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|---------------------------------------------------------------------------------------|-------------------------------------------------------------|
| Please check the examination details below before entering your candidate information |                                                             |
| Candidate surname                                                                     | Other names                                                 |
| Centre Number                                                                         | Candidate Number                                            |
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| <b>Pearson Edexcel International GCSE (9–1)</b>                                       |                                                             |
| <b>Monday 17 November 2025</b>                                                        |                                                             |
| Morning (Time: 1 hour 15 minutes)                                                     | <b>Paper reference</b> <b>4CH1/2C</b>                       |
| <b>Chemistry</b><br><b>UNIT: 4CH1</b><br><b>PAPER: 2C</b>                             |                                                             |
| <b>You must have:</b><br>Calculator, ruler                                            | Total Marks                                                 |

### Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*
- Show all the steps in any calculations and state the units.

### Information

- The total mark for this paper is 70.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*

### Advice

- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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The Periodic Table of the Elements

|                               |                             |                                                                         |                              |                        |                           |                          |                        |                           |                             |                            |                                                                                     |                       |                       |                       |                         |                         |                      |                             |  |                           |                             |                         |                              |                         |
|-------------------------------|-----------------------------|-------------------------------------------------------------------------|------------------------------|------------------------|---------------------------|--------------------------|------------------------|---------------------------|-----------------------------|----------------------------|-------------------------------------------------------------------------------------|-----------------------|-----------------------|-----------------------|-------------------------|-------------------------|----------------------|-----------------------------|--|---------------------------|-----------------------------|-------------------------|------------------------------|-------------------------|
| 1                             | 2                           | Key                                                                     |                              |                        |                           |                          |                        |                           |                             |                            |                                                                                     | 3                     | 4                     | 5                     | 6                       | 7                       | 0                    |                             |  |                           |                             |                         |                              |                         |
|                               |                             | relative atomic mass<br>atomic symbol<br>name<br>atomic (proton) number |                              |                        |                           |                          |                        |                           |                             |                            |                                                                                     |                       |                       |                       |                         |                         |                      | 1<br>H<br>hydrogen<br>1     |  | 4<br>He<br>helium<br>2    |                             |                         |                              |                         |
| 7<br>Li<br>lithium<br>3       | 9<br>Be<br>beryllium<br>4   |                                                                         |                              |                        |                           |                          |                        |                           |                             |                            |                                                                                     |                       |                       |                       |                         |                         |                      | 11<br>B<br>boron<br>5       |  | 12<br>C<br>carbon<br>6    | 14<br>N<br>nitrogen<br>7    | 16<br>O<br>oxygen<br>8  | 19<br>F<br>fluorine<br>9     | 20<br>Ne<br>neon<br>10  |
| 23<br>Na<br>sodium<br>11      | 24<br>Mg<br>magnesium<br>12 |                                                                         |                              |                        |                           |                          |                        |                           |                             |                            |                                                                                     |                       |                       |                       |                         |                         |                      | 27<br>Al<br>aluminium<br>13 |  | 28<br>Si<br>silicon<br>14 | 31<br>P<br>phosphorus<br>15 | 32<br>S<br>sulfur<br>16 | 35.5<br>Cl<br>chlorine<br>17 | 40<br>Ar<br>argon<br>18 |
| 39<br>K<br>potassium<br>19    | 40<br>Ca<br>calcium<br>20   | 45<br>Sc<br>scandium                                                    | 48<br>Ti<br>titanium         | 51<br>V<br>vanadium    | 52<br>Cr<br>chromium      | 55<br>Mn<br>manganese    | 56<br>Fe<br>iron       | 59<br>Co<br>cobalt        | 59<br>Ni<br>nickel          | 63.5<br>Cu<br>copper       | 65<br>Zn<br>zinc                                                                    | 70<br>Ga<br>gallium   | 73<br>Ge<br>germanium | 75<br>As<br>arsenic   | 79<br>Se<br>selenium    | 80<br>Br<br>bromine     | 84<br>Kr<br>krypton  |                             |  |                           |                             |                         |                              |                         |
| 85<br>Rb<br>rubidium<br>37    | 88<br>Sr<br>strontium<br>38 | 89<br>Y<br>yttrium                                                      | 91<br>Zr<br>zirconium        | 93<br>Nb<br>niobium    | 96<br>Mo<br>molybdenum    | [98]<br>Tc<br>technetium | 101<br>Ru<br>ruthenium | 103<br>Rh<br>rhodium      | 106<br>Pd<br>palladium      | 108<br>Ag<br>silver        | 112<br>Cd<br>cadmium                                                                | 115<br>In<br>indium   | 119<br>Sn<br>tin      | 122<br>Sb<br>antimony | 128<br>Te<br>tellurium  | 127<br>I<br>iodine      | 131<br>Xe<br>xenon   |                             |  |                           |                             |                         |                              |                         |
| 133<br>Cs<br>caesium<br>55    | 137<br>Ba<br>barium<br>56   | 139<br>La*<br>lanthanum                                                 | 178<br>Hf<br>hafnium         | 181<br>Ta<br>tantalum  | 184<br>W<br>tungsten      | 186<br>Re<br>rhenium     | 190<br>Os<br>osmium    | 192<br>Ir<br>iridium      | 195<br>Pt<br>platinum       | 197<br>Au<br>gold          | 201<br>Hg<br>mercury                                                                | 204<br>Tl<br>thallium | 207<br>Pb<br>lead     | 209<br>Bi<br>bismuth  | [209]<br>Po<br>polonium | [210]<br>At<br>astatine | [222]<br>Rn<br>radon |                             |  |                           |                             |                         |                              |                         |
| [223]<br>Fr<br>francium<br>87 | [226]<br>Ra<br>radium<br>88 | [227]<br>Ac*<br>actinium                                                | [261]<br>Rf<br>rutherfordium | [262]<br>Db<br>dubnium | [266]<br>Sg<br>seaborgium | [264]<br>Bh<br>bohrium   | [277]<br>Hs<br>hassium | [268]<br>Mt<br>meitnerium | [271]<br>Ds<br>darmstadtium | [272]<br>Rg<br>roentgenium | Elements with atomic numbers 112-116 have been reported but not fully authenticated |                       |                       |                       |                         |                         |                      |                             |  |                           |                             |                         |                              |                         |

\* The Lanthanides (atomic numbers 58-71) and the Actinides(atomic numbers 90-103) have been omitted.

Cu and Cl have not been rounded to the nearest whole number.

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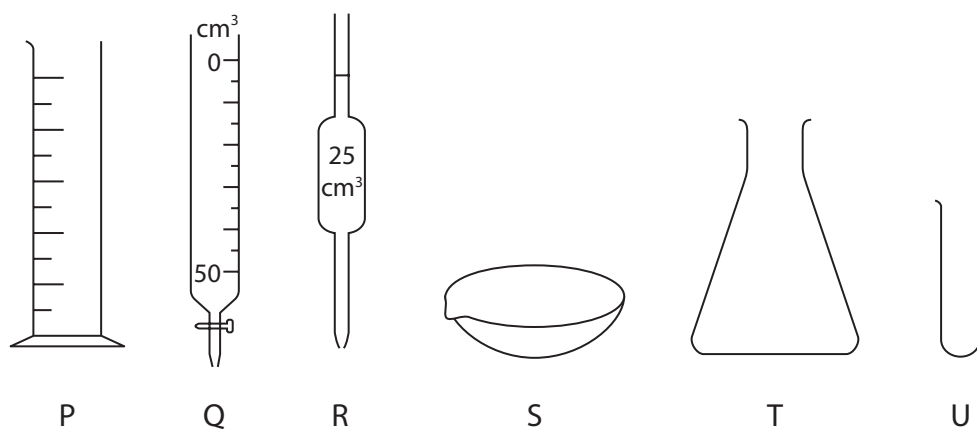
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**Answer ALL questions.**

- 1 The diagram shows some pieces of apparatus that can be used for different processes.  
The pieces of apparatus are not to scale.



- (a) Complete the table by placing ticks (✓) in each column to show if a piece of apparatus can be used for a process.

One tick has been done for you.

Each piece of apparatus can be used for one process, more than one process, or not at all.

(5)

| Letter | Process   |                            |                                        |
|--------|-----------|----------------------------|----------------------------------------|
|        | titration | measures different volumes | evaporates solvent to produce crystals |
| P      |           |                            |                                        |
| Q      | ✓         |                            |                                        |
| R      |           |                            |                                        |
| S      |           |                            |                                        |
| T      |           |                            |                                        |
| U      |           |                            |                                        |

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(b) Give the letter for the piece of apparatus that is a burette.

(1)

(c) Name the piece of apparatus labelled R.

(1)

**(Total for Question 1 = 7 marks)**



2 This question is about the halogens.

(a) The table lists some halogens and their properties.

Complete the table by giving the missing information.

(3)

| Halogen  | State at 25°C | Colour      |
|----------|---------------|-------------|
| fluorine |               | pale yellow |
| chlorine | gas           |             |
| bromine  |               | brown       |
| iodine   | solid         | dark grey   |

(b) Suggest the state of astatine at 25 °C.

(1)

(c) A sample of bromine atoms contains 42.0% bromine-79 and 58.0% bromine-81.

Calculate the relative atomic mass of this sample of bromine atoms.

Give your answer to three significant figures.

(3)

relative atomic mass = .....



- (d) A sample of chlorine contains 0.75 mol of  $^{35}\text{Cl}$  atoms and 0.25 mol of  $^{37}\text{Cl}$  atoms.

The table gives the relative molecular masses ( $M_r$ ) of the different diatomic molecules of chlorine.

The table also gives the probability of having a molecule of  $^{37}\text{Cl}^{37}\text{Cl}$  in this sample.

| Molecule    | $^{35}\text{Cl}^{35}\text{Cl}$ | $^{35}\text{Cl}^{37}\text{Cl}$ and $^{37}\text{Cl}^{35}\text{Cl}$ | $^{37}\text{Cl}^{37}\text{Cl}$ |
|-------------|--------------------------------|-------------------------------------------------------------------|--------------------------------|
| $M_r$       | 70                             | 72                                                                | 74                             |
| Probability |                                |                                                                   | $0.25 \times 0.25 = 0.0625$    |

- (i) Calculate the probability of having a molecule with an  $M_r$  of 70

(1)

probability = .....

- (ii) Explain why the probability of a molecule having an  $M_r$  of 72 is not 0.1875

(2)

.....

.....

.....

.....



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- (e) Explain how displacement reactions involving halogens and halides provide evidence for the trend in reactivity in Group 7 of the Periodic Table.

Include examples of reactions in your answer.

(5)

(Total for Question 2 = 15 marks)



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**3** (a) Paint can be used to coat iron, which protects iron from rusting.

(i) Give the chemical name for rust.

(1)

(ii) Explain how painting prevents iron from rusting.

(2)

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(b) Steel is made from iron and carbon.

Explain how the difference in malleability of pure iron and high-carbon steel affects the uses of these materials.

(6)



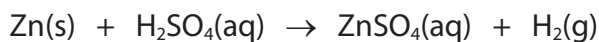
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- (c) Zinc reacts with dilute sulfuric acid to produce zinc sulfate and hydrogen.

This is the equation for the reaction.



A mass of 16 g of zinc reacts with an excess of sulfuric acid.

Calculate the maximum volume, at rtp, of hydrogen produced.

[for hydrogen at rtp, molar volume =  $24 \text{ dm}^3$ ]

(2)

volume of hydrogen = .....  $\text{dm}^3$

- (d) A solution of zinc sulfate is electrolysed to form zinc on the negative electrode.

- (i) The ionic half-equation at the negative electrode is

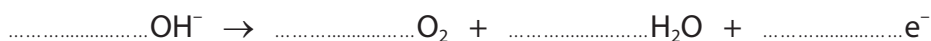


Give a reason why this half-equation shows reduction.

(1)

- (ii) Complete the ionic half-equation for the reaction that could occur at the positive electrode.

(1)



- (iii) A sample of the solution surrounding the positive electrode is tested with universal indicator.

Explain the final colour of the universal indicator.

(2)

(Total for Question 3 = 15 marks)



4 (a) Steam can be used to manufacture ethanol.

(i) Give the other reactant needed for this reaction.

(1)

(ii) State the pressure and catalyst used for this reaction to manufacture ethanol.

(2)

pressure

catalyst

(b) The glucose in grapes can be fermented to make ethanol.

(i) State the condition needed to prevent the formation of ethanoic acid.

(1)

(ii) Explain why fermentation needs to happen in the range of 30 °C to 40 °C.

(2)

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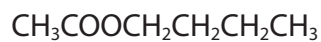
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(c) Grapes also contain esters.

This is the structural formula of an ester.



(i) Draw the displayed formula of this ester.

(2)

(ii) Deduce the name of the carboxylic acid and the name of the alcohol that react to form this ester.

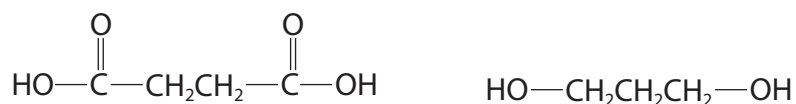
(2)

carboxylic acid

alcohol



- (d) These are the structural formulae of two monomers that are used to make a polyester.



- (i) Give the name of this type of polymerisation.

(1)

- (ii) Draw the structure of the repeat unit of the polyester formed from the two monomers.

(2)

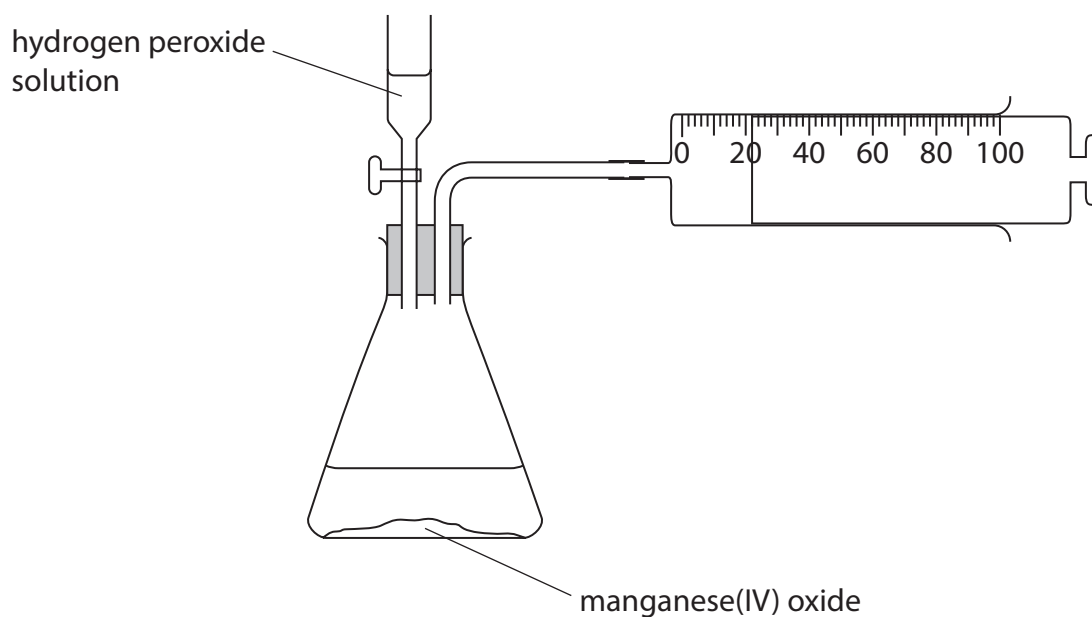
- (iii) Identify the small molecule formed when these two monomers react together.

(1)

(Total for Question 4 = 14 marks)



- 5 A student uses this apparatus to investigate the decomposition of hydrogen peroxide solution.



This is the equation for the reaction.



- (a) Give a chemical test for the presence of water.

(2)

.....

.....



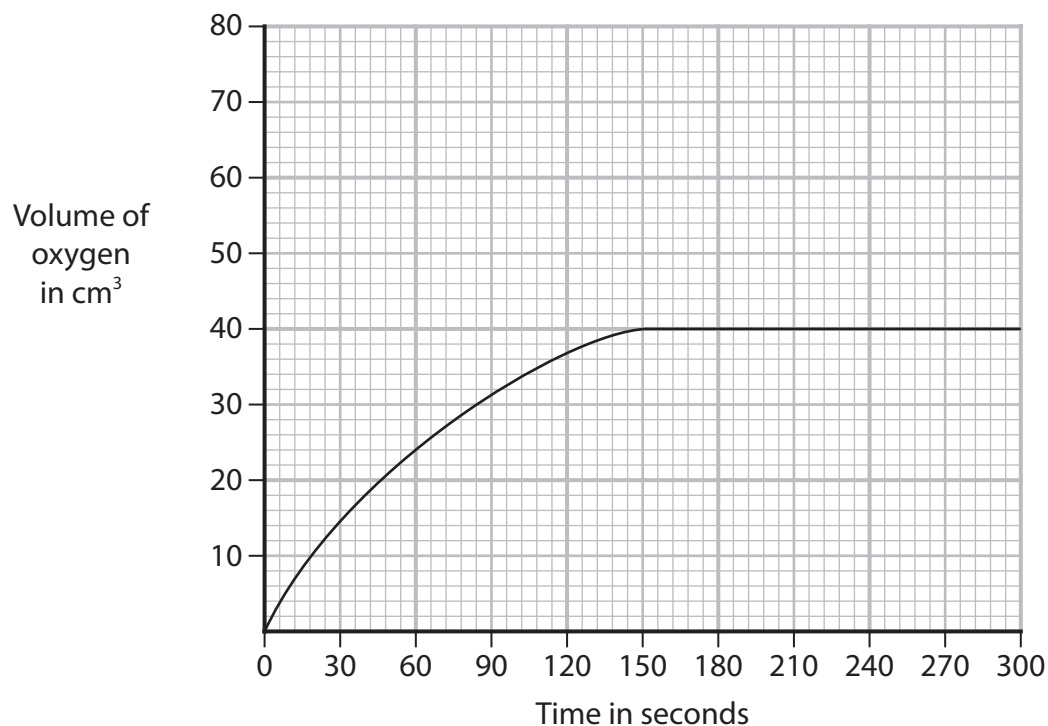
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- (b) In the first experiment the student uses hydrogen peroxide solution with a concentration of  $0.020 \text{ mol/dm}^3$ .

The graph shows the student's results.



In a second experiment, the student uses hydrogen peroxide solution with a concentration of  $0.025 \text{ mol/dm}^3$ .

All other conditions remain the same.

- (i) On the grid, draw the curve you would expect the student to obtain from the second experiment.

(2)

- (ii) On the grid, draw the curve you would expect the student to obtain for the second experiment carried out at a lower temperature.

(2)



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- (c) Potassium iodide has been suggested as an alternative catalyst to manganese(IV) oxide.

Describe a method to show which catalyst is more effective for the decomposition of hydrogen peroxide.

(5)

(Total for Question 5 = 11 marks)

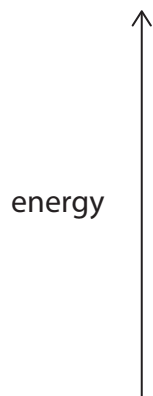


- 6 The equation shows one of the possible substitution reactions that occurs during the reaction between methane and chlorine.



- (a) Complete the reaction profile diagram to show the levels of the reactants, the products and the activation energy,  $E_a$ .

(3)



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(b) The table gives some bond energies.

| Bond                  | C—H | Cl—Cl | H—Cl |
|-----------------------|-----|-------|------|
| Bond energy in kJ/mol | 414 | 242   | 431  |

Using information from the equation and the table, calculate the bond energy of the C—Cl bond.

(5)

C—Cl bond energy = ..... kJ/mol

(Total for Question 6 = 8 marks)

TOTAL FOR PAPER = 70 MARKS



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