Cambridge Assessment International Education

Cambridge IGCSE™

11: Redox, electrochemistry and Group VII – Topic questions

Paper 4

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
4	2016	June	41
5	2016	November	41
5	2016	November	42

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at www.cambridgeinternational.org/support

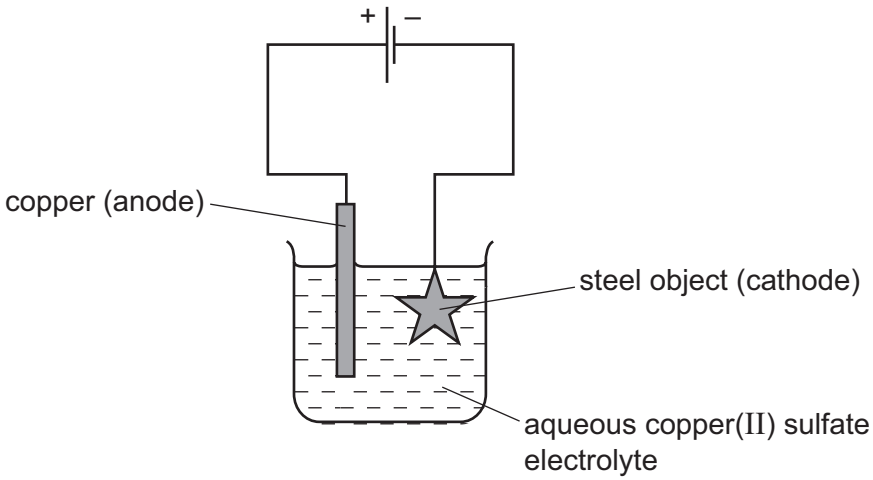
4 Electroplating steel objects with silver involves a three-step process.

step 1 A coating of copper is applied to the object.

step 2 A coating of nickel is applied to the object.

step 3 The coating of silver is applied to the object.

(a) A diagram of the apparatus used for **step 1** is shown.



(i) The chemical process taking place on the surface of the object is

$$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$$

Explain whether this process is oxidation or reduction.

.....

..... [1]

(ii) Explain why the concentration of copper ions in the electrolyte remains constant throughout **step 1**.

.....

.....

..... [2]

(b) Give **two** changes which would be needed in order to coat nickel onto the object in **step 2**.

.....

.....

.....

..... [2]

(c) Copper, nickel and silver are transition elements.
Typical physical properties of transition elements are a high density and a high melting point.

Give **three** different properties of transition metals which are not typical of other metals.

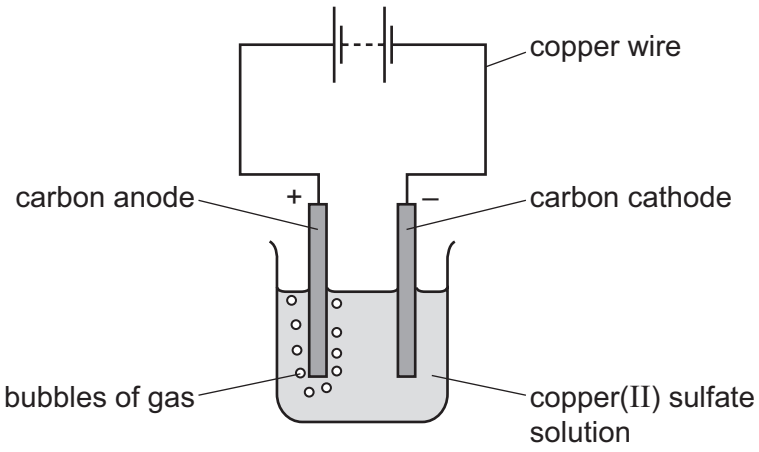
.....

.....

..... [3]

[Total: 8]

5 Copper(II) sulfate solution was electrolysed using the apparatus shown.



(a) A gas was formed at the anode.

Identify this gas and give the test for this gas.

gas .....

test .....

result of test .....

[3]

(b) During electrolysis, electricity passes through the copper(II) sulfate solution.

Solid copper(II) sulfate does not conduct electricity.

Explain **both** of these statements.

.....

.....

.....

.....

..... [3]

(c) The electrolysis was repeated using copper electrodes in place of carbon electrodes. The ionic half-equations for the reactions at the two electrodes are shown.

anode $Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$

cathode $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

(i) Which species is reduced during the electrolysis? Explain your answer.

.....

.....

..... [2]

(ii) The masses of the copper electrodes changed during the electrolysis.

State how **and** explain why the masses of the **two** copper electrodes changed.
Use the ionic half-equations to help you.

.....

.....

.....

.....

.....

.....

..... [3]

(iii) Explain why, during the electrolysis, the colour of the copper(II) sulfate solution does **not** change.

.....

.....

..... [1]

[Total: 12]

5 Chlorine, bromine and iodine are halogens.

(a) Chlorine can be made in the laboratory by heating manganese(IV) oxide with concentrated hydrochloric acid.

$$MnO_2(s) + 4HCl(aq) \rightarrow MnCl_2(aq) + 2H_2O(l) + Cl_2(g)$$

Calculate the volume of 8.00 mol / dm^3 HCl(aq) needed to react with 3.48 g of MnO_2.

- moles of MnO_2 used

..... mol

- moles of HCl needed

..... mol

- volume of HCl needed

..... cm^3

[4]

(b) A student bubbled chlorine gas into a test-tube containing aqueous potassium bromide.

(i) Describe the colour change seen in the test-tube.

from ..... to .....

[2]

(ii) Complete the **ionic** equation for this reaction.

Include state symbols.

$$Cl_2(g) + ...Br^-(aq) \rightarrow ..... + ...$$

[3]

(c) When one mole of bromine, Br_2, reacts with one mole of propene, one organic product is formed.

(i) Which part of the propene molecule reacts with bromine?

..... [1]

(ii) What is the name of the type of reaction which takes place between bromine and propene?

..... [1]

(d) When one mole of chlorine, Cl_2, reacts with one mole of propane, a mixture of two structural isomers is formed.

(i) What is the name of the type of reaction which takes place between chlorine and propane?

..... [1]

(ii) Explain what is meant by the term *structural isomers*.

.....

..... [2]

(iii) Draw the structure of **two** structural isomers formed when **one** mole of chlorine reacts with **one** mole of propane.

[2]

(e) Iodine forms an oxide which has the composition by mass: I, 76.0%; O, 24.0%.

(i) Use this information to determine the empirical formula of this oxide of iodine.

empirical formula ..... [3]

(ii) The oxide of iodine in **(e)(i)** dissolves in water.

Predict and explain the effect of adding Universal Indicator to an aqueous solution of this oxide of iodine.

effect on Universal Indicator .....

explanation .....
[2]

[Total: 21]

Question	Answer	Marks
4 (a) (i)	reduction and (the Cu^{2+} ion / copper ions) is gaining electrons / is decreasing in oxidation number	**1**
4 (a) (ii)	formation of Cu^{2+} / copper ions at the anode happens at the same rate as; removal of Cu^{2+} / copper ions at the cathode ora;	**2** 1 1
4 (b)	replace (anode of) copper with nickel; replace electrolyte with nickel(II) sulfate / $NiSO_4$;	**2** 1 1
4 (c)	(good) catalysts; variable oxidation numbers; form coloured compounds / coloured ions	**3** 1 1 1
		Total: 8
5 (a)	(gas) oxygen (test) glowing splint (result of test) relights	**1** **1** **1**
5 (b)	reference to ions / ionic ions cannot move in solid **OR** are in fixed positions in solid ions can move when in solution	**1** **1** **1**
5 (c) (i)	copper ions / Cu^{2+} gain of electrons / oxidation number decreases	**1** **1**
5 (c) (ii)	any 3 from: anode decreases (in mass) copper removed (from anode) / solid (copper from anode) becomes aqueous cathode increases (in mass) copper deposited / added / Cu^{2+} deposited as Cu (on cathode)	**3**
5 (c) (iii)	copper is both added and removed (at same rate) **OR** the concentration (of copper ions) does not change	**1**
		Total: 12

Continues on next page …

Question	Answer	Marks
5 (a)	20 cm^3 **M1** M_r of MnO_2: 87 **M2** moles of MnO_2 used: 3.48/87 = 0.04 **M3** moles of HCl needed: 0.04 × 4 = 0.16 **M4** volume of HCl needed: (0.16/8.0) × 1000 **AND** 20 cm^3	**4**
5 (b) (i)	from colourless to yellow / orange / brown	**2**
5 (b) (ii)	$Cl_2(g) + 2Br^-(aq) \rightarrow Br_2(aq) + 2Cl^-(aq)$ **M1** (aq) as state symbols for the two products given **M2** correct products **M3** balancing	**3**
5 (c) (i)	the (C=C) double bond	**1**
5 (c) (ii)	addition **OR** bromination	**1**
5 (d) (i)	substitution	**1**
5 (d) (ii)	(compounds with the) same molecular formula different structural formulae or structures	**2**
5 (d) (iii)	structure of 1-chloropropane structure of 2-chloropropane	**2**
5 (e) (i)	I_2O_5 **M1** 76.0/127 **AND** 24.0/16.0 **M2** 0.59 **AND** 1.5 **OR** 1 **AND** 2.5 **M3** I_2O_5	**3**
5 (e) (ii)	(turns) red / pink / orange / yellow iodine is a non-metal	**2**
		Total: 21

