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Level 1 Chemistry, 2016

90933 Demonstrate understanding of aspects of selected elements

2.00 p.m. Monday 21 November 2016
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of aspects of selected elements.	Demonstrate in-depth understanding of aspects of selected elements.	Demonstrate comprehensive understanding of aspects of selected elements.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

A periodic table and other reference material are provided in the Resource Booklet L1–CHEMR.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–9 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Merit

TOTAL 15

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QUESTION ONE

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(a) (i) Give TWO physical properties each for the elements magnesium and nitrogen.

Magnesium is a lustrous and malleable metal and is solid at room temperature due to having a high melting point. Nitrogen has a very low boiling point and is a gas at room temperature. It is also ~~insoluble in water~~

(ii) Explain how the formation of magnesium ions differs from the formation of nitrogen ions, and link this to the positions of magnesium and nitrogen on the periodic table.

Magnesium is located in group 2 period on the periodic table, which means that it has 2 valence electrons in its outer shell. In order to become stable it must lose 2 electrons to have a full outer shell and become stable forming Mg^{2+} ions. Nitrogen is located in group 15, period 2 on the periodic table which means it has 5 valence electrons in its outer shell, so it must gain 3 electrons to have a full outer shell and become stable thus forming N^{3-} ions

(b) What similarities and differences do elements in the same **group** of the periodic table show, in:

- the reactions they take part in?
- their reactivity?

Use the elements Li, Na, F, and Cl to illustrate and explain your answer.

In your answer, you should include links to the electron arrangements of these elements.

No chemical equations are needed.

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Lithium and sodium both have the same number of valence electrons (1), so they will both form ions with a +1 charge, i.e. Li^+ & Na^+, while flourine and chlorine both have 7 electrons in their outer shell, thus they will both have to gain 1 electron forming −1 ions, ie: F^- & Cl^-. So elements in the same group form the same charged ions due to having the same number of valence electrons. Since they will have the same number of valence electrons and form the same charged ions, we should expect them to have similar reactions, eg: Lithium and Sodium both react vigorously when added to water, but sodium reacts notably more vigorously than Lithium due to its valence electrons being further away from the centre of the atom.

M5

QUESTION TWO

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Iron is a very useful metal because its physical properties make it suitable for uses such as car bodies, framing, and roofs. Iron is often alloyed (combined) with carbon to form steel.

(a) (i) Describe why alloying iron with carbon to form steel makes it more useful, with reference to the relevant physical and chemical properties of steel.

Adding carbon to the iron makes the steel harder and ~~steel~~ less malleable. This allows the new alloyed iron (steel) to take on more force before it breaks as pure iron is.

U.

(ii) For the reaction of iron with oxygen:

- complete the word equation in the box below
- give the balanced symbol equation in the box below.

Word equation:

iron + oxygen → iron oxide

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Balanced symbol equation:

$2Fe + O_2 \longrightarrow 2FeO$

(b) Iron and steel can be galvanised with zinc.

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Explain how the physical and chemical properties of zinc make it suitable for galvanising iron/steel.

You may refer to the activity series in your resource booklet.

Zinc has a lower melting point than steel/iron, so dipping the steel/iron into ~~zinc will deform~~ molten zinc won't deform the iron/steel.

Zinc is also more reactive than iron/steel so when iron/steel is coated in zinc, the zinc will react first with the oxygen in the air forming an unreactive layer of zinc oxide that will protect the iron/steel by preventing moisture and oxygen from reacting with it.

M5

QUESTION THREE

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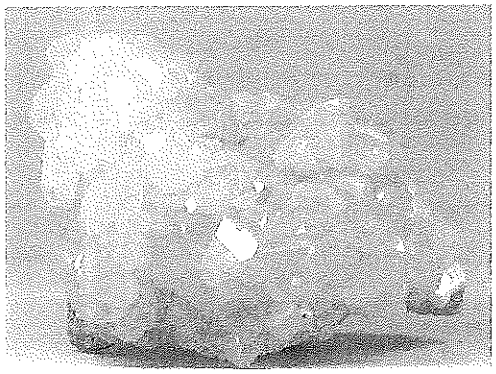
The elements sulfur, S_8, and diamond, C, are both important in many manufacturing processes.



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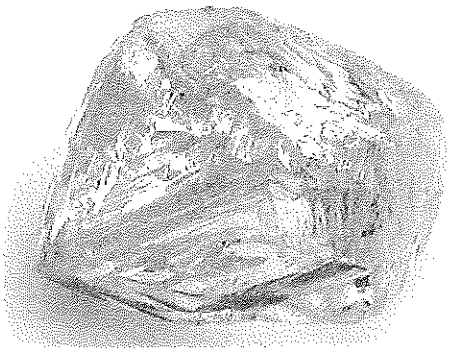

http://www.safarinsouthafrica.com/day-safaris/diamonds-tour.html

(a) Give TWO ways that the two elements are different in their physical properties.

Diamond is harder than sulfur, as diamond has a 3-D tetrahedral structure, U

Diamond is colourless and transparent//

(b) Carbon exists in different forms, called allotropes, which allow it to be used for a wide variety of uses. Two common uses for carbon allotropes are:

- pencil tips
- miniature wires in electrical circuits.

Complete the table below by naming the allotrope of carbon that is most likely to be used for each of the uses given above.

Explain your choice by linking the uses to the properties of each allotrope.

Use	Carbon allotrope
pencil tips	//Graphite// U
miniature wires in electrical circuits	//Graphene//

Explanation

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Pencil tips: Graphite is made up of many 2D sheets of carbon which form layers. The layers of graphite are able to slide over each other which makes it ideal for pencil tips as the sheets are able to slide off onto the paper //

Miniature wires: Graphene is ideal for use as miniture wires as it has a free delocalised ~~el~~ electron that is able to carry a charge which make graphene ~~el~~ electrically conductive. Graphene sheets are also only one atom thick allows it to fit into tight spots on electrical circuits //.

Question Three continues on the following page.

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(c) Oxygen also exists in different forms. Ozone, O_3, is an allotrope of oxygen, O_2.

Give one use for each of the allotropes, O_2 and O_3, and link each use to a physical and a chemical property of the allotrope.

Support your answer with balanced symbol equations, where relevant.

Ozone is used to disinfect water as it is a strong oxidizer. When ozone comes into contact with microorganisms in the water it oxidizes the outer cell wall, letting the contents of the cell leak out thus killing it. Ozone is a gas at room temperature which means it can be bubbled into water tanks and open contact with the organism's cell wall. It reverts back into oxygen which leaves no traces behind, ie: does not affect the pH or taste of the water.

Oxygen is used to power rocket engines as it reacts with the hydrogen gas when ignited propelling the rocket upwards. It is a gas at room temperature which means it can be compressed into tanks and stored away, and it is highly flamable which when reacted with hydrogen will release large amounts on energy.

Balanced symbol equations:

$O_2 + 2H_2 \longrightarrow 2H_2O$

M5

Annotated Exemplar Template

Merit exemplar 2016

Subject:	Chemistry	Standard:	90933	Total score:	15

Q	Grade score	Annotation
1	M5	M5 has been awarded here as in part (a)(ii), the candidate has linked the position of each element on the periodic table to the number of valence electrons lost or gained in ion formation. In part (b), the candidate has correctly linked the electron configurations to the similarity in reactions in a group of elements for both groups 1 and 17. To move to Excellence, the candidate could have included (in part (a)(ii)) detail about how the charge on each ion formed, and / or in part (b), included detail as to reasons for the differences in reactivity moving up or down group 1 compared to group 17.
2	M5	Part (b) of the question regarding galvanising of iron / steel with zinc resulted in M5 being awarded as the candidate has: • Linked the melting point of zinc to it being able to be coated onto solid iron / steel. • Linked the reactivity of zinc (stated it is more reactive) to its preferential reaction and therefore protection of iron / steel. The candidate could have lifted their grade into Excellence territory by referencing the positions of zinc and iron to the activity series, and linking this to zinc's use in galvanising.
3	M5	In part (b), the candidate has linked physical properties of graphite to its use in pencil tips and then in part (c), the candidate has linked chemical properties of ozone to its use as a disinfectant. The answer could have been improved upon by, in part (b), correctly identifying carbon nanotubes as the appropriate allotrope for use in miniature circuits with supporting explanation of conductivity. In part (c), the discussion of the O_2 allotrope of oxygen was insufficient and there was no correct symbol equation given to support either the O_3 or O_2 part of the candidates answer.