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# Applied Science

**Unit 1: Principles and Applications of Science I**  
**Chemistry**  
**SECTION B: PERIODICITY AND PROPERTIES OF ELEMENTS**

Friday 25 May 2018 – Morning <b>Time: 40 minutes</b>	Paper Reference <b>31617H/1C</b>
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<b>You must have:</b> A calculator	Total Marks
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### 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 is comprised of 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 Hydrocarbons are molecules which are made of hydrogen and carbon only.

The bonding between atoms of hydrogen and carbon is covalent.

(a) (i) State what is meant by the term **covalent bond**.

(2)

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(ii) Methane is a hydrocarbon and has the molecular formula CH<sub>4</sub>.

Draw a dot-and-cross diagram for a molecule of methane.  
Show outer electrons only.

(2)

(b) The melting point of methane is -182 °C.

Explain, in terms of intermolecular forces, the melting point of methane.

(3)

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(Total for Question 1 = 7 marks)



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2 (a) A phosphorus atom contains 15 electrons.

Complete the electronic configuration for a phosphorus atom.

(2)



(b) An oxygen atom contains 8 electrons.

Complete Figure 1 to show the arrangement of electrons in an oxygen atom.

(2)

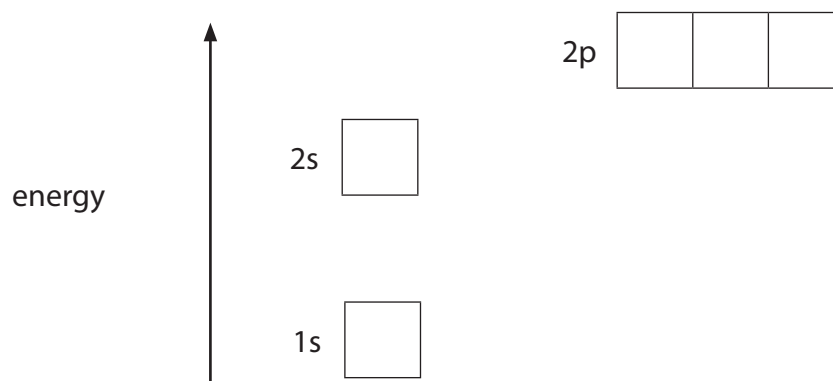


Figure 1

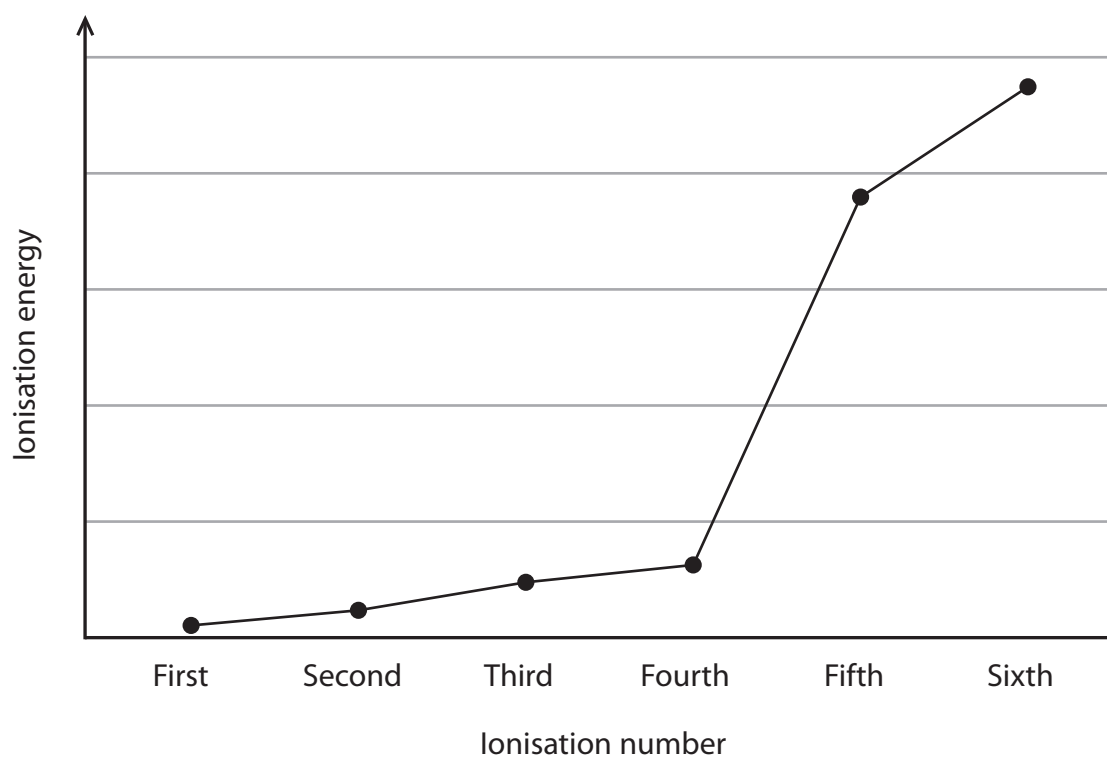
(c) Which equation shows the first ionisation of potassium?

(1)

- A  $K(g) \rightarrow K^-(g) + e^-$
- B  $K^-(g) \rightarrow K^+(g) + e^-$
- C  $K^+(g) \rightarrow K^-(g) + e^-$
- D  $K(g) \rightarrow K^+(g) + e^-$



(d) Figure 2 shows the first six ionisation energies of an unknown element.



**Figure 2**

Identify the group number in which this element can be found.

(1)

- A** 1
- B** 2
- C** 4
- D** 6

(Total for Question 2 = 6 marks)



3 Calcium is a metal.

Word equations for two reactions of calcium are shown.

calcium + oxygen → calcium oxide

calcium + hydrochloric acid → calcium chloride + hydrogen

(a) Complete the word equation for the reaction of calcium with sulfuric acid.

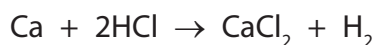
(2)

calcium + sulfuric acid → .....

(b) Write the balanced equation for the reaction of calcium, Ca, with oxygen.

(2)

(c) The equation for the reaction of dilute hydrochloric acid with calcium is



Calculate the maximum mass of calcium chloride produced by reacting 8.02 grams of calcium with excess hydrochloric acid.

relative atomic mass: Ca = 40.1

relative formula mass: CaCl<sub>2</sub> = 111.1

Show your working.

(3)

Maximum mass = .....g

**(Total for Question 3 = 7 marks)**



4 Manganese, Mn, is a metal.

It has a metallic structure.

(a) Explain why metals are malleable.

(2)

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(b)  $\text{KMnO}_4$  is a useful compound of manganese.

Calculate the relative formula mass for  $\text{KMnO}_4$ .

(2)

relative formula mass = .....

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(c) Manganese and zinc are both metals in the d block of the periodic table.

Table 1 shows some information about manganese and zinc.

metal	short electronic configuration	common oxidation states
manganese	[Ar] 3d <sup>5</sup> 4s <sup>2</sup>	+2, +4, +7
zinc	[Ar] 3d <sup>10</sup> 4s <sup>2</sup>	+2

**Table 1**

Discuss why manganese is classified as a transition metal, but zinc is not.

(6)

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(Total for Question 4 = 10 marks)

TOTAL FOR PAPER = 30 MARKS









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