



CANDIDATE
NAME

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0620/33

May/June 2024

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.

IB24 06_0620_33/3RP
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[Turn over

1 Fig. 1.1 shows the structures of seven substances, **A**, **B**, **C**, **D**, **E**, **F** and **G**.

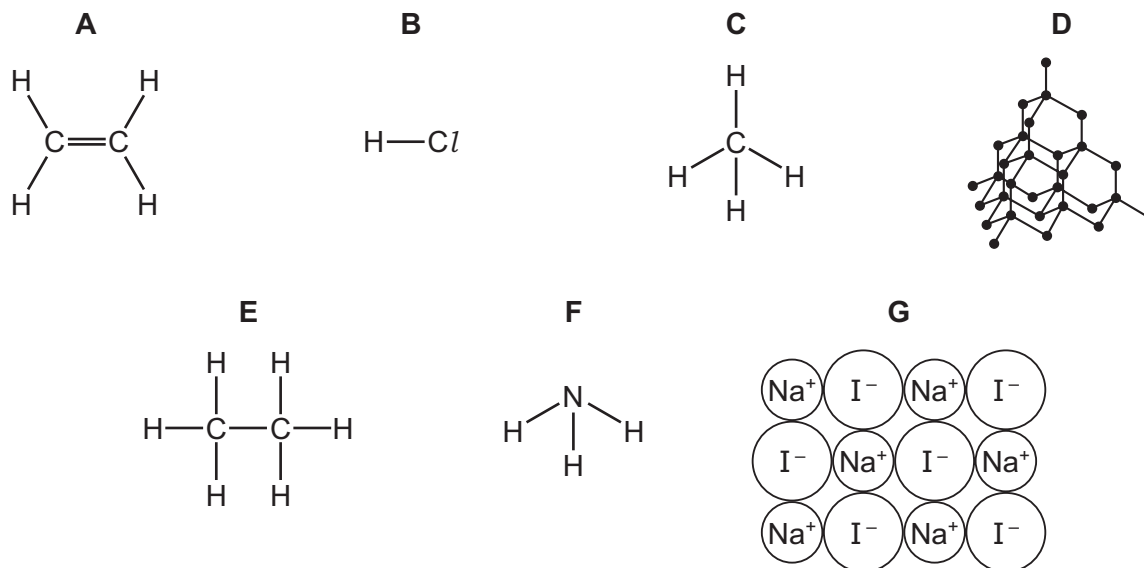


Fig. 1.1

- (a) Answer the following questions using only the structures in Fig. 1.1.
Each structure may be used once, more than once or not at all.

State which structure represents:

- (i) a compound that is the main constituent of natural gas

..... [1]

- (ii) the monomer used to produce poly(ethene)

..... [1]

- (iii) a giant covalent structure

..... [1]

- (iv) a compound that has a high melting point

..... [1]

- (v) a waste gas from digestion in animals

..... [1]

- (vi) a solid at room temperature that conducts electricity when dissolved in water.

..... [1]

- (b) Complete Fig. 1.2 to show the dot-and-cross diagram for structure **B**.
Show the outer electron shells only.

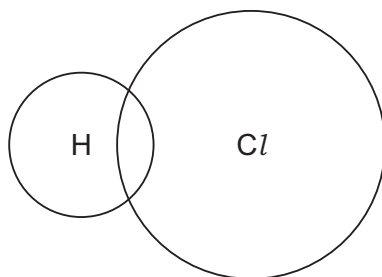


Fig. 1.2

[2]

[Total: 8]

- 2 (a) Intracellular fluid is the solution between the cells in the human body.

Table 2.1 shows the masses, in mg, of some ions in 100 cm^3 of intracellular fluid.

Table 2.1

name of ion	formula of ion	mass of ion in 100 cm^3 of intracellular fluid / mg
calcium	Ca^{2+}	6
chloride	Cl^-	7
hydrogencarbonate	HCO_3^-	49
phosphate	PO_4^{3-}	547
magnesium	Mg^{2+}	31
potassium	K^+	624
sodium	Na^+	23
sulfate	SO_4^{2-}	96

Answer these questions using information from Table 2.1.

- (i) Name the positive ion that is present in the lowest concentration.

..... [1]

- (ii) Name the ion that contains an element in Group IV of the Periodic Table.

..... [1]

- (b) Describe a test for sulfate ions.

test

.....

observations

.....

[2]

- (c) Small amounts of ammonium ions and chloride ions are formed in some cells of the body.

State the formula of the compound formed from ammonium ions and chloride ions.

..... [1]

(d) Choose from the list the salt that is insoluble in water.

Tick (✓) **one** box.

copper(II) nitrate	☐
lead(II) chloride	☐
potassium nitrate	☐
sodium chloride	☐

[1]

(e) Table 2.2 shows some properties of the Group I metals.

Table 2.2

metal	hardness / MPa	observations on reaction with water
lithium	5.0	bubbles form very slowly and no flame
sodium	0.69	bubbles form very slowly and no flame
potassium		bubbles form very rapidly and flame
rubidium	0.22	

Use the information in Table 2.2 to:

- predict the hardness of potassium

.....

- describe the observations when rubidium reacts with water.

.....

[2]

(f) Sodium reacts with hydrogen to produce sodium hydride, NaH.

Complete the symbol equation for this reaction.



[Total: 10]

3 (a) Molten calcium bromide is electrolysed.

(i) Define the term electrolysis.

.....
 [2]

(ii) Name an inert metal that can be used for the electrodes.

..... [1]

(iii) Name the product formed at each electrode.

positive electrode

negative electrode [2]

(b) Calcium reacts with water. An alkaline solution is produced.

(i) Name the ion which causes a solution to be alkaline.

..... [1]

(ii) Choose the pH value of an alkaline solution.

Draw a circle around your chosen answer.

pH 1 pH 5 pH 7 pH 9 [1]

(iii) Dilute hydrochloric acid is added to a solution of litmus in alkaline solution until the acid is in excess.

State the colour change of the litmus.

from to [2]

(c) Calcium carbonate is added to the blast furnace in the production of iron.

Calcium carbonate breaks down when heated to produce calcium oxide and a gas that turns limewater milky.

(i) Name the gas that turns limewater milky.

..... [1]

(ii) Name the type of chemical reaction that takes place when calcium carbonate is heated.

..... [1]

[Total: 11]

4 (a) Chlorophyll is a coloured compound found in plants. Chlorophyll is needed for photosynthesis.

(i) Complete the word equation for photosynthesis.



[2]

(ii) State one **other** condition that is essential for photosynthesis.

..... [1]

(b) Several other coloured compounds are found in plant leaves.

A student extracts a mixture of coloured compounds from a plant leaf.

Fig. 4.1 shows the apparatus used to separate the coloured compounds.

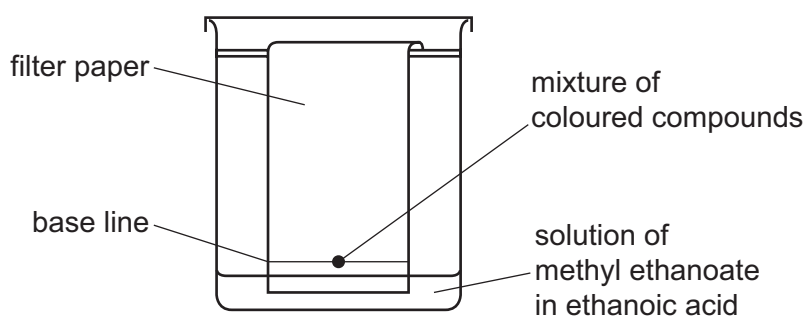


Fig. 4.1

(i) Name this method of separation.

..... [1]

(ii) Suggest why the base line is drawn in pencil and **not** in ink.

..... [1]

(iii) The liquid used to separate the coloured compounds is a solution of methyl ethanoate in ethanoic acid.

State the meaning of the term solution.

.....
 [1]

(c) Fig. 4.2 shows the displayed formula of a compound found in plant cells.

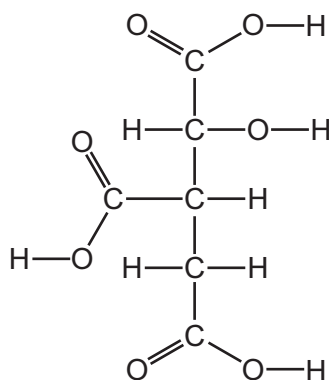


Fig. 4.2

On Fig. 4.2, draw a circle around the alcohol functional group.

[1]

[Total: 7]

- 5 (a) An atom of phosphorus is represented by the symbol shown.



Describe this atom of phosphorus in terms of:

- the position of the electrons, neutrons and protons in the atom

.....

- the number of neutrons and the number of protons

.....

- the electronic configuration.

..... [5]

- (b) Complete the symbol equation for the reaction of phosphorus with oxygen.



- (c) Fig. 5.1 shows the displayed formula of a compound of phosphorus.

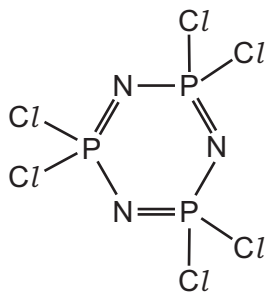


Fig. 5.1

Deduce the molecular formula of this compound.

..... [1]

- (d) Another compound of phosphorus has the formula Na_3PO_4 .

Complete Table 5.1 to calculate the relative formula mass of Na_3PO_4 .

Table 5.1

type of atom	number of atoms	relative atomic mass	
sodium	3	23	$3 \times 23 = 69$
phosphorus		31	
oxygen		16	

relative formula mass = [2]

- (e) Phosphates in rivers can cause deoxygenation of water.

State **one** source of phosphates in river water.

..... [1]

[Total: 11]

- 6 Dilute hydrochloric acid reacts with small pieces of calcium carbonate.



- (a) State the meaning of the state symbol (aq).

..... [1]

- (b) Fig. 6.1 shows how the mass of small pieces of calcium carbonate changes as the reaction proceeds. The calcium carbonate is in excess.

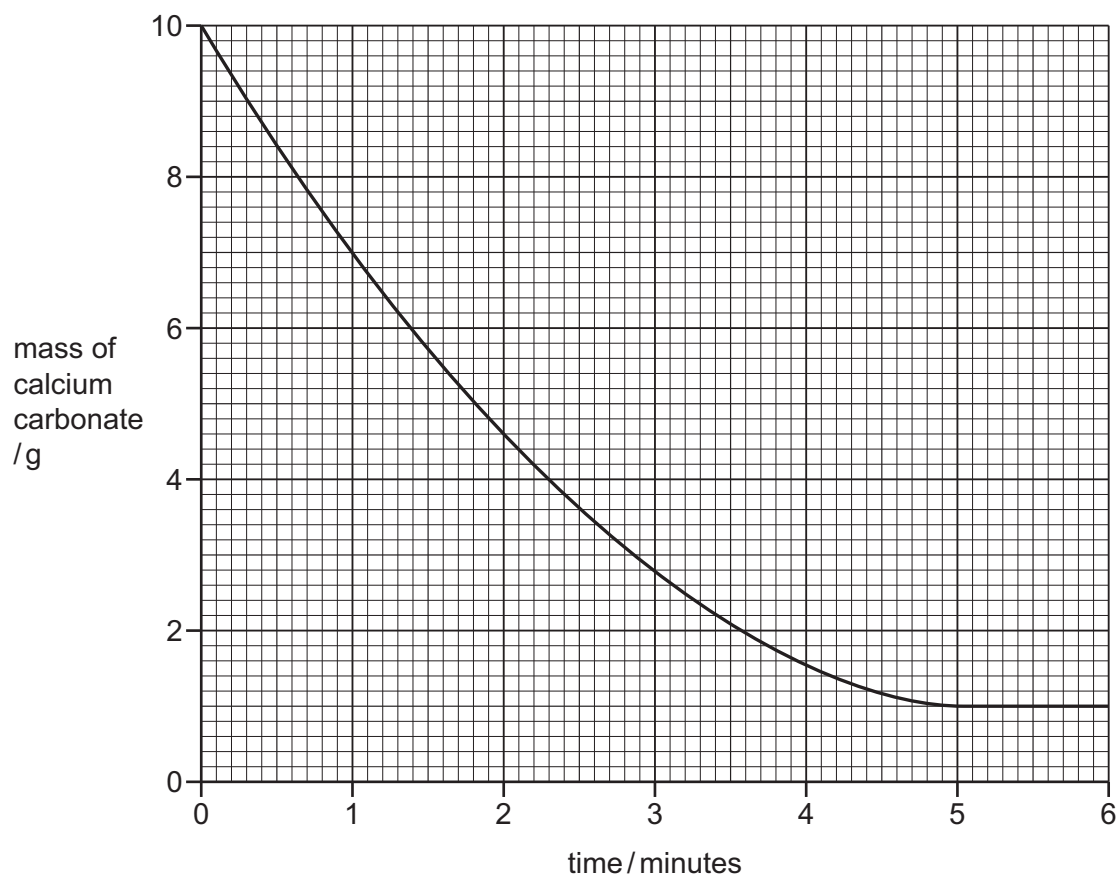


Fig. 6.1

- (i) Deduce the mass of calcium carbonate two minutes from the start of the reaction.

..... [1]

- (ii) Explain how the graph shows that the calcium carbonate is in excess.

..... [1]

- (iii) The experiment is repeated at a higher temperature.

All other conditions stay the same.

Draw a line on Fig. 6.1 to show how the mass of calcium carbonate changes at a higher temperature as the time increases. [2]

- (c) (i) Describe the effect, if any, on the rate of reaction when large pieces of calcium carbonate are used instead of small pieces of calcium carbonate.

All other conditions stay the same.

..... [1]

- (ii) Increasing the concentration of dilute hydrochloric acid increases the rate of reaction of dilute hydrochloric acid with calcium carbonate.

Choose the correct unit of concentration from the list.

Draw a circle around your chosen answer.

dm^3/g g/dm^2 mol/dm mol/dm^3 [1]

- (d) Concentrated hydrochloric acid gives off hydrogen chloride gas.
Hydrogen chloride is an acidic gas that turns damp universal indicator paper red.

A long glass tube is set up as shown in Fig. 6.2.

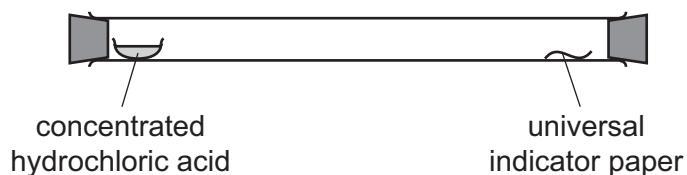


Fig. 6.2

At first, the universal indicator paper does not change colour.
The universal indicator paper turns red after a short time.

Explain these results in terms of kinetic particle theory.

.....

 [3]

- (e) Hydrogen chloride breaks down to form hydrogen and chlorine at 1500°C .
The reaction is endothermic.

State the meaning of the term endothermic.

..... [1]

[Total: 11]

- 7 Chromium and iron are transition elements. They are ductile and have high melting and boiling points.

(a) State three **other** physical properties of chromium.

1

2

3

[3]

(b) The formula for rust is $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$.

(i) State the chemical name of rust.

..... [2]

(ii) An iron object is coated with plastic.

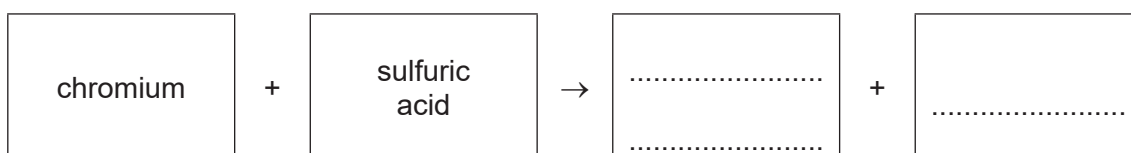
Explain how this prevents the iron from rusting.

.....

..... [2]

(c) Chromium behaves as a typical metal when it reacts with sulfuric acid.

Complete the word equation for this reaction.



[2]

(d) The list shows five metals.

aluminium calcium copper iron zinc

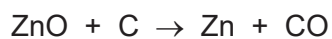
Put these metals in order of their reactivity.

Put the most reactive metal at the top.

most reactive	<input type="text"/>
	<input type="text"/>
	<input type="text"/>
	<input type="text"/>
least reactive	<input type="text"/>

[2]

(e) Zinc can be produced by heating zinc oxide with carbon.



Describe how this equation shows that zinc oxide is reduced.

.....

..... [1]

[Total: 12]

8 This question is about hydrocarbons.

- (a) Table 8.1 shows the names, formulae and boiling points of methane, ethane, propane and butane.

Table 8.1

name	formula	boiling point/°C
methane	CH ₄	−164
ethane	C ₂ H ₆	−88
propane	C ₃ H ₈	−42
butane	C ₄ H ₁₀	0

Use the information in Table 8.1 to answer these questions.

- (i) Name the homologous series that includes methane, ethane, propane and butane.

..... [1]

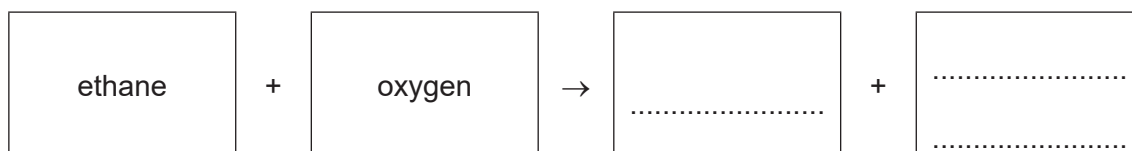
- (ii) State the trend in the boiling point of this homologous series as the number of carbon atoms increases.

..... [1]

- (iii) Deduce the general formula of this homologous series.

..... [1]

- (b) Complete the word equation for the complete combustion of ethane.



[2]

(c) Long-chain hydrocarbons can be cracked to produce alkenes and hydrogen.

(i) State **two** conditions for cracking.

1

2 [2]

(ii) The diesel oil fraction from the fractional distillation of petroleum can be used for cracking.

Give one **other** use of the diesel oil fraction.

..... [1]

(d) Alkene molecules can react together to produce polymers.

Define the term polymer.

.....

..... [2]

[Total: 10]

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The Periodic Table of Elements

Group																												
I	II											III	IV	V	VI	VII	VIII											
<div><div>1Hhydrogen1</div><div><div>Key</div><div>atomic number atomic symbol name relative atomic mass</div></div></div>																												
3Li lithium 7	4Be beryllium 9																											
11Na sodium 23	12Mg magnesium 24																											
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 —	113Nh nihonium —	114Fl flerovium —	115Mc moscovium —	116Lv livermorium —	117Ts tennessine —	118Og oganesson —										
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														
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 —														
actinoids																												