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Phone: +442081445350

www.chemistryonlinetuition.com

Email: asherrana@chemistryonlinetuition.com

CHEMISTRY

Physical Chemistry

Level & Board	AQA (A-LEVEL)
TOPIC:	Oxidation Reducation & Redox
PAPER TYPE:	QUESTION PAPER - 3
TOTAL QUESTIONS	10
TOTAL MARKS	30

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Oxidation, Reduction and Redox Equations - 3

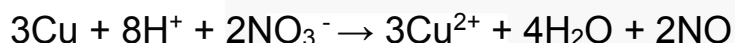
1. Oxidation and reduction can be defined in terms of electron transfer.

(a) Define the term reduction in terms of electrons.

(1)

(b) The oxide of nitrogen formed when copper reacts with nitric acid depends upon the concentration and the temperature of the acid.

The reaction of copper with cold, dilute acid produces NO as indicated by the following equation.



In warm, concentrated acid, NO₂ is formed.

Oxidation states can be used to understand electron transfer in these reactions.

i. Give the oxidation states of nitrogen in NO₃⁻, NO₂ and NO

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(2)

ii. Identify, as oxidation or reduction, the formation of NO₂ from NO₃⁻ ions in the presence of H⁺ ions.
Deduce the half-equation for the reaction.

(2)

- iii. Deduce the half-equation for the formation of NO_2 from NO_3^- ions in the presence of H^+ ions.

(2)

- iv. Deduce the overall equation for the reaction of copper with ions and H^+ ions to produce Cu^{2+} ions, NO_2 and water.

(2)

2. In which reaction is the metal oxidised?

- A. $2\text{Cu}^{2+} + 4\text{I}^- \rightarrow 2\text{CuI} + \text{I}_2$
B. $[\text{Fe}(\text{H}_2\text{O})_6]^{3+} + \text{Cl}^- \rightarrow [\text{Fe}(\text{H}_2\text{O})_5(\text{Cl})]^{2+} + \text{H}_2\text{O}$
C. $[\text{CoCl}_4]^{2-} + 6\text{H}_2\text{O} \rightarrow [\text{Co}(\text{H}_2\text{O})_6]^{2+} + 4\text{Cl}^-$
D. $\text{Mg} + \text{S} \rightarrow \text{MgS}$

(Total 1 mark)

3. This question is about the extraction of metals.
Coke is mainly carbon and is a raw material used in the extraction of iron from iron(III) oxide.

(a) Write an equation for the formation of carbon monoxide from carbon.

(1)

(b) Write an equation for the reduction of iron(III) oxide to iron by carbon monoxide.

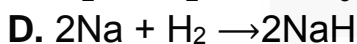
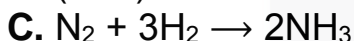
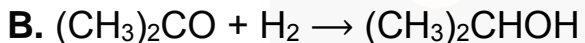
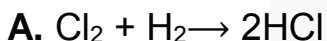
(1)

(c) The Earth's resources of iron(III) oxide are very large and commercial ores have a high iron content.

Give one economic and one environmental reason for recycling scrap iron and steel.

(2)

4. In which reaction is hydrogen acting as an oxidising agent?



(Total 1 mark)

5. This question is about the extraction of metals.

Pure titanium is extracted by the reduction of titanium(IV) chloride, but not by the direct reduction of titanium(IV) oxide using carbon.

(a) Write an equation for the conversion of titanium(IV) oxide into titanium(IV) chloride.

(2)

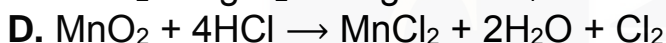
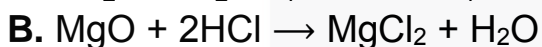
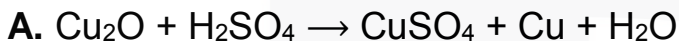
(b) Write an equation for the extraction of titanium from titanium(IV) chloride

(2)

(c) State why titanium is not extracted directly from titanium(IV) oxide using carbon.

(1)

6. Which of these is not a redox reaction?



(Total 1 mark)

7. This question is about the extraction of metals.

Aluminium is extracted by the electrolysis of a molten mixture containing aluminium oxide.

(a) State why the electrolysis needs to be of a molten mixture.

(1)

(b) Write an equation for the reaction of oxide ions at the positive electrode during the electrolysis.

(1)

(c) State why the positive electrodes need frequent replacement.

(1)

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(d) Give the major reason why it is less expensive to recycle aluminium than to extract it from aluminium oxide by electrolysis.

(1)

8. Which of the following shows chlorine in its correct oxidation states in the compounds shown?

	HCl	HClO	KClO ₃
A.	-1	+3	+1
B.	+1	-5	-1
C.	-1	+5	+1
D.	+1	+5	-1

(Total 1 mark)

9. Which of these shows nitrogen in its correct oxidation states in the compounds given?

	NH ₃	N ₂ O	HNO ₂
A.	+3	-1	+5
B.	-3	+1	+3
C.	-3	+1	-5
D.	+3	-1	-3

(Total 1 mark)

10. The term oxidation was used originally to describe a reaction in which a substance gained oxygen. The oxygen was provided by the oxidising agent.

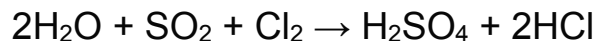
Later the definition of oxidation was revised when the importance of electron transfer was recognised.

An aqueous solution of sulfur dioxide was reacted in separate experiments as follows.

Reaction 1 with HgO



Reaction 2 with chlorine



(a) In Reaction 1, identify the substance that donates oxygen and therefore is the oxidising agent.

(1)

(b) Show, by writing a half-equation, that this oxidising agent in reaction 1 is an electron acceptor.

(1)

(c) Write a half-equation for the oxidation process occurring in reaction 2.

(1)

(d) Write a half-equation for the reduction process occurring in reaction 2.

(1)

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DR. ASHAR RANA
M.B.B.S / MS. CHEMISTRY



- Founder & CEO of Chemistry Online Tuition Ltd.
- Completed Medicine (M.B.B.S) in 2007
- Tutoring students in UK and worldwide since 2008
- CIE & EDEXCEL Examiner since 2015
- Chemistry, Physics, Math's and Biology Tutor

CONTACT INFORMATION FOR CHEMISTRY ONLINE TUITION

- UK Contact: 02081445350
 - International Phone/WhatsApp: 00442081445350
 - Website: www.chemistryonlinetuition.com
 - Email: asherrana@chemistryonlinetuition.com
- Address: 210-Old Brompton Road, London SW5 OBS, UK