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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.

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

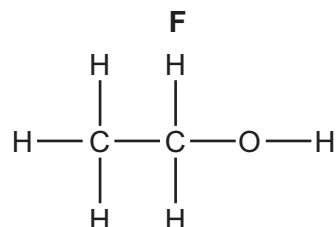
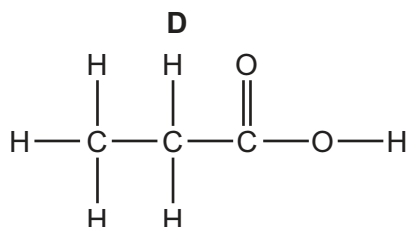
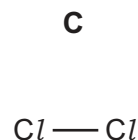
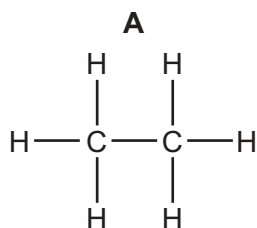


Figure 1.1

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]





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

..... and [2]

[Total: 9]



- 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

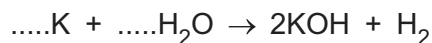
..... [2]

- (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.



[2]



- (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.

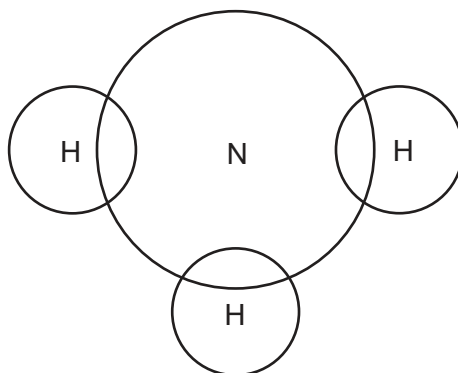


Figure 2.1

[2]

[Total: 10]

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



- (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.

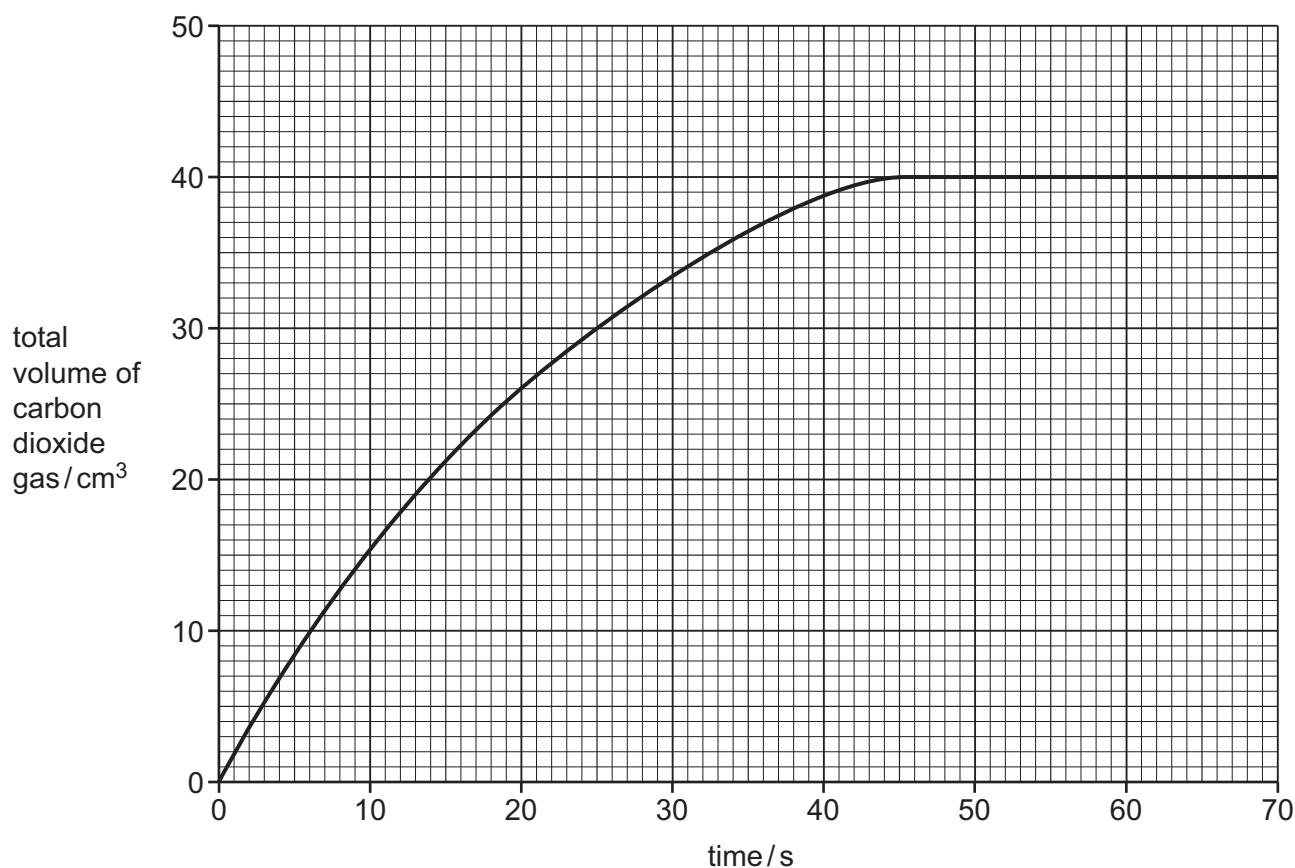


Figure 3.1



- (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 = ... cm³ [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]

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**.

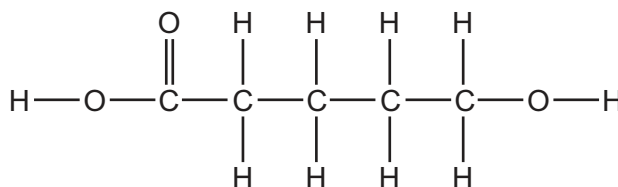


Figure 4.1

(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]



(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]



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]



(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]



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.



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.



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

Give a reason for your answer.

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



(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 $\text{Ni}(\text{OH})_2$.

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

Table 6.1

type of atom	number of atoms	relative atomic mass	
nickel	1	59	$1 \times 59 = 59$
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]



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.

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

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

mass = ... g [1]



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

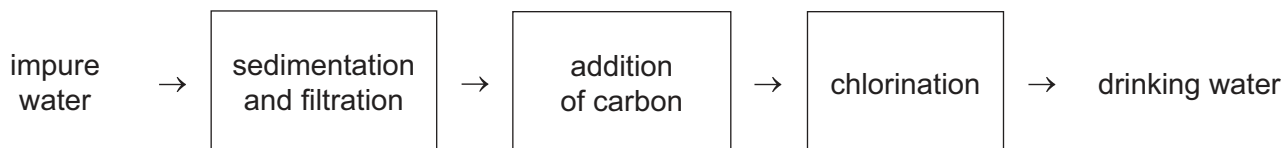


Figure 7.1

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

Group

Group																		
I	II											III	IV	V	VI	VII	VIII	
		1Hhydrogen1																
		Key																
		atomic number atomic symbol name relative atomic mass																
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

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
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 —

actinoids

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).