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Candidate surname

Other names

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Nationals Certificate,  
Extended Certificate,  
Foundation Diploma,  
Diploma, Extended  
Diploma

Centre Number

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Learner Registration Number

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**Wednesday 13 January 2021**

Morning (Time: 40 minutes)

Paper Reference **31617H/1C**

# Applied Science/Forensic and Criminal Investigation

**Unit 1: Principles and Applications of Science I  
Chemistry**

**SECTION B: PERIODICITY AND PROPERTIES OF ELEMENTS**

**You must have:**

A calculator and a ruler.

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and learner registration number.
- Answer **all** questions.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*

## Information

- The exam comprises three papers worth 30 marks each:
  - Section A: Structures and Functions of Cells and Tissues (Biology)
  - Section B: Periodicity and Properties of Elements (Chemistry)
  - Section C: Waves in Communication (Physics).
- The total mark for this exam is 90.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*
- The periodic table of elements can be found at the back of this paper.

## Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

- 1 (a) The use of a metal depends on the properties of that metal.

Metals can be used to make saucepans because metals are good conductors of heat.

Give **one other** use of a metal and the property that is important for that use.

(2)

use

.....

.....

property

.....

.....

- (b) Aluminium is a metal.

An aluminium atom contains 13 electrons.

- (i) Complete Figure 1 to show the arrangement of electrons in an aluminium atom.

(1)

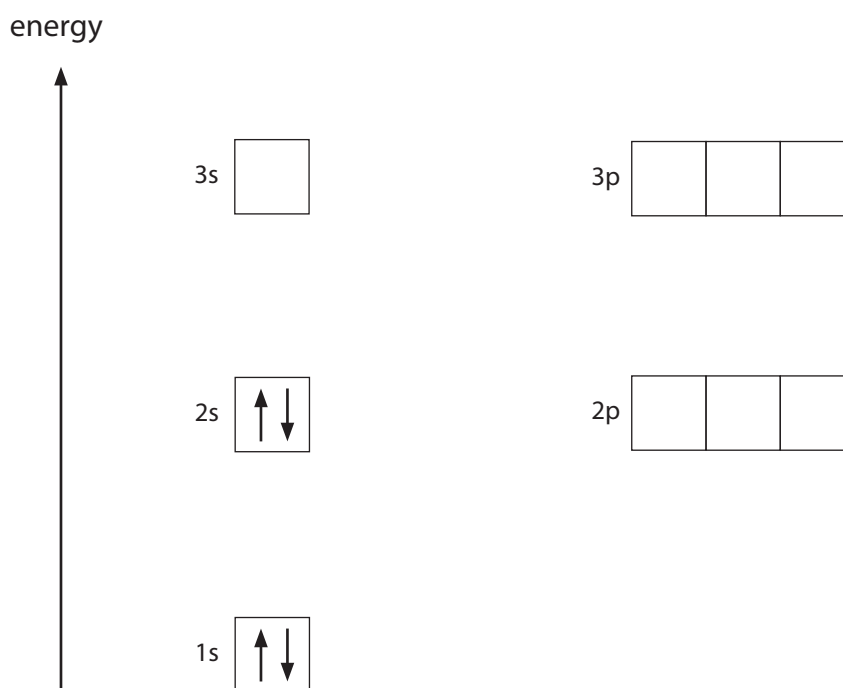


Figure 1

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(ii) Figure 2 shows a graph of the first 10 ionisation energies of aluminium.

Add **three** more points to the graph to show the ionisation energies for electron numbers 11, 12 and 13.

(2)

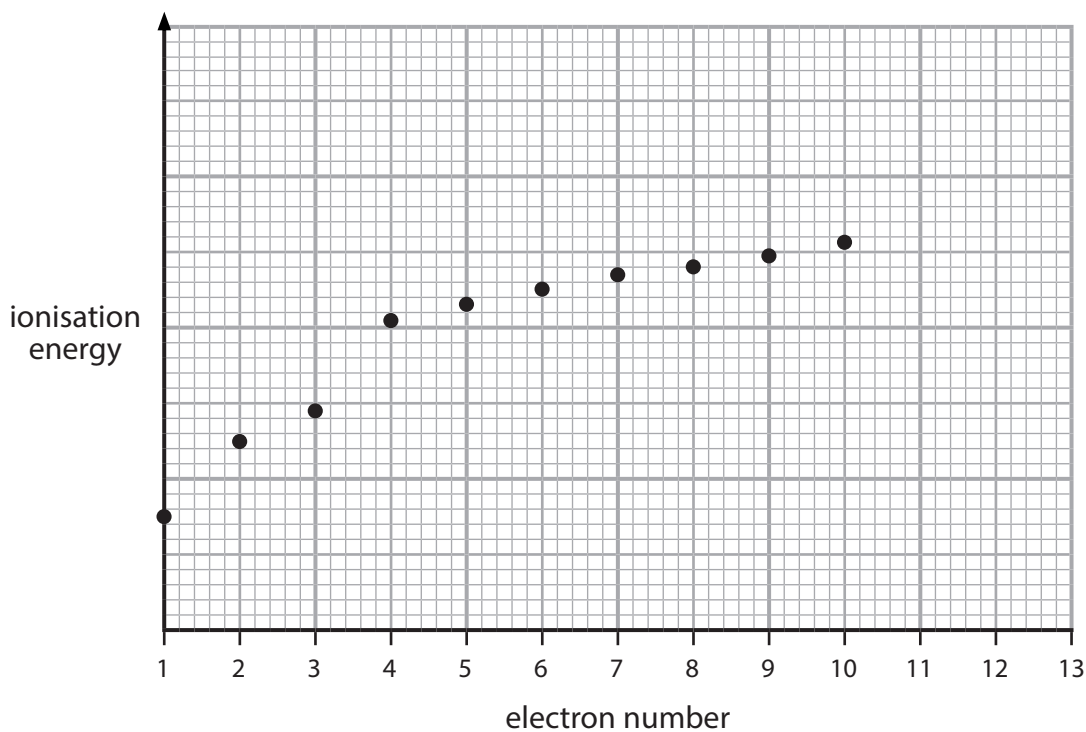


Figure 2

(Total for Question 1 = 5 marks)



P 6 7 5 0 4 A 0 3 1 2

2 Sodium sulfate is an ionic compound.

(a) Identify a property of solid sodium sulfate.

(1)

- A good conductor of electricity
- B high melting point
- C insoluble in water
- D malleable

(b) Give **one** use of sodium sulfate.

(1)

(c) Sodium sulfate contains sodium ions ( $\text{Na}^+$ ) and sulfate ions ( $\text{SO}_4^{2-}$ ).

(i) Complete Sentence 1.

(1)

The sodium atom (Na) becomes the sodium ion ( $\text{Na}^+$ ) by .....  
an electron.

**Sentence 1**

(ii) Identify the oxidation number of sulfur in the sulfate ion,  $\text{SO}_4^{2-}$ .

(1)

- A +2
- B +4
- C +6
- D +8

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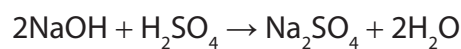
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(d) Sodium hydroxide reacts with sulfuric acid to form sodium sulfate.

The equation for this reaction is:



(i) Calculate the number of moles in 2.842 g of sodium sulfate,  $\text{Na}_2\text{SO}_4$ .

(relative formula mass of  $\text{Na}_2\text{SO}_4 = 142.1$ )

(1)

number of moles = .....

(ii) Calculate, using your answer to (d)(i), the minimum mass of sodium hydroxide needed to form 2.842 g of sodium sulfate.

(relative formula mass of  $\text{NaOH} = 40.0$ )

If you did not get an answer for (d)(i), use the value 0.025 for the number of moles.

(3)

minimum mass of sodium hydroxide = ..... g



(iii) A learner reacted sodium hydroxide with sulfuric acid.

The reaction produced a mass of 1.700 g of sodium sulfate.

The learner expected a mass of 2.842 g of sodium sulfate to be produced.

Identify the percentage yield for the learner's reaction.

(1)

- A 1.67%
- B 4.83%
- C 45.42%
- D 59.82%

(Total for Question 2 = 9 marks)

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3 (a) Simple covalent molecules have low boiling points.

State **two other** physical properties of simple covalent molecules.

(2)

property 1

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.....

property 2

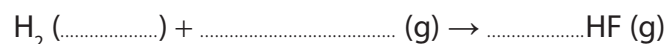
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(b) Hydrogen (H<sub>2</sub>) is a simple covalent molecule.

Hydrogen reacts with fluorine to form hydrogen fluoride gas (HF).

Complete the balanced equation, including state symbols for the reaction.

(3)



(c) There are hydrogen bonds between hydrogen fluoride molecules.

Describe how a hydrogen bond forms between two hydrogen fluoride molecules.

(2)

You may include a diagram to support your answer.

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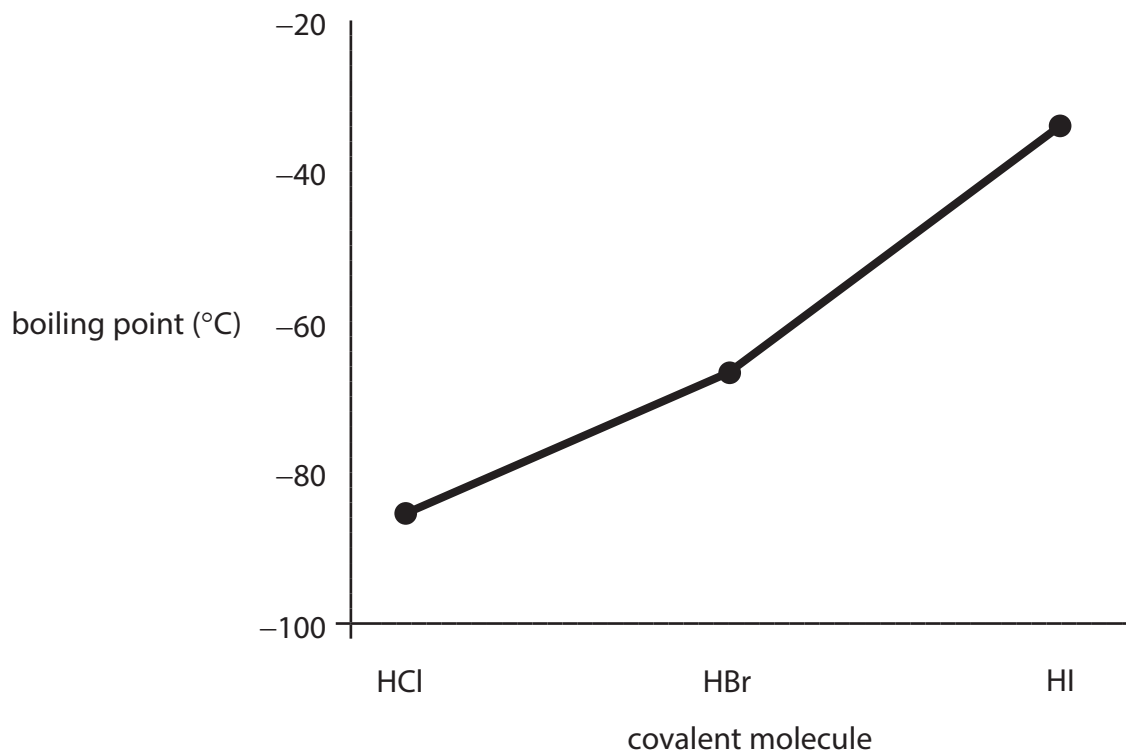
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(d) Figure 3 shows a graph of the boiling points of hydrogen chloride, hydrogen bromide and hydrogen iodide.



**Figure 3**

Explain, in terms of intermolecular forces, the change in boiling point from hydrogen chloride to hydrogen iodide.

(3)

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(Total for Question 3 = 10 marks)



4 Table 1 shows the bond lengths and bond energies of three covalent bonds.

covalent bond	bond length (nm)	bond energy (kJ mol <sup>-1</sup> )
C=C	0.134	612
C-C	0.154	347
C-Br	0.194	285

**Table 1**

Discuss the relative strength of the **three** covalent bonds.

You should use the information in Table 1 to support your answer.

(6)

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**(Total for Question 4 = 6 marks)**

**TOTAL FOR SECTION B = 30 MARKS**



