



CANDIDATE
NAME

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CENTRE
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0620/32

October/November 2022

1 hour 15 minutes

You must answer on the question paper.

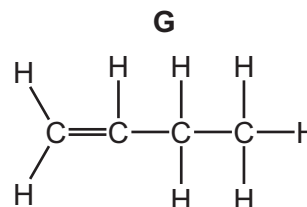
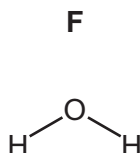
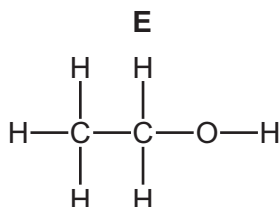
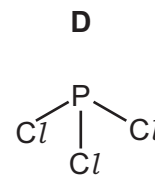
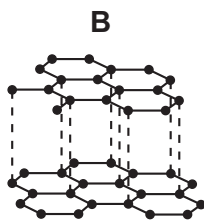
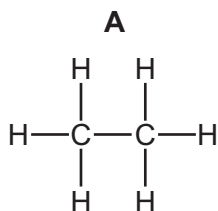
No additional materials are needed.

- 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 **20** pages. Any blank pages are indicated.

1 The structures of seven compounds or elements, **A**, **B**, **C**, **D**, **E**, **F** and **G**, are shown.



- (a) Answer the following questions about these structures.
Each structure may be used once, more than once or not at all.

State which structure, **A**, **B**, **C**, **D**, **E**, **F** or **G**, represents:

- (i) a compound that contains atoms of a Group VII element

..... [1]

- (ii) an element with a giant covalent structure

..... [1]

- (iii) a compound that turns anhydrous copper(II) sulfate blue

..... [1]

- (iv) an element that conducts electricity

..... [1]

- (v) an unsaturated hydrocarbon.

..... [1]

- (b) Describe a test for an unsaturated hydrocarbon.

test

observations

[2]

- (c) Name the **two** products formed when compound **A** undergoes complete combustion.

1

2

[2]

[Total: 9]

- 2 (a) The table compares the percentage by mass of the elements in the Earth's crust and in the Moon's crust.

element	percentage by mass in the Earth's crust	percentage by mass in the Moon's crust
aluminium	8.20	7.50
calcium	3.60	7.50
iron	5.00	13.50
magnesium	2.00	5.50
oxygen	46.60	40.00
silicon	29.50	19.50
titanium	0.55	3.00
other elements	4.55	
total	100.00	100.00

Answer these questions using only the information in the table.

- (i) Deduce the percentage by mass of the other elements in the Moon's crust.

..... [1]

- (ii) State which element is present in the Earth's crust in the greatest percentage by mass.

..... [1]

- (iii) Give **two** major differences in the composition of the Earth's crust and in the Moon's crust.

1

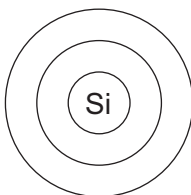
.....

2

.....

[2]

- (b) Complete the diagram to show the electron arrangement in a silicon atom.



[2]

(c) Iron reacts with oxygen to form an oxide of iron with the formula Fe_3O_4 .

(i) Complete the chemical equation for this reaction.



(ii) Complete these sentences about the extraction of iron from iron ore in a blast furnace using words from the list.

air decomposed dioxide hydrogen iron
monoxide oxidised reduced slag

The raw materials put into the blast furnace are iron ore, limestone and

Carbon monoxide reacts with iron(III) oxide to produce iron. In this reaction iron(III) oxide is

Limestone decomposes to produce calcium oxide and carbon

Calcium oxide reacts with impurities in the iron ore to form

[4]

(d) Iron is converted to steel using oxygen and one other type of compound.

(i) Explain how the oxygen removes the carbon.

..... [1]

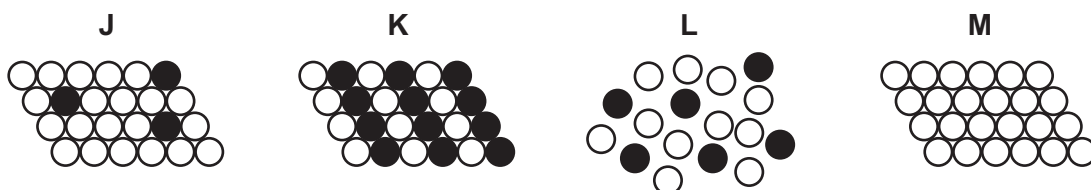
(ii) Choose from the list the name of the other type of compound used to convert iron into steel.

acidic oxide
alcohol
basic oxide
hydrocarbon

..... [1]

(iii) Steel is an alloy.

Choose the diagram, J, K, L or M, which best represents an alloy.



..... [1]

[Total: 15]

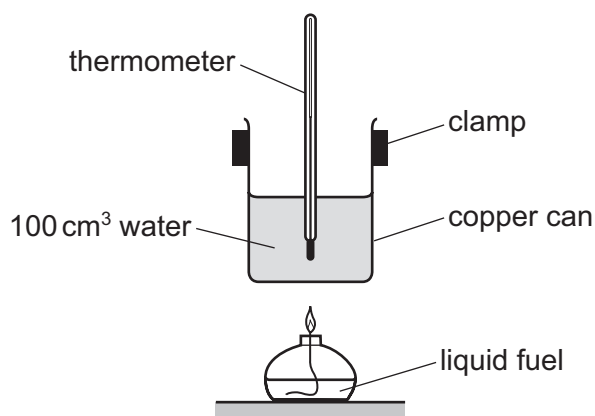
3 This question is about fuels and energy production.

(a) Chemical reactions can be endothermic or exothermic.

State the meaning of the term *endothermic*.

.....
 [1]

(b) The diagram shows the apparatus used to compare the energy released when 100 cm³ of water is heated by burning different liquid fuels, **P**, **Q**, **R** and **S**.



All conditions are kept the same, apart from the type of fuel and mass of fuel burned.

The results are shown.

fuel	mass of fuel burned / g	increase in temperature / °C
P	3	6
Q	2	8
R	1	3
S	3	9

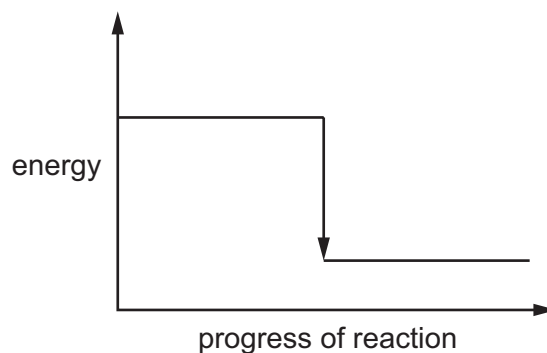
Deduce which fuel, **P**, **Q**, **R** or **S**, releases the least energy per gram.

..... [1]

(c) Name a gas that is used as a fuel.

..... [1]

(d) An energy level diagram for the burning of a fuel is shown.



Complete the diagram using these words:

- products
- reactants.

[1]

(e) The radioactive isotope ^{235}U is used as a source of energy.

State one **other** use of radioactive isotopes.

..... [1]

[Total: 5]

4 This question is about halogens.

(a) The table shows some properties of four halogens.

halogen	melting point in °C	boiling point in °C	density at room temperature and pressure in g/cm ³
chlorine	−101	−35	0.003
bromine	−7	59	3.12
iodine	114	184	
astatine	302		6.35

- (i) Complete the table by predicting:
- the density of iodine at room temperature and pressure
 - the boiling point of astatine.

[2]

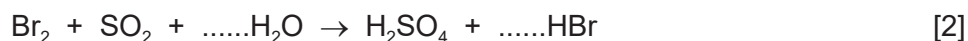
- (ii) Predict the physical state of bromine at 20 °C.
Give a reason for your answer.

.....

..... [2]

(b) Bromine reacts with sulfur dioxide and water.

- (i) Complete the chemical equation for this reaction.



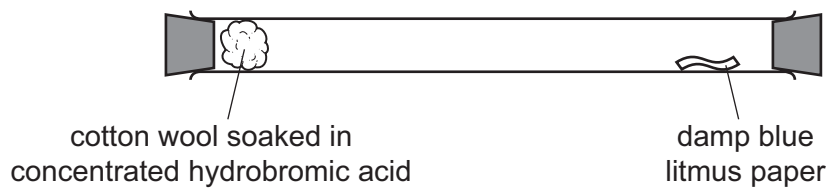
- (ii) In this reaction both oxidation and reduction take place.

State the meaning of the term *reduction*.

..... [1]

- (c) Concentrated aqueous hydrobromic acid releases fumes of acidic hydrogen bromide gas.

A long glass tube is set up as shown.



At first the blue litmus paper does not turn red.
After a short time the blue litmus paper turns red.

Explain these observations using the kinetic particle model.

.....

.....

.....

..... [3]

[Total: 10]

5 This question is about air and fertilisers.

(a) Air contains nitrogen, oxygen, noble gases and carbon dioxide.

State the percentage of nitrogen in clean, dry air.

..... [1]

(b) Polluted air contains oxides of nitrogen.

(i) Give **one** source of oxides of nitrogen in the air.

..... [1]

(ii) State **one** adverse effect of oxides of nitrogen on health.

..... [1]

(c) Many fertilisers contain nitrogen and potassium.

(i) Name one **other** element found in most fertilisers.

..... [1]

(ii) Explain why farmers use fertilisers on fields where crops are to be grown.

..... [1]

(iii) Describe a test for potassium ions.

test

observations [2]

[Total: 7]

6 This question is about acids, bases and salts.

- (a)** Describe the reaction of excess dilute sulfuric acid with magnesium carbonate and with magnesium oxide. Give the names of the products and any observations.

reaction with magnesium carbonate

- products

.....

- observations

.....

.....

reaction with magnesium oxide

- products

.....

- observations

.....

.....

[4]

- (b)** State the colour change when excess aqueous sodium hydroxide is added to a solution of litmus in dilute sulfuric acid.

from to [2]

- (c) (i) Describe how universal indicator can be used to find the pH of an acidic solution.

.....

 [2]

- (ii) Choose the pH value that is acidic.

Draw a circle around your answer.

pH 2 pH 7 pH 10 pH 14 [1]

- (d) The salt zinc chloride can be prepared by reacting hydrochloric acid with zinc oxide.

- (i) Choose the type of reaction that occurs.

Draw a circle around your answer.

addition neutralisation polymerisation reduction [1]

- (ii) The method for preparing pure dry crystals of zinc chloride is given.

Complete the missing steps 3 and 6.

- 1 Add excess zinc oxide to dilute hydrochloric acid.
- 2 Warm the mixture to complete the reaction.
- 3
- 4 Evaporate the filtrate until the point of crystallisation and leave for crystals to form.
- 5 Remove the crystals.
- 6 [2]

- (e) (i) Small pieces of zinc react with excess dilute hydrochloric acid at different temperatures. The time taken for each reaction to finish is recorded.

The temperatures are:

- 20 °C
- 40 °C
- 60 °C.

All other conditions stay the same.

Complete the table by writing the temperatures in the first column.

temperature of acid / °C	time taken for the reaction to finish / s
	64
	16
	256

[1]

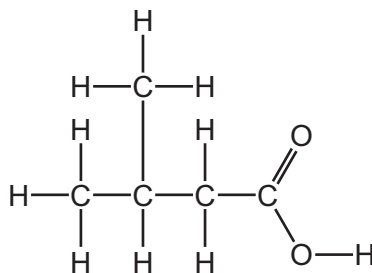
- (ii) Describe the effect on the time taken for the reaction to finish when it is carried out with dilute hydrochloric acid of a higher concentration.

All other conditions stay the same.

..... [1]

[Total: 14]

- 7 (a) The structure of compound **T** is shown.



- (i) Choose from the list the word that describes compound **T**.

alcohol
alkane
alkene
carboxylic acid

..... [1]

- (ii) Deduce the formula of compound **T** to show the number of carbon, hydrogen and oxygen atoms.

..... [1]

- (b) Compound **T** reacts with ethanol in the presence of a catalyst.

- (i) State the meaning of the term *catalyst*.

..... [1]

- (ii) Complete the sentence about ethanol using a word from the list.

combustion cracking electrolysis fermentation

Ethanol is manufactured from ethene or by [1]

- (c) Ethene can be produced from ethanol.

- (i) Draw the structure of ethene to show all of the atoms and all of the bonds.

[1]

- (ii) Ethene is a gas at room temperature.

Use the kinetic particle model to describe the separation of the particles in a gas.

..... [1]

- (iii) Ethene can be produced by cracking long-chain hydrocarbons to form short-chain hydrocarbons.

Explain why long-chain hydrocarbons are cracked to form short-chain hydrocarbons.

.....
..... [1]

- (iv) Ethene can be polymerised.

State the name of the polymer formed.

..... [1]

- (d) *Terylene* is a polymer.

Give **one** use of *Terylene*.

..... [1]

- (e) Name a polymer that is a constituent of food.

..... [1]

[Total: 10]

8 This question is about metals.

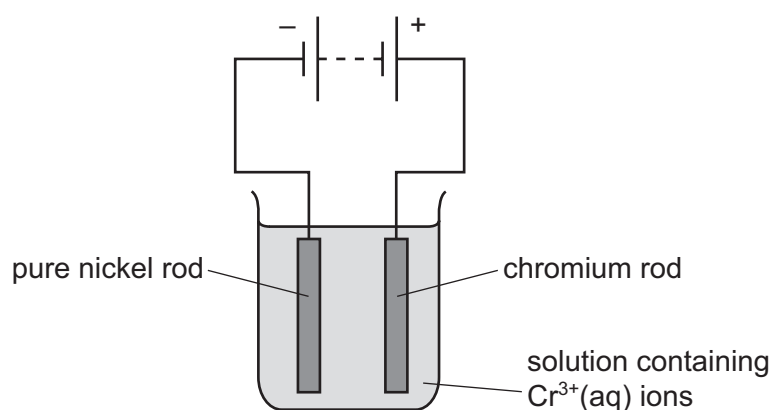
- (a) Chromium is a transition element. Potassium is an element in Group I of the Periodic Table. Chromium has a higher density than potassium.

Give two **other** ways in which the physical properties of chromium differ from the physical properties of potassium.

1

2 [2]

- (b) The apparatus used to electroplate a nickel rod with chromium is shown.



- (i) Choose a word from the list which describes the nickel rod.

Draw a circle around your answer.

anode cathode cation electrolyte mixture [1]

- (ii) One use of electroplating is to make objects attractive.

Describe one **other** reason for electroplating an object.

..... [1]

- (c) Deduce the number of electrons and neutrons in one atom of the isotope of chromium shown.



number of electrons

number of neutrons

[2]

(d) A compound of chromium has the formula CrH_2O_6 .

Complete the table to calculate the relative molecular mass of CrH_2O_6 .

atom	number of atoms	relative atomic mass	
chromium	1	52	$1 \times 52 = 52$
hydrogen		1	
oxygen		16	

relative molecular mass = [2]

(e) The table shows the rates of reaction of four metals with air.

metal	rate of reaction
chromium	reacts very slowly only when heated strongly
silver	does not react at room temperature or when heated strongly
sodium	reacts quickly at room temperature
uranium	reacts slowly at room temperature

Put the four metals in order of their reactivity.

Put the least reactive metal first.

least reactive $\longrightarrow$ most reactive

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[2]

[Total: 10]

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The Periodic Table of Elements

Group								
I	II	III	IV	V	VI	VII	VIII	
Key atomic number name atomic symbol relative atomic mass								1Hhydrogen1
3Li lithium7	4Be beryllium9							2He helium4
11Na sodium23	12Mg magnesium24							10Ne neon20
19K potassium39	20Ca calcium40	21Sc scandium45	22Ti titanium48	23V vanadium51	24Cr chromium52	25Mn manganese55	26Fe iron56	27Co cobalt59
37Rb rubidium85	38Sr strontium88	39Y yttrium89	40Zr zirconium91	41Nb niobium93	42Mo molybdenum96	43Tc technetium—	44Ru ruthenium101	45Rh rhodium103
55Cs caesium133	56Ba barium137	57–71lanthanoids	72Hf hafnium178	73Ta tantalum181	74W tungsten184	75Re rhenium186	76Os osmium190	77Ir iridium192
87Fr francium—	88Ra radium—	89–103actinoids	104Rf rutherfordium—	105Db dubnium—	106Sg seaborgium—	107Bh bohrium—	108Hs hassium—	109Mt meitnerium—
lanthanoids		57La lanthanum139	58Ce cerium140	59Pr praseodymium141	60Nd neodymium144	61Pm promethium—	62Sm samarium150	63Eu europium152
actinoids		89Ac actinium—	90Th thorium232	91Pa protactinium231	92U uranium238	93Np neptunium—	94Pu plutonium—	95Am americium—
		67Ho holmium165	68Er erbium167	69Tm thulium169	70Yb ytterbium173	71Lu lutetium175		
		114Fl flerovium—	115Ts tennessine—	116Lv livermorium—	117Nh nihonium—	118Og oganesson—		

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).