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Candidate surname

Other names

Pearson BTEC Level 3
Nationals Certificate,
Extended Certificate,
Foundation Diploma,
Diploma, Extended
Diploma

Centre Number

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 in a box . 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)

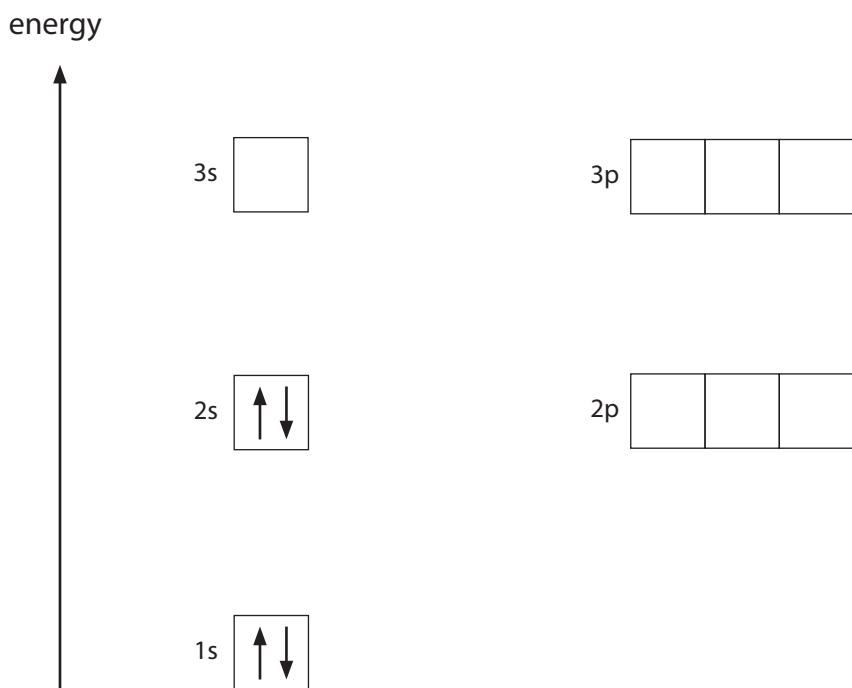


Figure 1



(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)

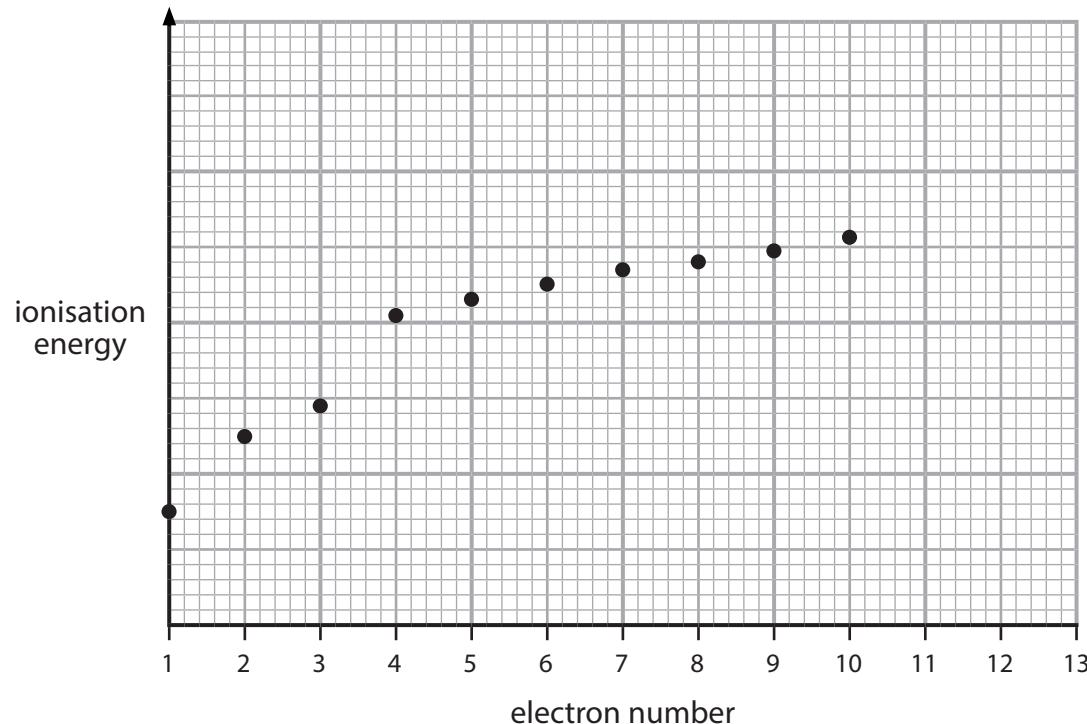


Figure 2

(Total for Question 1 = 5 marks)



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 (Na^+) and sulfate ions (SO_4^{2-}).

(i) Complete Sentence 1.

(1)

The sodium atom (Na) becomes the sodium ion (Na^+) by
an electron.

Sentence 1

(ii) Identify the oxidation number of sulfur in the sulfate ion, SO_4^{2-} .

(1)

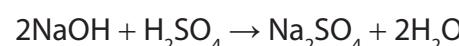
- A +2
- B +4
- C +6
- D +8



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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, Na_2SO_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 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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P 6 7 5 0 4 A 0 7 1 2

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

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

(2)

property 1

.....
.....

property 2

.....
.....

- (b) Hydrogen (H_2) 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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- (d) Figure 3 shows a graph of the boiling points of hydrogen chloride, hydrogen bromide and hydrogen iodide.

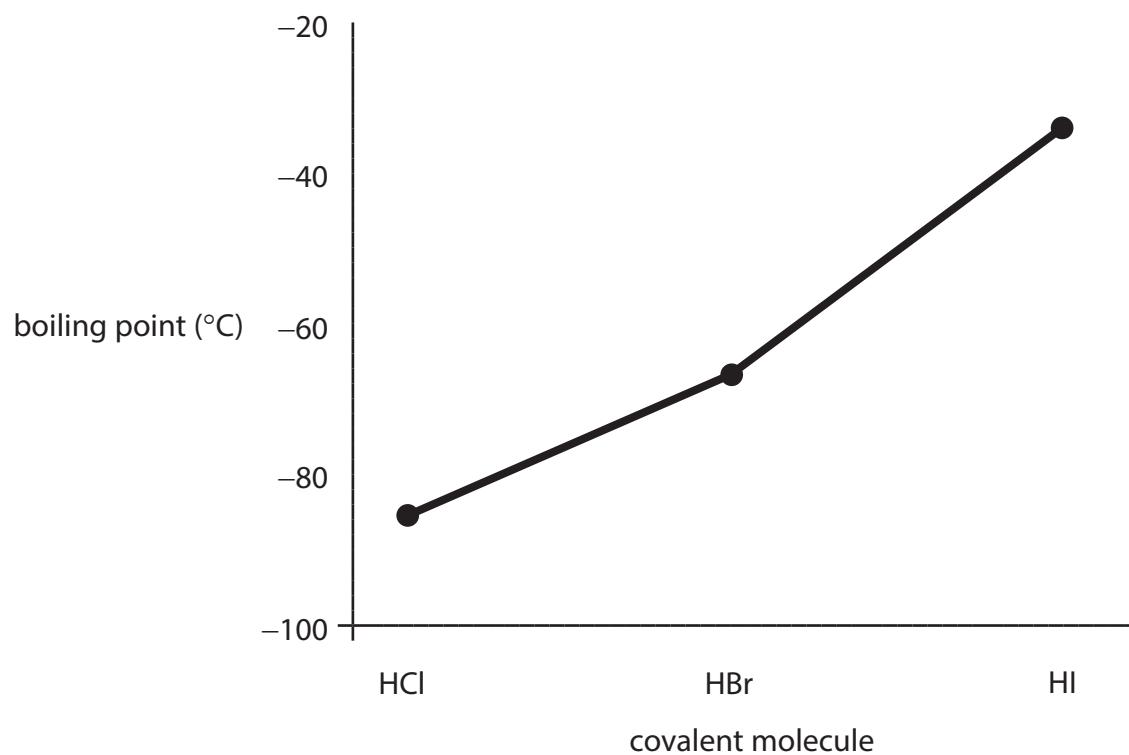


Figure 3

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

(3)

(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⁻¹)
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



The Periodic Table of Elements

(1)	(2)	Key										
		relative atomic mass atomic symbol name atomic (proton) number										
6.9 Li lithium 3	9.0 Be beryllium 4	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	
23.0 Na sodium 11	24.3 Mg magnesium 12	39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.7 Co cobalt 27	63.5 Cu copper 29	
85.5 Rb rubidium 37	87.6 Sr strontium 38	91.2 Y yttrium 39	92.9 Zr zirconium 40	95.9 Nb niobium 41	[98] Mo molybdenum 42	[98] Tc technetium 43	[98] Ru ruthenium 44	[98] Rh rhodium 45	102.9 Pd palladium 46	106.4 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La* lanthanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	204.4 Hg mercury 80	207.2 Tl thallium 81
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[268] Hs hassium 108	[271] Mt meitnerium 109	[272] Rg roentgenium 110	[272] Rg roentgenium 111		
Elements with atomic numbers 112-116 have been reported but not fully authenticated												

* Lanthanide series
* Actinide series

140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	[147] Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	163 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
232 Th thorium 90	[231] Pa protactinium 91	238 U uranium 92	[237] Np neptunium 93	[242] Pu plutonium 94	[243] Am americium 95	[247] Cm curium 96	[245] Bk berkelium 97	[251] Cf californium 98	[254] Es einsteinium 99	[253] Fm fermium 100	[256] Md mendelevium 101	[254] No nobelium 102	[257] Lr lawrencium 103



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