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VCE Chemistry ½

Metal Reactions & Recycling [1.4]

Test Solutions

20 Marks. 1 Minute Reading. 16 Minutes Writing.

Results:

Test Questions	_____ / 15
Extension	_____ / 5

Section A: Test Questions (15 Marks)

Question 1 (3 marks)

Tick whether the following statements are true or false:

	True	False
a. An aqueous solution refers to one in which a solute has been dissolved in water.	✓	
b. When a metal oxide forms, the entire metal loses its shine including the outside of the metal and the inside of the metal.		✓
c. Francium is the most reactive metal due to it having the lowest first ionisation energy.	✓	
d. Metals with a high electronegativity are more likely to be used for jewellery, due to their low reactivity.	✓	
e. When a group one metal reacts with water, no visible reaction will take place.		✓
f. A circular economy promotes more reuse and transformation than a linear economy, which typically has more waste.	✓	

Space for Personal Notes

Question 2 (9 marks)

Adhvika takes a sample of magnesium, previously stored in oil, and places it on a table. After wiping the oil away, she notices that the magnesium has a characteristic metallic shine to it. However, after looking back at it a few minutes later, she notices the metal is now dull in colour, with little lustre.

a. Explain why the magnesium chunk was previously lustrous, but now lacks that lustre. (3 marks)

Previously magnesium existed in a metallic lattice, in which magnesium cations were dispersed in a sea of delocalised electrons. These electrons on the surface were able to reflect light. However after reacting with oxygen gas an oxide layer is formed which consumes these electrons, meaning less light is reflected.

b. Provide the equation for the reaction taking place. (1 mark)

$2Mg(s) + O_2(g) \rightarrow 2MgO(s)$

c. Curious by her observations, Adhvika places the magnesium chunk into water, in hopes of restoring the shine on the metal. However, when she does this, she instead experiences a fiery explosion.

i. Provide the equation for the reaction occurring. (1 mark)

$Mg(s) + 2H_2O(l) \rightarrow Mg(OH)_2(aq) + H_2(g)$

ii. Explain why a fiery explosion occurs in this reaction. (2 marks)

When magnesium reacts with water, one of the byproducts produced is hydrogen gas. Hydrogen gas is extremely explosive, and ignites very easily to release lots of thermal energy.

d. How instead would Adhvika be able to restore the shine of her magnesium chunk? (2 marks)

Adhvika can simply cut the magnesium block, and shed away the outside layer. This would allow the inside magnesium to be exposed in the lattice, which still has free unreacted delocalised electrons.

Question 3 (3 marks)

Chemists across the world are looking for ways to move from a circular economy towards a linear economy. As part of this process, many chemists are looking into the ways in which the metals inside of electronics such as phones can be recycled, however there has been little progress. What is the difference between the two aforementioned economies, and why is there difficulty with recycling metals in electronics?

A linear economy refers to one in which resources are mined/obtained , used and then discarded. On the other hand, a circular economy is one which resources are recycled and repurposed in order to minimise waste. For small electronic devices such as phones, it is often energy and cost inefficient to recycle the small metal parts inside of them.

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Section B: Extension (5 Marks)

Question 4 (5 marks)

Neer, known for reacting to a range of different chemicals and reporting his observations, takes some time out of his day to react to some group 1 and 2 metals with water. Neer considers a reaction between both calcium and water and caesium and water.

a. Which of the following chemicals will react more vigorously with the water and why? (2 marks)

Caesium. Caesium is in group 1, and as a result has a lower core change. Further, it has more electron shells meaning the valence electrons are further from the core. This means that the first ionisation energy is lower.

b. Provide the formula for the reaction between calcium and water. (1 mark)

$$Ca(s) + 2H_2O(l) \rightarrow Ca(OH)_2(ag) + H_2(g)$$

c. Why does dull calcium not react rapidly with water, whereas lustrous calcium has a strong and violent reaction with water? (2 marks)

When calcium is dull, it has an oxidised layer on its outside. This layer, prevents the pure calcium in the core form coming into contact with water. As a result, there is less of a prominent reaction between oxidised calcium and water.

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