

## Metals – 2021 O Level

1. Nov/2021/Paper\_11/No.31

Different metals react with water in different ways.

Which statement is correct?

- A Calcium does not react with cold water.
- B Iron reacts slowly with steam to produce an oxide of iron and hydrogen.
- C Magnesium reacts with steam to produce magnesium hydroxide and oxygen.
- D Sodium reacts with cold water to produce aqueous sodium oxide and hydrogen.

2. Nov/2021/Paper\_11/No.32

Metal X is more reactive than zinc but less reactive than sodium.

What would be the best method for obtaining metal X from its ore?

- A electrolysis of an aqueous solution of a salt of X
- B electrolysis of the molten oxide of X
- C heating the oxide of X in hydrogen
- D heating the oxide of X with powdered carbon

3. Nov/2021/Paper\_11/No.33

Steel is often galvanised.

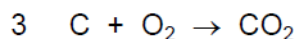
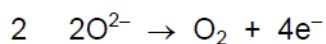
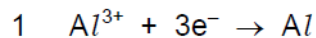
Which statements about galvanising are correct?

- 1 Galvanising makes a steel alloy.
- 2 Galvanising provides a sacrificial protection against rusting.
- 3 Galvanising coats a layer of zinc onto steel.

- A 1 and 2 only    B 1 and 3 only    C 2 and 3 only    D 1, 2 and 3

4. Nov/2021/Paper\_11/No.34

In the extraction of aluminium from aluminium oxide, the following three reactions take place.



Which reactions take place at the positive electrode?

- A** 1 only      **B** 2 only      **C** 1 and 3      **D** 2 and 3

5. Nov/2021/Paper\_12/No.31

The table gives properties of four metals, P, Q, R and S.

	method of extraction	reaction with water	reaction with acid
P	electrolysis only	no reaction	reacts slowly
Q	heating oxide with carbon	reacts slowly with steam	reacts slowly
R	electrolysis only	reacts rapidly with steam	reacts rapidly
S	heating oxide with carbon	no reaction	no reaction

Which statement is correct?

- A** P is the least reactive.  
**B** Q would displace R from a solution of its salt.  
**C** R could be zinc.  
**D** S could be copper.

6. Nov/2021/Paper\_12/No.32

Which statements about extracting metals from their ores are correct?

- 1 Aluminium is extracted by the electrolysis of aluminium oxide dissolved in cryolite.
- 2 Silver is difficult to extract from its ores because of its low reactivity.
- 3 Iron is extracted from haematite by reduction in the blast furnace.

- A** 1 and 2 only      **B** 1 and 3 only      **C** 2 and 3 only      **D** 1, 2 and 3

7. Nov/2021/Paper\_12/No.33

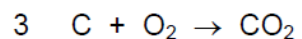
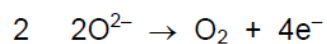
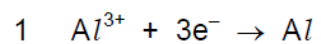
Which statements about the corrosion of iron are correct?

- 1 Corrosion can be prevented by coating the iron with zinc.
- 2 Corrosion only occurs in the presence of both air and water.
- 3 Rust is an alloy of iron and oxygen.
- 4 Sacrificial protection occurs when iron is connected to a less reactive metal.

A 1 and 2      B 1 and 3      C 2 and 4      D 3 and 4

8. Nov/2021/Paper\_12/No.34

In the extraction of aluminium from aluminium oxide, the following three reactions take place.



Which reactions take place at the positive electrode?

A 1 only      B 2 only      C 1 and 3      D 2 and 3



This question is about metals and metal compounds.

(a) Silver is a transition element. Potassium is a metal in Group I of the Periodic Table.

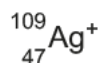
State two differences in the physical properties of silver and potassium.

1 .....

2 .....

[2]

(b) An ion of silver has the symbol



Deduce the number of protons, neutrons and electrons in this ion.

number of protons .....

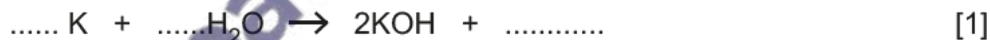
number of neutrons .....

number of electrons .....

[3]

(c) Potassium reacts with water to form a gas which 'pops' with a lighted splint.

Complete the equation for this reaction.



(d) When zinc carbonate is warmed in a closed container, an equilibrium mixture is formed.



The forward reaction is endothermic.

(i) Describe and explain the effect, if any, on the position of equilibrium when the temperature is decreased.

.....

.....

..... [2]

(ii) Describe and explain the effect, if any, on the position of equilibrium when the concentration of carbon dioxide is increased.

.....  
.....  
..... [2]

[Total: 10]

10. Jun/2021/Paper\_11/No.26

Some properties which indicate the differences in elements are listed.

- 1 metallic character
- 2 number of electron shells in an atom
- 3 number of protons in an atom
- 4 total number of electrons in an atom

Which two properties increase across a period of the Periodic Table?

- A** 1 and 2      **B** 1 and 3      **C** 2 and 4      **D** 3 and 4

11. Jun/2021/Paper\_11/No.29

The properties of four substances are shown.

Which substance is a metal?

- A** It conducts electricity when dissolved in water but not when solid.
- B** It has a high melting point and conducts heat when solid.
- C** It has a low melting point and is brittle.
- D** It has a giant covalent structure with a high melting point.

12. Jun/2021/Paper\_11/No.31

Tin is more reactive than lead but less reactive than iron.

Which method would be most suitable for extracting tin from its ore?

- A** electrolysis
- B** heating alone
- C** heating with carbon
- D** reacting with hydrogen

13. Jun/2021/Paper\_11/No.32

Attaching pieces of magnesium to underground iron pipes can protect the iron from corrosion.

Which reaction protects the iron from corrosion?

- A  $\text{Fe}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Fe}(\text{s})$
- B  $\text{Fe}(\text{s}) \rightarrow \text{Fe}^{2+}(\text{aq}) + 2\text{e}^{-}$
- C  $\text{Mg}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Mg}(\text{s})$
- D  $\text{Mg}(\text{s}) \rightarrow \text{Mg}^{2+}(\text{aq}) + 2\text{e}^{-}$

14. Jun/2021/Paper\_11/No.33

Which reactions take place during the extraction of aluminium from aluminium oxide using carbon electrodes?

- 1  $2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^{-}$
- 2  $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
- 3  $\text{Al}^{2+} + 2\text{e}^{-} \rightarrow \text{Al}$

- A 1 only      B 1 and 2 only      C 2 and 3 only      D 1, 2 and 3

15. Jun/2021/Paper\_12/No.27

Germanium is in Group IV of the Periodic Table. It has a proton number of 32.

Selenium is in Group VI of the Periodic Table. It has a proton number of 34.

Which prediction can be made, based on the positions of germanium and selenium in the Periodic Table?

- A A germanium atom has two more valence electrons than a selenium atom.
- B Germanium forms a  $\text{Ge}^{3+}$  ion and selenium forms an  $\text{Se}^{3-}$  ion.
- C Germanium has more metallic character than selenium.
- D Germanium has similar properties to tellurium, and selenium has similar properties to tin.

16. Jun/2021/Paper\_12/No.31

Three correct statements about aluminium are listed.

- 1 Aluminium is the most common metal in the Earth's crust.
- 2 It is costly to extract aluminium from its ore, bauxite.
- 3 The world's supply of bauxite is limited.

Which statements explain why aluminium should be recycled?

- A 1 and 2 only      B 2 and 3 only      C 3 only      D 1, 2 and 3

17. Jun/2021/Paper\_12/No.32

Attaching pieces of magnesium to underground iron pipes can protect the iron from corrosion.

Which reaction protects the iron from corrosion?

- A  $\text{Fe}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Fe}(\text{s})$
- B  $\text{Fe}(\text{s}) \rightarrow \text{Fe}^{2+}(\text{aq}) + 2\text{e}^{-}$
- C  $\text{Mg}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Mg}(\text{s})$
- D  $\text{Mg}(\text{s}) \rightarrow \text{Mg}^{2+}(\text{aq}) + 2\text{e}^{-}$

18. Jun/2021/Paper\_12/No.33

Iron is extracted from its ore, haematite, in a blast furnace.

Which statement about this extraction process is correct?

- A Air is blown into the blast furnace to react with carbon.
- B At the bottom of a blast furnace a layer of molten iron floats on top of a layer of molten slag.
- C Limestone is decomposed in the blast furnace to produce carbon monoxide.
- D Silicon dioxide, an impurity in the ore, is a basic oxide.

19. Jun/2021/Paper\_12/No.34

Which statement about the preparation and properties of aluminium is correct?

- A Aluminium is obtained by heating aluminium oxide with carbon.
- B Aluminium is produced at the anode by electrolysis of aluminium oxide dissolved in molten cryolite.
- C Aluminium is unreactive as it forms an oxide coating.
- D Aluminium is used in overhead electricity cables as it is a good conductor of electricity and has a high density.

Copper(II) chloride, copper(II) iodide and copper(II) carbonate are ionic compounds.

(a) Predict two physical properties, other than electrical conductivity, of copper(II) chloride.

1. ....

2. ....

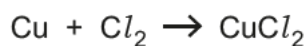
[2]

(b) Copper is a transition element.

Suggest **one** property of copper(II) chloride that is characteristic of a compound of a transition element.

..... [1]

(c) Copper reacts with chlorine to make copper(II) chloride.



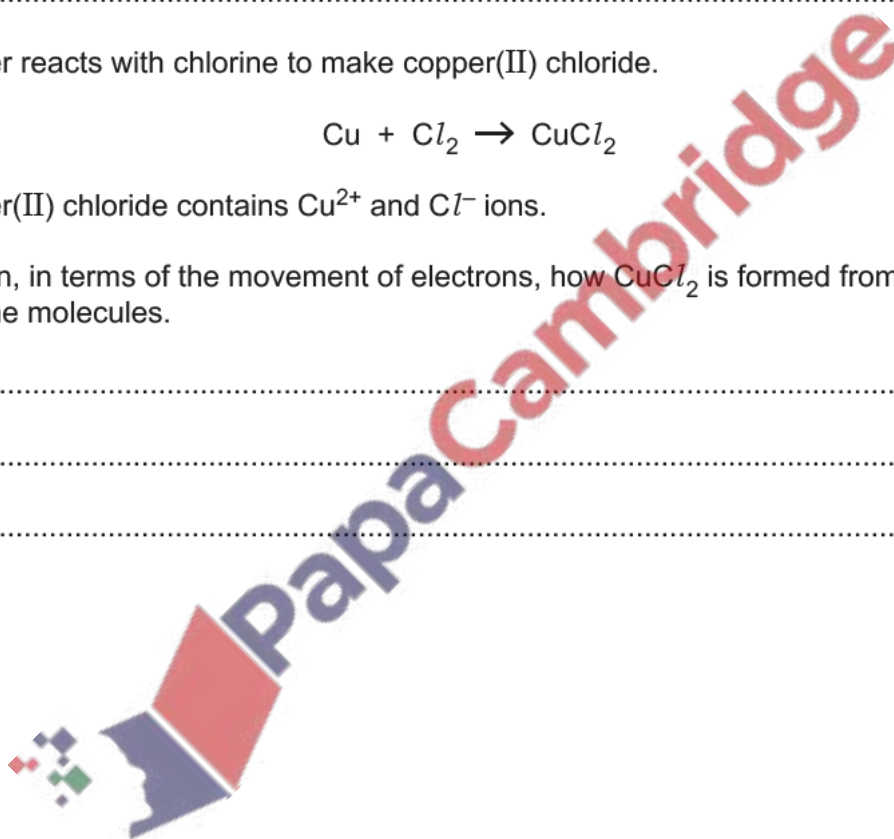
Copper(II) chloride contains  $\text{Cu}^{2+}$  and  $\text{Cl}^-$  ions.

Explain, in terms of the movement of electrons, how  $\text{CuCl}_2$  is formed from copper atoms and chlorine molecules.

.....

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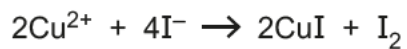
..... [2]





(d) Copper(II) iodide decomposes to make iodine and copper(I) iodide.

The ionic equation for this reaction is shown.



(i) Use the information to explain that oxidation takes place.

.....  
..... [1]

(ii) Use the information to explain that reduction takes place.

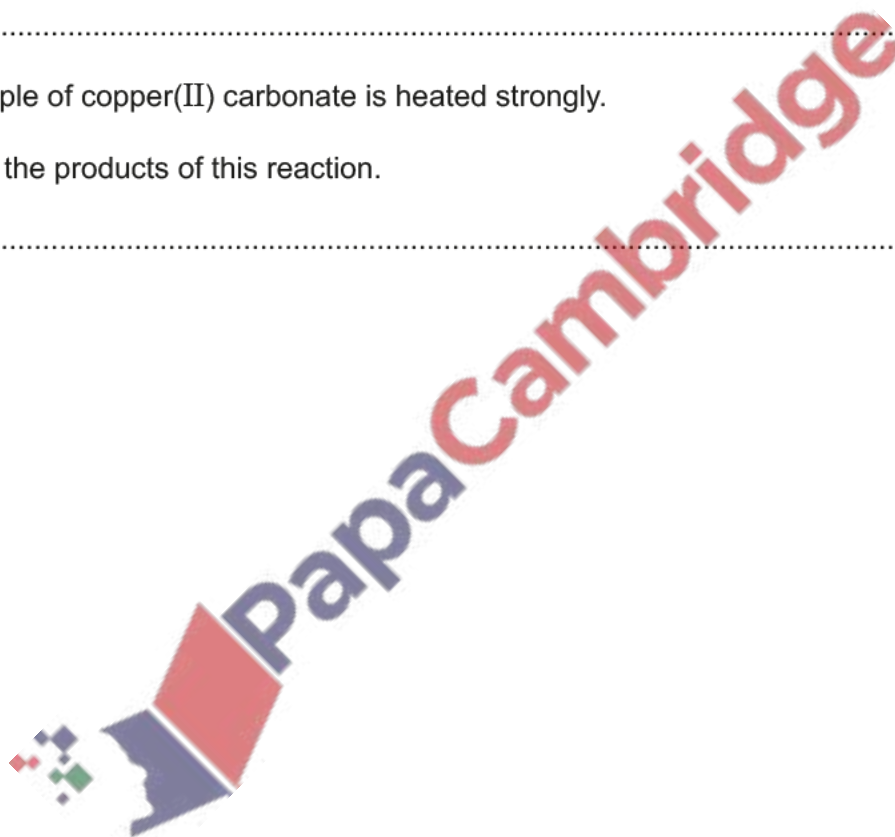
.....  
..... [1]

(e) A sample of copper(II) carbonate is heated strongly.

Name the products of this reaction.

..... [1]

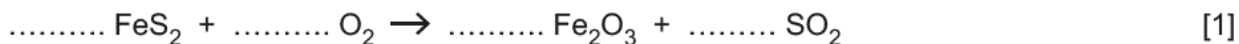
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Iron pyrite, FeS<sub>2</sub>, is an ore of iron.

When heated in air, FeS<sub>2</sub> produces both iron(III) oxide and sulfur dioxide.

(a) Balance the equation shown.



(b) Describe one environmental problem caused by sulfur dioxide in the air.

..... [1]

(c) Describe how sulfur dioxide is converted into sulfuric acid in the contact process.

..... [3]

(d) State one **other** use of sulfur dioxide.

..... [1]

(e) Iron(III) oxide, coke, limestone and hot air are heated together in a blast furnace to make molten iron.

Describe the function in the blast furnace of:

(i) coke

..... [1]

(ii) limestone

..... [1]

(iii) hot air.

..... [1]

[Total: 9]