Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO NOT WRITE IN ANY BARCODES.

Answer all questions.
Electronic calculators may be used.
A copy of the Periodic Table is printed on page 20.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The owner of a factory plans to install a wind turbine to generate electricity.

(a) Describe advantages and disadvantages of generating electricity using a wind turbine.

Advantages ..........................................................................................................................................
...................................................................................................................................................
...................................................................................................................................................

Disadvantages ................................................................................................................................
...................................................................................................................................................
...................................................................................................................................................
................................................................................................................................................... [4]

(b) State the type of installation needed to generate electricity from sunlight.
.................................................................................................................................................. [1]

[Total: 5]
Candle wax contains hydrocarbons.

Fig. 2.1 shows a burning wax candle inside a bell jar containing air.

![Diagram of a burning wax candle inside a bell jar containing air.]

The bell jar is placed in a trough of water.

Carbon dioxide gas is much more soluble in water than oxygen gas.

As the candle burns, the water level rises up inside the bell jar.

(a) Explain why the water level rises when the candle burns.

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

(b) After several minutes the candle stops burning.

Circle the name of the main gas in the bell jar after the candle stops burning.

argon  chlorine  oxygen  nitrogen

[1]

(c) Explain why it can be hazardous to burn hydrocarbons in a limited supply of air.

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

[Total: 5]
Fig. 3.1 shows how the speed of an object varies during a period of 30 s.

(a) (i) State the speed of the object at point A.

speed = ................................................... m/s [1]

(ii) State the speed of the object at point D.

speed = ................................................... m/s [1]

(b) Describe the motion of the object between points B and C.

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

(c) Determine the distance travelled between points C and D.

distance = ...................................................... m [3]
(d) The total distance travelled by the object between points A and D is 750 m.

Calculate the average speed of the object.

State the formula you use and show your working.

\[
\text{average speed} = \text{................................................... m/s} \; [3]
\]

[Total: 9]
4 Carbon-12, $^{12}_{6}\text{C}$, and carbon-14, $^{14}_{6}\text{C}$, are isotopes of carbon.

Complete Table 4.1 to give the number of protons, electrons and neutrons in one atom of each isotope.

<table>
<thead>
<tr>
<th>isotope</th>
<th>protons</th>
<th>electrons</th>
<th>neutrons</th>
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</thead>
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<td>carbon-12</td>
<td>$^{12}_{6}\text{C}$</td>
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<td></td>
</tr>
<tr>
<td>carbon-14</td>
<td>$^{14}_{6}\text{C}$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[2]

[Total: 2]
A teacher demonstrates the properties of water waves using a shallow container of water. A barrier is placed in the container. Fig. 5.1 shows a view of the container from above.

The vibrator produces a series of waves of constant frequency. These waves move towards the barrier and do not pass over it.

(a) On Fig. 5.1, draw a double-headed arrow (↔) to show one wavelength. [1]

(b) (i) Name the wave property demonstrated by the waves that have hit the barrier.

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

(ii) On Fig. 5.1, draw three wavefronts after they hit the barrier. [3]

[Total: 5]
Copper(II) oxide is added to dilute sulfuric acid until there is no further reaction.

The mixture is filtered to obtain a blue solution (filtrate).

The blue solution contains copper(II) ions.

(a) A reagent is added to the blue solution to identify the copper(II) ions.

Name the reagent and describe the positive result.

reagent ........................................................................................................................................

result .........................................................................................................................................

...................................................................................................................................................

[2]

(b) (i) Explain how dry crystals of a blue solid can be obtained from this blue solution.

........................................................................................................................................

........................................................................................................................................

...........................................................................................................................................

............................................................................................................................................ [3]

(ii) Name this blue solid.

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

[Total: 6]
7. Fig. 7.1 represents the regions of the electromagnetic spectrum.

- X-rays
- Ultraviolet
- Visible
- Microwaves
- Radio waves

(a) Two of the regions have not been named on Fig. 7.1.

In the two boxes in Fig. 7.1, write the names of these regions. [2]

(b) On Fig. 7.1, write the letter S at the short wavelength end of the electromagnetic spectrum. [1]

(c) State one use of

- Microwaves ........................................................................................................................................
- X-rays ................................................................................................................................................. [2]

[Total: 5]
8 Sodium is in Group I of the Periodic Table.

(a) State two observations made when sodium reacts with water.

1. ...............................................................................................................................................
2. ...............................................................................................................................................

(b) Name one element in Group I that is more reactive than sodium and one element in Group I that is less reactive than sodium.

more reactive than sodium ...............................................................
less reactive than sodium ...............................................................

(c) Sodium is in Period 3 of the Periodic Table.

Name one metal and one non-metal in the same period as sodium.

metal ...............................................................
non-metal ...............................................................

(d) Sodium reacts with chlorine to form sodium chloride, an ionic compound.

Draw a dot-and-cross diagram to show the ions in sodium chloride.
Question 9 starts on page 12
A student builds the circuit shown in Fig. 9.1.

(i) Calculate the total resistance in the circuit.

\[ \text{resistance} = \frac{12}{150 + 200} \Omega \, [1] \]

(ii) Use your answer to (i) to calculate the current in the circuit.

State the formula that you use, show your working and give the unit in your answer.

\[ \text{current} = \frac{12}{\text{resistance}} \text{ unit} \, [3] \]

(iii) Calculate the potential difference (p.d.) across the lamp.

Show your working.

\[ \text{p.d.} = 12 \, V \, [2] \]

(iv) Describe how the circuit may be modified so that the brightness of the lamp can be controlled.

...........................................................................................................................................

...................................................................................................................................... \, [1]
(b) The student builds another circuit as shown in Fig. 9.2.

![Circuit Diagram](image)

Fig. 9.2

Predict how the brightness of the lamp in this circuit compares to the lamp in Fig. 9.1. Explain your answer.

...................................................................................................................................................

...................................................................................................................................................

...................................................................................................................................................

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

[Total: 9]
10. The structures of diamond and chlorine are shown in Fig. 10.1.

Fig. 10.1

(a) Describe the structure of these two substances.

Use the list of words to help you.

- covalent
- diatomic
- giant structure
- macromolecule
- molecule

diamond ........................................................................................................................................
...................................................................................................................................................
...................................................................................................................................................
...................................................................................................................................................

chlorine .....................................................................................................................................
...................................................................................................................................................
...................................................................................................................................................
...................................................................................................................................................

[4]
(b) The molecular structure of a compound containing carbon and chlorine is shown in Fig. 10.2.

![Molecular structure](image)

Fig. 10.2

Give the formula of this compound.

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

(c) Chlorine is a halogen.

Table 10.1 shows some properties of the halogens.

<table>
<thead>
<tr>
<th>element</th>
<th>boiling point / °C</th>
<th>density in liquid state /g per dm³</th>
<th>colour at room temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>fluorine</td>
<td>−188</td>
<td>1.51</td>
<td>yellow</td>
</tr>
<tr>
<td>chlorine</td>
<td>−35</td>
<td>1.56</td>
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<tr>
<td>bromine</td>
<td>−7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iodine</td>
<td>+114</td>
<td>4.93</td>
<td>grey-black</td>
</tr>
</tbody>
</table>

(i) Complete Table 10.1 to

- give the colours of chlorine and bromine,
- predict the density of liquid bromine.

[3]

(ii) Describe the trend in boiling point of the halogens down the group.

...................................................................................................................................... [1]
(d) Chlorine reacts with a solution of potassium iodide, KI in a displacement reaction. The products are potassium bromide and iodine, I₂.

(i) Give the formula for potassium bromide.

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

(ii) Use your answer in (i) to complete the balanced symbol equation for this reaction.

\[
\text{Br}_2 + \text{KI} \rightarrow \text{...} + \text{I}_2
\] [1]

(iii) Suggest why bromine does not react with a solution of potassium chloride.

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

[Total: 12]
11 (a) Fig. 11.1 shows two samples of the same radioactive isotope. The samples have different mass. The substance emits β-particles during radioactive decay.

[Image]

(i) Put a tick (✓) alongside any of the following quantities which is the same for both samples.

- The half-life. [ ]
- The number of atoms decaying each second. [ ]
- The number of β-particles emitted each second. [ ]

[1]

(ii) Complete the sentences below to describe the radioactive decay of this isotope.

Beta particles are emitted from the ........................................ of the atom.
In this process, a ........................................ changes into a proton.

[2]

(b) People handling radioactive materials need to take certain safety precautions.

(i) Explain why handling radioactive materials is dangerous to humans.

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

(ii) State two safety precautions used by people handling radioactive materials.

1. .......................................................................................................................................

2. .......................................................................................................................................

[2]

[Total: 7]
Ethane and ethene are hydrocarbons. They each contain two carbon atoms per molecule.

(a) Complete Fig. 12.1 to show the structure of a molecule of ethane and a molecule of ethene.

Show the arrangement of all of the atoms and bonds.

![Fig. 12.1]

(b) Describe a chemical test to distinguish between a saturated and unsaturated hydrocarbon.

<table>
<thead>
<tr>
<th>Test</th>
<th>Result with saturated hydrocarbon</th>
<th>Result with unsaturated hydrocarbon</th>
</tr>
</thead>
</table>

(c) Poly(ethene) is made from ethene.

Name the type of reaction that happens when poly(ethene) is made from ethene.

[Total: 7]
The Periodic Table of Elements

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<th>III</th>
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The volume of one mole of any gas is 24 dm$^3$ at room temperature and pressure (r.t.p.).