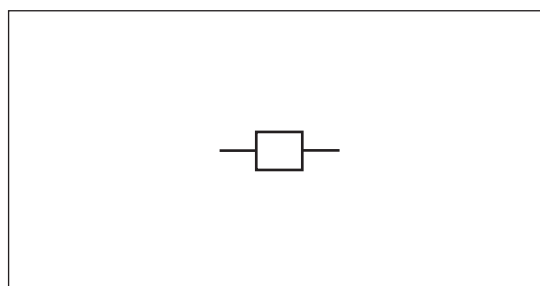
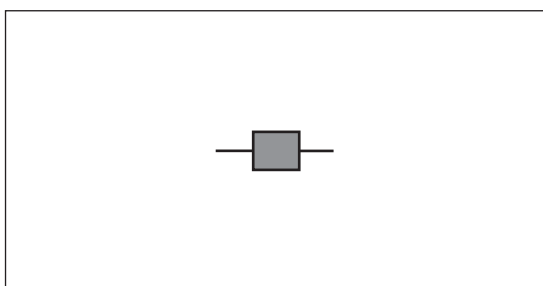
[Total: 14]

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