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CANDIDATE NAME

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8303160701

CHEMISTRY **0971/32**

Paper 3 Theory (Core) **May/June 2026**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- 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. Do **not** use correction fluid or tape.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- 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.

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1 Six substances, **A** to **F**, are shown in Figure 1.1.

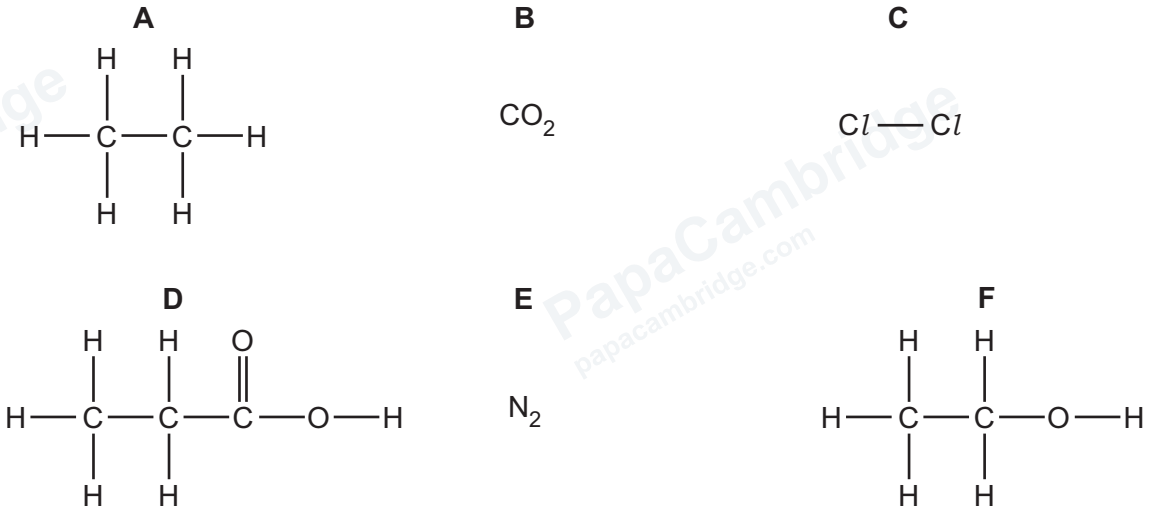

Figure 1.1

Answer the following questions about these substances.

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

(a) State which substance is:

(i) an alcohol

..... [1]

(ii) a gas that is approximately 78% of clean, dry air

..... [1]

(iii) a compound in the same homologous series as ethanoic acid

..... [1]

(iv) a hydrocarbon

..... [1]

(v) a compound that is a product of the complete combustion of an alkane

..... [1]

(vi) a gas that turns limewater milky

..... [1]

(vii) a pale yellow-green gas at room temperature and pressure.

..... [1]

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(b) State which **two** substances are elements.

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

[Total: 9]

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2 Table 2.1 shows some properties of the Group I elements.

Table 2.1

metal	melting point / °C	boiling point / °C	atomic radius / pm
lithium	180	1342	152
sodium		883	186
potassium	64	762	
rubidium	39	688	248

(a) Use the information in Table 2.1 to answer the following questions.

(i) Predict the melting point of sodium.

..... [1]

(ii) Predict the atomic radius of potassium.

..... [1]

(iii) Deduce the physical state of lithium at 95 °C.

Give a reason for your answer.

physical state .....

reason .....

.....
[2]

(iv) State how the density of the Group I elements changes down the group.

..... [1]

(b) Potassium hydroxide, KOH, is made by adding potassium to water.

(i) Complete the symbol equation for this reaction.

$$.....K + ...H_2O \rightarrow 2KOH + H_2$$

[2]

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(ii) Bubbles of hydrogen gas are observed.

State the test for hydrogen gas.

test .....

.....

positive result .....

.....

[1]

(c) Complete Figure 2.1 to show the dot-and-cross diagram for a molecule of ammonia.

Show outer shell electrons only.

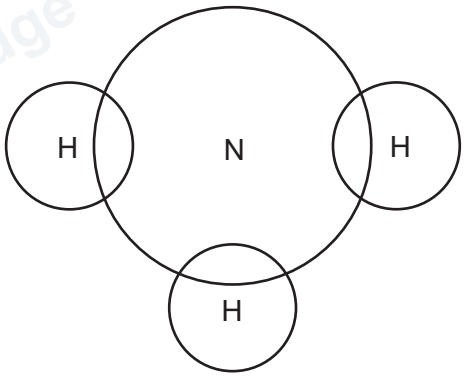

Figure 2.1

[2]

[Total: 10]

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3 The equation for the reaction of magnesium carbonate with dilute sulfuric acid is shown.

$$MgCO_3(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + CO_2(g) + H_2O(l)$$

(a) **(i)** State the meaning of the symbol (s) in this equation.

..... [1]

(ii) Name the salt formed when magnesium carbonate reacts with dilute sulfuric acid.

..... [1]

(iii) Name the piece of apparatus used to collect and measure the volume of carbon dioxide produced in this reaction.

..... [1]

(b) A student investigates the reaction of large pieces of magnesium carbonate with dilute sulfuric acid. The magnesium carbonate is in excess.

Figure 3.1 shows the total volume of carbon dioxide gas released as the reaction proceeds.

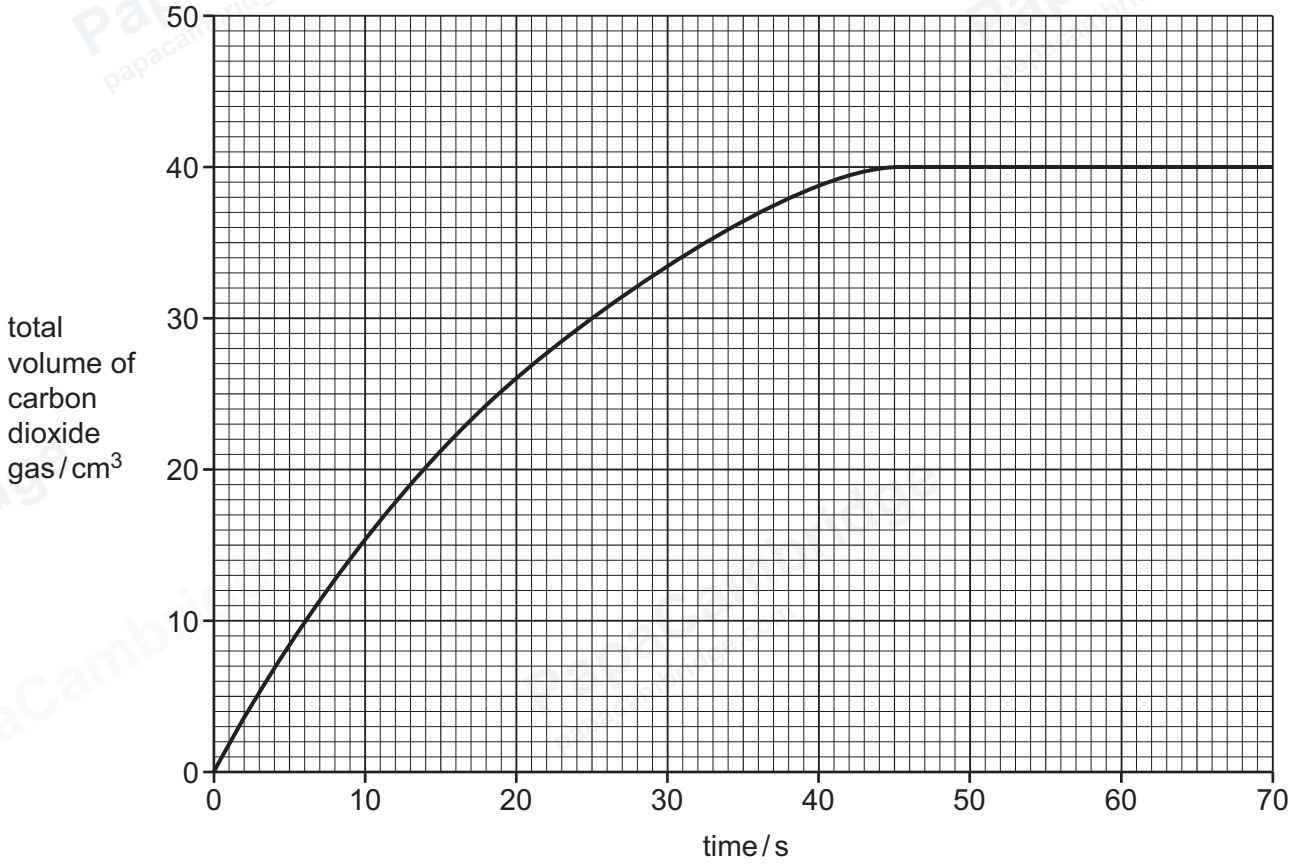

Figure 3.1

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(i) Use the graph in Figure 3.1 to determine the total volume of carbon dioxide gas released in 20 s.

total volume of carbon dioxide gas = ... cm^3 [1]

(ii) Use the graph in Figure 3.1 to deduce the time taken for the reaction to finish.

time = ... s [1]

(iii) The student repeats the experiment using the same volume of dilute sulfuric acid but with smaller pieces of magnesium carbonate.

Draw a line on the grid in Figure 3.1 to show how the total volume of carbon dioxide gas released changes over time in this second experiment. [2]

(iv) State how the rate of reaction differs, if at all, when a higher temperature is used.

..... [1]

(v) State how the rate of reaction differs, if at all, when a lower concentration of dilute sulfuric acid is used.

..... [1]

(c) **(i)** Write the formula of the ion that is in all acids.

..... [1]

(ii) Choose the pH value for an acidic solution.

Draw a circle around your chosen answer.

pH 2 **pH 7** **pH 9** **pH 12** [1]

[Total: 11]

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4 This question is about organic compounds and their reactions.

(a) Compound **P** is saturated.

Figure 4.1 shows the displayed formula of compound **P**.

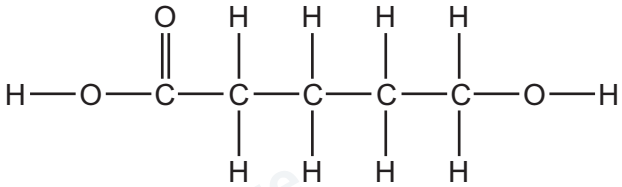

Figure 4.1

(i) On Figure 4.1, draw a circle around the alcohol functional group. [1]

(ii) Deduce the molecular formula of compound **P**.

..... [1]

(iii) State why compound **P** is saturated.

.....

..... [1]

(b) **(i)** Outline how ethanol is manufactured using aqueous glucose.

In your answer, include:

- the name of this process
- **two** conditions that are needed.

name of process .....

condition 1 .....

condition 2 .....

[3]

(ii) State **one** use of ethanol.

..... [1]

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(c) Ethanol is oxidised to ethanoic acid.

Complete the word equation for the reaction of ethanoic acid with magnesium.

ethanoic acid	+	magnesium	→	....	+	.....

[2]

[Total: 9]

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5 Three states of matter are solid, liquid and gas.

(a) State **two** general properties of a liquid.

1 .....

.....

2 .....

.....

[2]

(b) Complete Table 5.1 to show the motion and separation of particles in a solid and a liquid.

Table 5.1

physical state	motion of particles	separation of particles
solid		
liquid		

[4]

(c) Draw a line from each statement to the correct change of state.

statement	change of state
liquid nitrogen turns into solid nitrogen	evaporating
liquid cobalt changes into cobalt gas	freezing
steam changes into liquid water	condensing

[2]

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(d) Name the process in which gas particles spread out from an area of high concentration to an area of low concentration.

..... [1]

[Total: 9]

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6 Nickel is a metal.

(a) **(i)** State the period number of nickel in the Periodic Table.

..... [1]

(ii) Deduce the number of electrons, neutrons and protons in the nickel ion shown.

$^{60}_{28}Ni^{2+}$

number of electrons .....

number of neutrons .....

number of protons .....
[3]

(b) **(i)** Nickel(II) chloride is a compound with ionic bonding.

State the meaning of the term ionic bond.

.....

..... [2]

(ii) State **two** physical properties of an ionic compound.

1 .....

2 .....
[2]

(c) **(i)** Nickel reacts with oxygen to form nickel(II) oxide.

Complete the symbol equation for this reaction.

.....Ni + ... → 2NiO [2]

(ii) State if nickel(II) oxide is an acidic oxide or a basic oxide.

Give a reason for your answer.

.....

..... [1]

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(d) Nickel(II) bromide is another compound of nickel.

Molten nickel(II) bromide is electrolysed using platinum electrodes.

(i) Name a non-metal that is used as an inert electrode.

..... [1]

(ii) Name the products formed at each electrode during the electrolysis of molten nickel(II) bromide, and give the observations at the positive electrode.

product at the negative electrode .....

product at the positive electrode .....

observations at the positive electrode .....

.....
[3]

(e) Nickel(II) hydroxide has the formula $Ni(OH)_2$.

Complete Table 6.1 to calculate the relative formula mass of $Ni(OH)_2$.

Table 6.1

type of atom	number of atoms	relative atomic mass	
nickel	1	59	1 × 59 = 59
oxygen		16	
hydrogen		1	

relative formula mass = ... [2]

(f) Stainless steel is an alloy that contains nickel.

(i) State the meaning of the term alloy.

.....

..... [1]

(ii) Name **two** elements in stainless steel, other than nickel.

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

[Total: 20]

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7 **(a)** Natural water sources can be polluted by nitrates and some metal compounds.

(i) State **one** source of nitrates that pollute natural water sources.

..... [1]

(ii) State **one** reason why nitrates in river water are harmful.

.....

..... [1]

(iii) State **one** reason why some metal compounds in river water are harmful.

.....

..... [1]

(b) Sea water contains potassium ions.

Name the test to identify potassium ions. Give the observations for a positive test.

test .....

observations .....
[2]

(c) Potassium reacts with iodine to produce potassium iodide.

13.2 g of potassium reacts with excess iodine to produce 56.2 g of potassium iodide.

Calculate the mass of potassium iodide produced when 6.6 g of potassium reacts with excess iodine.

mass = ... g [1]

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(d) Figure 7.1 shows three stages in the treatment of the domestic water supply.

impure water → sedimentation and filtration → addition of carbon → chlorination → drinking water

Figure 7.1

State what happens at each stage in the treatment of the domestic water supply.

sedimentation and filtration .....

.....

addition of carbon .....

.....

chlorination .....

..... [3]

(e) Explain why distilled water rather than tap water is used in practical chemistry.

.....

..... [1]

(f) State the colour change when water is added to anhydrous cobalt(II) chloride.

from ..... to ..... [2]

[Total: 12]

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The Periodic Table of Elements

Key

atomic number
atomic symbol
name
relative atomic mass

Group

I	II											III	IV	V	VI	VII	VIII
							1 **H** hydrogen 1										2 **He** helium 4
3 **Li** lithium 7	4 **Be** beryllium 9											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 –	113 **Nh** nihonium –	114 **Fl** flerovium –	115 **Mc** moscovium –	116 **Lv** livermorium –	117 **Ts** tennessine –	118 **Og** oganesson –

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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