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# SL Paper 1

Which changes could take place at the positive electrode (cathode) in a voltaic cell?

- I.  $\text{Zn}^{2+}(\text{aq})$  to  $\text{Zn}(\text{s})$
  - II.  $\text{Cl}_2(\text{g})$  to  $\text{Cl}^{-}(\text{aq})$
  - III.  $\text{Mg}(\text{s})$  to  $\text{Mg}^{2+}(\text{aq})$
- 
- A. I and II only
  - B. I and III only
  - C. II and III only
  - D. I, II and III

## Markscheme

A

## Examiners report

One respondent commented that a full cell representation should have been given in the question so that candidates could ascertain the direction of electron flow. This question is based on AS 9.4.2 which states that candidates should know that reduction takes place at the cathode and oxidation takes place at the anode. In this question, the correct answer is A, corresponding to I. and II., as in I. zinc changes from a +2 oxidation state in  $\text{Zn}^{2+}(\text{aq})$  to 0 in  $\text{Zn}(\text{s})$ , which is reduction and in II. Chlorine changes from a 0 oxidation state in  $\text{Cl}_2(\text{g})$  to a -1 oxidation state in  $\text{Cl}^{-}(\text{aq})$ . III. is ruled out as magnesium is in a 0 oxidation state in  $\text{Mg}(\text{s})$  and changes to a +2 oxidation state in  $\text{Mg}^{2+}(\text{aq})$  which is oxidation. Hence, it was not necessary to know the direction of electron flow from a representation of the voltaic cell to answer this question. The question was also well answered by candidates with 70% giving A as the correct answer.

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What occurs at the anode (positive electrode) during the electrolysis of molten strontium bromide?

- A. Formation of bromine and oxidation
- B. Formation of bromine and reduction
- C. Formation of strontium and oxidation
- D. Formation of strontium and reduction

## Markscheme

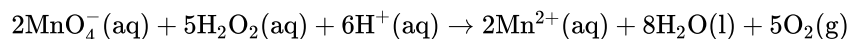
A

## Examiners report

[N/A]

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What happens to the manganese in the following reaction?



- A. It is oxidized and its oxidation number increases.
- B. It is oxidized and its oxidation number decreases.
- C. It is reduced and its oxidation number increases.
- D. It is reduced and its oxidation number decreases.

## Markscheme

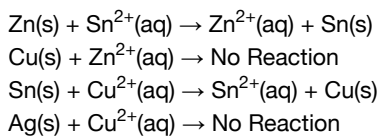
D

## Examiners report

[N/A]

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What is the order of decreasing reactivity of the metals (most reactive first)?



- A. Zn > Cu > Sn > Ag
- B. Sn > Zn > Ag > Cu
- C. Ag > Cu > Zn > Sn
- D. Zn > Sn > Cu > Ag

## Markscheme

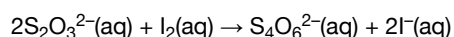
D

## Examiners report

[N/A]

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What is the oxidation half-equation in the redox reaction?



- A.  $\text{I}_2(\text{aq}) + 2\text{e}^- \rightarrow 2\text{I}^-(\text{aq})$
- B.  $2\text{I}^-(\text{aq}) \rightarrow \text{I}_2(\text{aq}) + 2\text{e}^-$
- C.  $2\text{S}_2\text{O}_3^{2-}(\text{aq}) \rightarrow \text{S}_4\text{O}_6^{2-}(\text{aq}) + 2\text{e}^-$
- D.  $\text{S}_4\text{O}_6^{2-}(\text{aq}) + 2\text{e}^- \rightarrow 2\text{S}_2\text{O}_3^{2-}(\text{aq})$

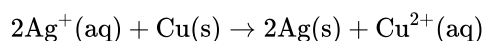
## Markscheme

C

## Examiners report

[N/A]

What occurs during the operation of a voltaic cell based on the following overall reaction?



	External circuit	Ion movement in solution
A.	electrons move from Cu(s) to Ag(s)	$\text{Ag}^+(\text{aq})$ move towards Cu(s)
B.	electrons move from Ag(s) to Cu(s)	$\text{Ag}^+(\text{aq})$ move towards Ag(s)
C.	electrons move from Cu(s) to Ag(s)	$\text{Ag}^+(\text{aq})$ move towards Ag(s)
D.	electrons move from Ag(s) to Cu(s)	$\text{Cu}^{2+}(\text{aq})$ move towards Cu(s)

## Markscheme

C

## Examiners report

There were also two G2 comments on this question. One respondent stated that knowledge of this depth is off-syllabus. This is not correct. Both the movement of ions in solution and across a salt bridge should be covered in the programme. Candidates are expected to know this as part of their understanding of voltaic cells and ion movement has been asked previously in papers. 47.59% got the correct answer C. Although this was a common question with HL, certainly at SL the question was found to be more challenging and performance at HL was invariably better as discussed in the corresponding subject report for HLP1T2Z. At SL, the question was the seventh most difficult question on the paper and had an associated discrimination index of 0.46.

What is the name of  $\text{Cu}_2\text{S}$ ?

- A. Copper(I) sulfide
- B. Copper(I) sulfate
- C. Copper(II) sulfide
- D. Copper(II) sulfate

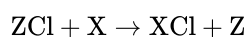
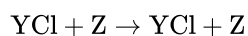
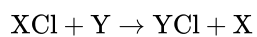
## Markscheme

A

## Examiners report

[N/A]

What is the correct **decreasing** order of reactivity of the metals X, Y and Z based on the following equations?



- A.  $\text{X} > \text{Y} > \text{Z}$
- B.  $\text{Y} > \text{Z} > \text{X}$
- C.  $\text{Z} > \text{Y} > \text{X}$
- D.  $\text{Y} > \text{X} > \text{Z}$

## Markscheme

D

## Examiners report

The two G2 comments on this question both stated that it would have been better if no reaction was given for the second equation, instead of repeating  $\text{YCl} + \text{Z}$  as the products. This is a valid comment. The question however was generally well answered and 69% got the correct answer, D.

Which can describe oxidation?

- A. Loss of hydrogen
- B. Decrease in oxidation number
- C. Gain of electrons

D. Loss of oxygen

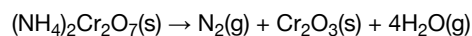
## Markscheme

A

## Examiners report

[N/A]

Which element is reduced in the following decomposition?



- A. N
- B. H
- C. Cr
- D. O

## Markscheme

C

## Examiners report

[N/A]

What is produced at the positive electrode (anode) and negative electrode (cathode) during the electrolysis of molten lithium chloride and molten lead bromide?

LiCl(l)		PbBr <sub>2</sub> (l)	
+	-	+	-
lithium	chlorine	lead	bromine
lithium	chlorine	bromine	lead
chlorine	lithium	lead	bromine
chlorine	lithium	bromine	lead

## Markscheme

D

# Examiners report

[N/A]

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Which of the following is **not** a redox reaction?

- A.  $\text{CH}_4(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow \text{CH}_3\text{Cl}(\text{g}) + \text{HCl}(\text{g})$
- B.  $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$
- C.  $2\text{CO}(\text{g}) \rightarrow \text{CO}_2(\text{g}) + \text{C}(\text{s})$
- D.  $\text{CH}_3\text{COOH}(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{CH}_3\text{COONa}(\text{aq}) + \text{H}_2\text{O}(\text{l})$

## Markscheme

D

# Examiners report

[N/A]

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Which of the following is a redox reaction?

- A.  $3\text{Mg}(\text{s}) + 2\text{AlCl}_3(\text{aq}) \rightarrow 2\text{Al}(\text{s}) + 3\text{MgCl}_2(\text{aq})$
- B.  $\text{SiO}_2(\text{s}) + 2\text{NaOH}(\text{aq}) \rightarrow \text{Na}_2\text{SiO}_3(\text{aq}) + \text{H}_2\text{O}(\text{l})$
- C.  $\text{KCl}(\text{aq}) + \text{AgNO}_3(\text{aq}) \rightarrow \text{AgCl}(\text{s}) + \text{KNO}_3(\text{aq})$
- D.  $2\text{NaHCO}_3(\text{aq}) \rightarrow \text{Na}_2\text{CO}_3(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$

## Markscheme

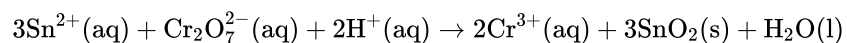
A

# Examiners report

[N/A]

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Consider the following reaction:



Which statement is correct?

- A.  $\text{Sn}^{2+}$  is the oxidizing agent because it undergoes oxidation.
- B.  $\text{Sn}^{2+}$  is the reducing agent because it undergoes oxidation.

C.  $\text{Cr}_2\text{O}_7^{2-}$  is the oxidizing agent because it undergoes oxidation.

D.  $\text{Cr}_2\text{O}_7^{2-}$  is the reducing agent because it undergoes oxidation.

## Markscheme

B

## Examiners report

[N/A]

What happens at the negative electrode in a voltaic cell and in an electrolytic cell?

	Voltaic cell	Electrolytic cell
A.	oxidation	reduction
B.	reduction	oxidation
C.	oxidation	oxidation
D.	reduction	reduction

## Markscheme

A

## Examiners report

[N/A]

Which statement is correct for a voltaic but **not** for an electrolytic cell?

A. An electrolyte is required.

B. The anode is where oxidation occurs.

C. Ions move in the electrolyte.

D. Electrons flow from the negative electrode to the positive electrode.

## Markscheme

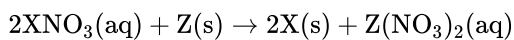
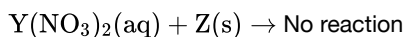
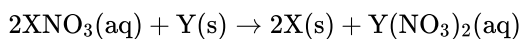
D

## Examiners report

[N/A]

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Consider the following reactions of three unknown metals X, Y and Z.



What is the order of **increasing** reactivity of the metals (least reactive first)?

- A.  $\text{X} < \text{Y} < \text{Z}$
- B.  $\text{X} < \text{Z} < \text{Y}$
- C.  $\text{Z} < \text{Y} < \text{X}$
- D.  $\text{Y} < \text{Z} < \text{X}$

## Markscheme

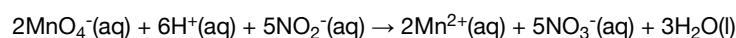
B

## Examiners report

[N/A]

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Which is a correct statement for the reaction below?



- A.  $\text{MnO}_4^-$  is the reducing agent and the oxidation number of Mn increases.
- B.  $\text{MnO}_4^-$  is the oxidizing agent and the oxidation number of Mn decreases.
- C.  $\text{NO}_2^-$  is the reducing agent and the oxidation number of N decreases.
- D.  $\text{NO}_2^-$  is the oxidizing agent and the oxidation number of N increases.

## Markscheme

B

## Examiners report

[N/A]

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Which element has the same oxidation number in both species?

- A. C in  $\text{C}_2\text{H}_4$  and  $\text{CO}_2$
- B. H in  $\text{H}_2\text{O}$  and NaH



- C. S in  $\text{SO}_4^{2-}$  and  $\text{SO}_3$
- D. O in  $\text{H}_2\text{O}_2$  and  $\text{H}_2\text{O}$

## Markscheme

C

## Examiners report

[N/A]

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Consider how current is conducted in an electrolytic cell. Which statement is correct?

- A. Electrons move through the electrolyte and the external circuit.
- B. Ions move through the electrolyte and the external circuit.
- C. Electrons move through the external circuit and ions move through the electrolyte.
- D. Electrons move through the electrolyte and ions move through the external circuit.

## Markscheme

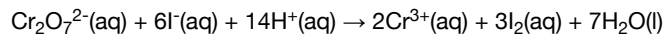
C

## Examiners report

[N/A]

---

Which experimental methods could be used to observe the progress of the following reaction?



- I. Change in colour
- II. Change in mass
- III. Change in electrical conductivity

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

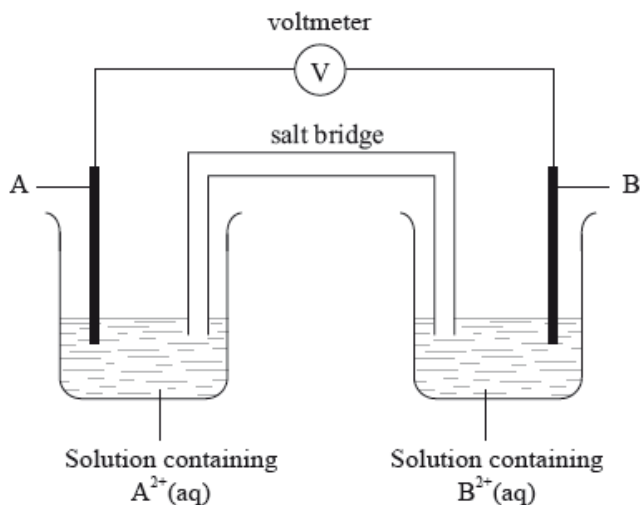
## Markscheme

B

# Examiners report

[N/A]

Metal A is more reactive than metal B. A standard voltaic cell is made as shown.



Which statement is correct?

- A. Electrons flow in the external circuit from A to B.
- B. Positive ions flow through the salt bridge from A to B.
- C. Positive ions flow in the external circuit from B to A.
- D. Electrons flow through the salt bridge from B to A.

## Markscheme

A

# Examiners report

[N/A]

Applying IUPAC rules, what is the name of  $\text{MnO}_2$ ?

- A. Magnesium(II) oxide
- B. Manganese(II) oxide
- C. Magnesium(IV) oxide
- D. Manganese(IV) oxide

## Markscheme

D

# Examiners report

[N/A]

---

Which statements are correct for a voltaic cell?

- I. A spontaneous redox chemical reaction produces electrical energy.
- II. Oxidation occurs at the cathode (negative electrode).
- III. Electrons flow from anode (negative electrode) to cathode (positive electrode).

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

## Markscheme

B

# Examiners report

[N/A]

---

Which of the following redox reactions take place?

- I.  $\text{Cl}_2(\text{aq}) + 2\text{NaI}(\text{aq}) \rightarrow \text{I}_2(\text{aq}) + 2\text{NaCl}(\text{aq})$
- II.  $\text{Br}_2(\text{aq}) + 2\text{NaI}(\text{aq}) \rightarrow \text{I}_2(\text{aq}) + 2\text{NaBr}(\text{aq})$
- III.  $\text{I}_2(\text{aq}) + 2\text{NaBr}(\text{aq}) \rightarrow \text{Br}_2(\text{aq}) + 2\text{NaI}(\text{aq})$

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

## Markscheme

A

# Examiners report

One respondent stated that the wording of the question could have been better if it was stated which of the redox reactions are likely to occur, which is a fair point. The question was one of the more difficult questions on the paper, though 54% did manage to get the correct answer, namely A.

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Metal M has only one oxidation number and forms a compound with the formula  $\text{MCO}_3$ . Which formula is correct?

- A.  $\text{MNO}_3$
- B.  $\text{MNH}_4$
- C.  $\text{MSO}_4$
- D.  $\text{MPO}_4$

## Markscheme

C

## Examiners report

The question proved surprisingly challenging, as indicated by a high number of blank responses and a difficulty index of 55%. This would seem to indicate that a disturbing number of candidates are not aware of the charges on the common ions. It was however a good discriminator with a discrimination index of 0.55.

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Which are redox reactions?

- I.  $2\text{FeCl}_2 + \text{Cl}_2 \rightarrow 2\text{FeCl}_3$
  - II.  $\text{Mg} + 2\text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + \text{H}_2$
  - III.  $\text{H}_2\text{O} + \text{SO}_3 \rightarrow \text{H}_2\text{SO}_4$
- A. I and II only
  - B. I and III only
  - C. II and III only
  - D. I, II and III

## Markscheme

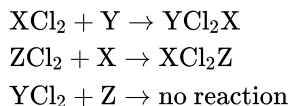
A

## Examiners report

[N/A]

---

What is the correct **increasing** order of reactivity of the metals X, Y and Z based on the following information?



- A.  $Z < X < Y$
- B.  $Y < X < Z$
- C.  $Z < Y < X$
- D.  $X < Z < Y$

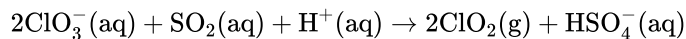
## Markscheme

A

## Examiners report

[N/A]

Which statement is correct for the following reaction?



- A.  $\text{ClO}_3^-$  is the oxidizing agent and it undergoes reduction.
- B.  $\text{ClO}_3^-$  is the reducing agent and it undergoes oxidation.
- C.  $\text{SO}_2$  is the oxidizing agent and it undergoes oxidation.
- D.  $\text{SO}_2$  is the reducing agent and it undergoes reduction.

## Markscheme

A

## Examiners report

[N/A]

What are the products of electrolysis when molten calcium bromide is electrolysed using graphite electrodes?

	Product at cathode (negative electrode)	Product at anode (positive electrode)
A.	calcium	bromine
B.	bromine	calcium
C.	calcium ions	bromide ions
D.	bromide ions	calcium ions

# Markscheme

A

## Examiners report

[N/A]

---

Which statement describes a reducing agent?

- A. It is reduced and gains electrons.
- B. It is reduced and loses electrons.
- C. It is oxidized and gains electrons.
- D. It is oxidized and loses electrons.

# Markscheme

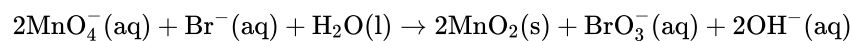
D

## Examiners report

[N/A]

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What is the reducing agent in the reaction below?



- A.  $\text{Br}^-$
- B.  $\text{BrO}_3^-$
- C.  $\text{MnO}_4^-$
- D.  $\text{MnO}_2$

# Markscheme

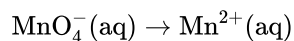
A

## Examiners report

[N/A]

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At which side of the equation are electrons,  $\text{H}^+$  ions and  $\text{H}_2\text{O}$  needed to complete the half-equation?



	Electrons	$\text{H}^+$ ions	$\text{H}_2\text{O}$
A.	reactant side	reactant side	product side
B.	reactant side	product side	reactant side
C.	product side	reactant side	product side
D.	product side	product side	reactant side

## Markscheme

A

## Examiners report

[N/A]

---

Which species could be reduced to form  $\text{NO}_2$ ?

- A.  $\text{N}_2\text{O}$
- B.  $\text{NO}_3^-$
- C.  $\text{HNO}_2$
- D.  $\text{NO}$

## Markscheme

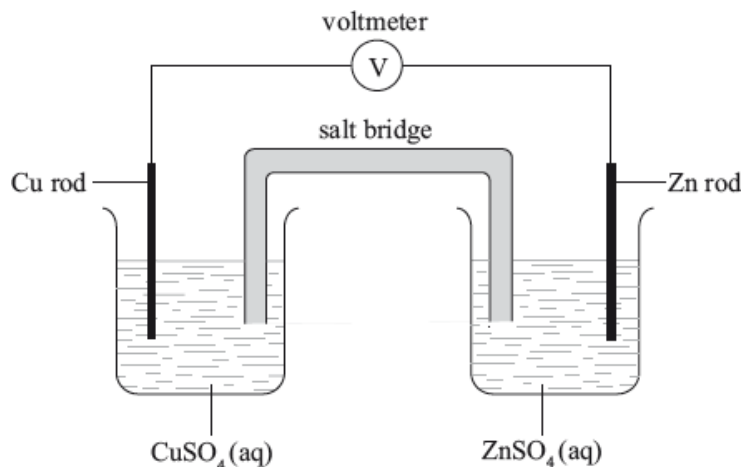
B

## Examiners report

[N/A]

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Zinc is more reactive than copper. In this voltaic cell, which species is reduced and in which direction do negative ions flow in the salt bridge?



	Species reduced	Direction of negative ion flow in salt bridge
A.	$\text{Cu}^{2+}$	from copper half-cell to zinc half-cell
B.	$\text{Cu}^{2+}$	from zinc half-cell to copper half-cell
C.	$\text{Zn}^{2+}$	from copper half-cell to zinc half-cell
D.	$\text{Zn}^{2+}$	from zinc half-cell to copper half-cell

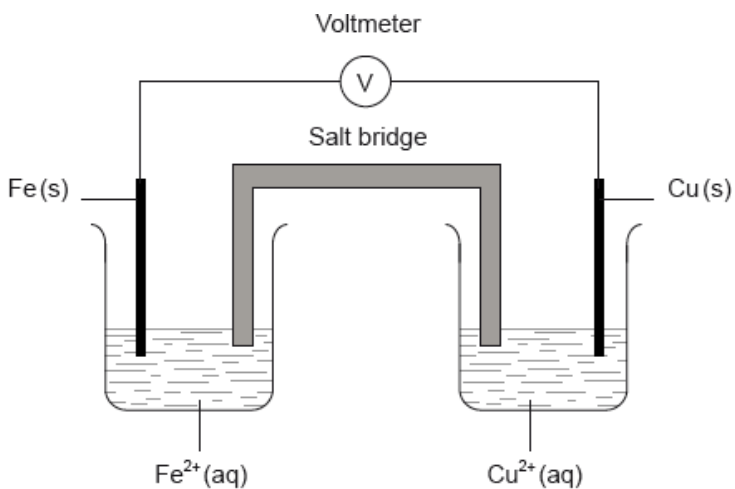
## Markscheme

A

## Examiners report

[N/A]

A voltaic cell is made by connecting a copper half-cell,  $\text{Cu(s)} | \text{Cu}^{2+}(\text{aq})$ , to an iron half-cell  $\text{Fe(s)} | \text{Fe}^{2+}(\text{aq})$ .



Which combination correctly identifies the positive electrode and the species being oxidized?



	Positive electrode	Species oxidized
A.	copper	iron
B.	copper	copper(II) ions
C.	iron	copper
D.	iron	copper(II) ions

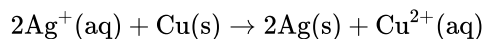
## Markscheme

A

## Examiners report

Questions such as this have been set in the past and we would expect a chemist at this level to have a rudimentary knowledge of metals in an activity series, particularly those as far apart as iron and copper. It was disappointing that less than 50% got this right.

Which species is oxidized in the following reaction?



- A.  $\text{Ag}^+$
- B.  $\text{Cu}$
- C.  $\text{Ag}$
- D.  $\text{Cu}^{2+}$

## Markscheme

B

## Examiners report

[N/A]

Which equation shows oxygen undergoing reduction?

- A.  $2\text{F}_2 + \text{O}_2 \rightarrow 2\text{F}_2\text{O}$
- B.  $\text{Na}_2\text{O} + \text{H}_2\text{O} \rightarrow 2\text{NaOH}$
- C.  $\text{H}_2\text{O}_2 + 2\text{HI} \rightarrow 2\text{H}_2\text{O} + \text{I}_2$
- D.  $2\text{CrO}_4^{2-} + 2\text{H}^+ \rightleftharpoons \text{Cr}_2\text{O}_7^{2-} + \text{H}_2\text{O}$

# Markscheme

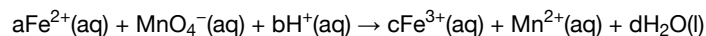
C

## Examiners report

[N/A]

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Which coefficients correctly balance this redox equation?



	a	b	c	d
A.	1	8	1	4
B.	5	4	5	2
C.	3	4	3	2
D.	5	8	5	4

# Markscheme

D

## Examiners report

[N/A]

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Which process occurs during the electrolysis of molten sodium chloride?

- A. Oxidation occurs at the positive electrode (anode).
- B. Electrons move through the electrolyte.
- C. Sodium ions move through the electrolyte to the positive electrode (anode).
- D. Chloride ions move through the electrolyte and are reduced at the negative electrode (cathode).

# Markscheme

A

## Examiners report

[N/A]

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Which process occurs when a molten salt is electrolysed?

- A. The metal ion is oxidized and deposited on the negative electrode (cathode).
- B. The metal ion is reduced and deposited on the negative electrode (cathode).
- C. The metal ion is oxidized and deposited on the positive electrode (anode).
- D. The metal ion is reduced and deposited on the positive electrode (anode).

## Markscheme

B

## Examiners report

[N/A]

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Which statement is correct for the electrolysis of molten lead iodide,  $\text{PbI}_2$ ?

- A. Chemical energy is converted into electrical energy.
- B.  $\text{Pb}^{2+}$  ions are oxidized at the negative electrode (cathode).
- C.  $\text{I}_2$  is produced at the positive electrode (anode).
- D. Ions are produced at both electrodes.

## Markscheme

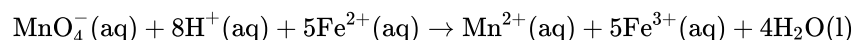
C

## Examiners report

[N/A]

---

Consider the following reaction.



Which statement is correct?

- A.  $\text{MnO}_4^-$  is the oxidizing agent and it loses electrons.
- B.  $\text{MnO}_4^-$  is the reducing agent and it loses electrons.
- C.  $\text{MnO}_4^-$  is the oxidizing agent and it gains electrons.
- D.  $\text{MnO}_4^-$  is the reducing agent and it gains electrons.

# Markscheme

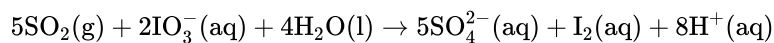
C

## Examiners report

[N/A]

---

Which is the oxidizing agent in the following reaction?



- A.  $\text{SO}_2$
- B.  $\text{IO}_3^-$
- C.  $\text{H}_2\text{O}$
- D.  $\text{SO}_4^{2-}$

# Markscheme

B

## Examiners report

[N/A]

---

What are the products of the electrolysis of molten zinc bromide?

	Negative electrode (cathode)	Positive electrode (anode)
A.	zinc	bromine
B.	hydrogen	bromine
C.	bromine	zinc
D.	bromine	hydrogen

# Markscheme

A

## Examiners report

[N/A]

---

Which represents a redox reaction?

- A.  $\text{NaH(s)} + \text{H}_2\text{O(l)} \rightarrow \text{NaOH(aq)} + \text{H}_2\text{(g)}$
- B.  $\text{CaCO}_3\text{(s)} \rightarrow \text{CaO(s)} + \text{CO}_2\text{(g)}$
- C.  $\text{CuCl}_2\text{(aq)} + \text{K}_2\text{S(aq)} \rightarrow \text{CuS(s)} + 2\text{KCl(aq)}$
- D.  $\text{HCl(aq)} + \text{NH}_3\text{(aq)} \rightarrow \text{NH}_4^+\text{CL}^-\text{(aq)}$

## Markscheme

A

## Examiners report

[N/A]

---

Which list represents the halogens in **increasing** order of oxidizing strength (weakest oxidizing agent first)?

- A.  $\text{Cl}_2$   $\text{I}_2$   $\text{Br}_2$
- B.  $\text{I}_2$   $\text{Br}_2$   $\text{Cl}_2$
- C.  $\text{I}_2$   $\text{Cl}_2$   $\text{Br}_2$
- D.  $\text{Cl}_2$   $\text{Br}_2$   $\text{I}_2$

## Markscheme

B

## Examiners report

[N/A]

---

Which statement about the electrolysis of molten sodium chloride is correct?

- A. A yellow-green gas would be produced at the negative electrode.
- B. A silvery metal is produced at the positive electrode.
- C. Chloride ions are attracted to the positive electrode and undergo oxidation.
- D. Sodium ions are attracted to the negative electrode and undergo oxidation.

## Markscheme

C

## Examiners report

[N/A]

---

What happens to iodine when iodate ions,  $\text{IO}_3^-$ , are converted to iodine molecules,  $\text{I}_2$ ?

- A. It undergoes reduction and its oxidation number changes from  $-1$  to  $0$
- B. It undergoes oxidation and its oxidation number changes from  $-1$  to  $0$
- C. It undergoes reduction and its oxidation number changes from  $+5$  to  $0$
- D. It undergoes oxidation and its oxidation number changes from  $+5$  to  $0$

## Markscheme

C

## Examiners report

[N/A]

---

In which species does sulfur have an oxidation number of  $0$ ?

- A.  $\text{SO}_3$
- B.  $\text{S}_8$
- C.  $\text{Na}_2\text{SO}_4$
- D.  $\text{H}_2\text{S}$

## Markscheme

B

## Examiners report

[N/A]

---

Which species can oxidize ethanol to ethanoic acid?

- A.  $\text{I}^-$
- B. Fe

- C.  $O^{2-}$
- D. Acidified  $K_2Cr_2O_7$

## Markscheme

D

## Examiners report

[N/A]

---

What are the correct oxidation numbers of chromium in  $Cr_2O_7^{2-}$  and manganese in  $KMnO_4$ ?

	Chromium in $Cr_2O_7^{2-}$	Manganese in $KMnO_4$
A.	+7	+7
B.	+6	+7
C.	+6	+4
D.	+7	+4

## Markscheme

B

## Examiners report

[N/A]

---

Two half-cells are connected via a salt bridge to make a voltaic cell. Which statement about this cell is correct?

- A. Oxidation occurs at the positive electrode (cathode).
- B. It is also known as an electrolytic cell.
- C. Ions flow through the salt bridge.
- D. It requires a power supply to operate.

## Markscheme

C

# Examiners report

[N/A]

---

What are the correct names for  $\text{KMnO}_4$  and  $\text{K}_2\text{Cr}_2\text{O}_7$ , using oxidation numbers?

- A. Potassium permanganate and potassium dichromate
- B. Potassium manganate(IV) and potassium chromate(VII)
- C. Potassium permanganate(IV) and potassium dichromate(VII)
- D. Potassium manganate(VII) and potassium dichromate(VI)

## Markscheme

D

# Examiners report

Many justified comments were made on this question, as there was indeed an unfortunate mistake in the answer D of the question, where dichromate became chromate. This question was therefore not taken into account and will be corrected for publication.

---

What are the oxidation states of each element in  $\text{K}_2\text{CrO}_4$ ?

	Potassium	Chromium	Oxygen
A.	+1	+6	-2
B.	-1	+6	-2
C.	+1	-6	+2
D.	-1	-6	+2

## Markscheme

A

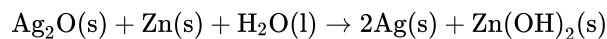
# Examiners report

[N/A]

---

Consider the overall reaction taking place in a voltaic cell.





What is the role of zinc in the cell?

- A. The positive electrode and the oxidizing agent.
- B. The positive electrode and the reducing agent.
- C. The negative electrode and the oxidizing agent.
- D. The negative electrode and the reducing agent.

## Markscheme

D

## Examiners report

One G2 comment suggested that it would have been better if other examples were used in this voltaic cell, instead of the salts chosen. Although a valid comment, candidates simply had to realise that zinc changes its oxidation number from 0 to +2 and hence is oxidized, so therefore must be the negative electrode and the reducing agent. The question itself was answered correctly by only 39.27% of candidates.

At which electrodes does oxidation occur in a voltaic cell and in an electrolytic cell?

	<b>Voltaic cell</b>	<b>Electrolytic cell</b>
A.	positive	positive
B.	positive	negative
C.	negative	positive
D.	negative	negative

## Markscheme

C

## Examiners report

[N/A]

Which statement is correct about a reducing agent?

- A. It is reduced by gaining electrons.
- B. It is oxidized by gaining electrons.
- C. It is oxidized by losing electrons.

D. It is reduced by losing electrons.

## Markscheme

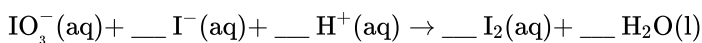
C

## Examiners report

[N/A]

---

What is the coefficient for  $\text{I}^-$  when the following equation is balanced using the smallest possible whole numbers?



- A. 1
- B. 2
- C. 3
- D. 5

## Markscheme

D

## Examiners report

We accept that this is a difficult question but many candidates will have come across the reaction in their laboratory work – and they should know that an equation must be balanced for charge as well as for species. It was the most difficult question on the paper but there do need to be questions that will differentiate the grade 7 candidates from those who achieve grade 6.

---

What is the name of  $\text{Co}_3(\text{PO}_4)_2$ ?

- A. Cobalt(II) phosphite
- B. Cobalt(II) phosphate
- C. Cobalt(III) phosphite
- D. Cobalt(III) phosphate

## Markscheme

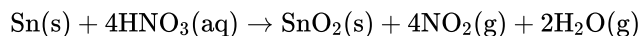
B

# Examiners report

[N/A]

---

Consider the following reaction.



Which statement is correct?

- A.  $\text{HNO}_3$  is the oxidizing agent because it undergoes oxidation.
- B.  $\text{HNO}_3$  is the reducing agent because the oxidation number of nitrogen changes from +5 to +4.
- C. Sn is the oxidizing agent because it undergoes reduction.
- D. Sn is the reducing agent because the oxidation number of tin changes from 0 to +4.

# Markscheme

D

# Examiners report

[N/A]

---

Which species of vanadium has a different oxidation number from the rest?

- A.  $\text{VO}_2^+$
- B.  $\text{VO}_3^-$
- C.  $\text{V}_2\text{O}_5$
- D.  $\text{VO}^{2+}$

# Markscheme

D

# Examiners report

[N/A]

---

What is the correct systematic name of  $\text{MnO}_2$ ?

- A. Manganese(II) oxide
- B. Manganese(IV) oxide

- C. Magnesium(II) oxide
- D. Magnesium(IV) oxide

## Markscheme

B

## Examiners report

[N/A]

---

Which statement about an electrolytic cell is correct?

- A. Chemical energy is converted to electrical energy.
- B. Electrons move through the electrolyte.
- C. The cathode is the negative electrode.
- D. The negative ions move towards the negative electrode.

## Markscheme

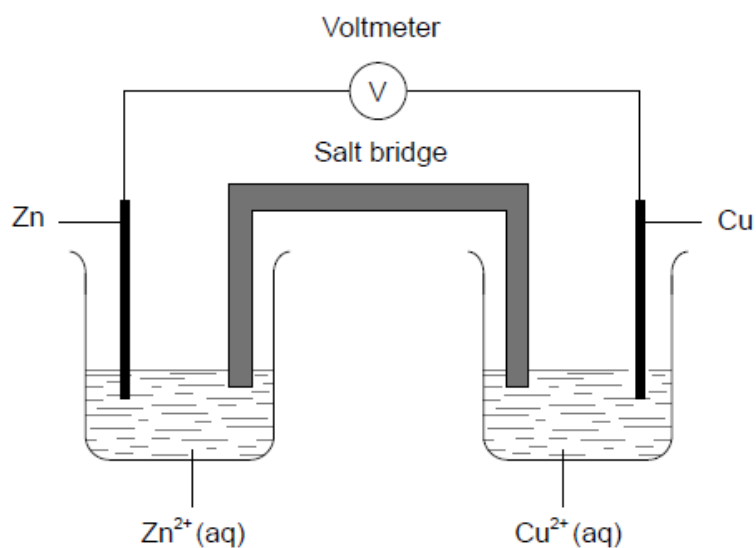
C

## Examiners report

[N/A]

---

A voltaic cell is constructed from zinc and copper half-cells. Zinc is more reactive than copper. Which statement is correct when this cell produces electricity?



- A. Electrons flow from the copper half-cell to the zinc half-cell.
- B. The concentration of  $\text{Cu}^{2+}(\text{aq})$  increases.
- C. Electrons flow through the salt bridge.
- D. Negative ions flow through the salt bridge from the copper half-cell to the zinc half-cell.

## Markscheme

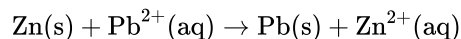
D

## Examiners report

[N/A]

---

A voltaic cell is made by connecting zinc and lead half-cells. The overall equation for the reaction occurring in the cell is shown below.



Which statements are correct when the cell produces electricity?

- I. The zinc is oxidized.
  - II. Electrons move from zinc to lead in the external circuit.
  - III. The mass of the lead electrode increases.
- 
- A. I and II only
  - B. I and III only
  - C. II and III only
  - D. I, II and III

## Markscheme

D

## Examiners report

[N/A]

---

Which statements are correct for the electrolysis of molten lead(II) bromide,  $\text{PbBr}_2(\text{l})$ ?

- I.  $\text{Pb}^{2+}$  is reduced at the negative electrode (cathode).
- II.  $\text{Br}^-$  is oxidized at the positive electrode (anode).
- III. Bubbles of a brown gas are observed at the negative electrode (cathode).

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

## Markscheme

A

## Examiners report

[N/A]

What are the oxidation states of chromium in  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$  (s) and  $\text{Cr}_2\text{O}_3$  (s)?

	$(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ (s)	$\text{Cr}_2\text{O}_3$ (s)
A.	+7	+3
B.	+6	+3
C.	+6	+6
D.	+7	+6

## Markscheme

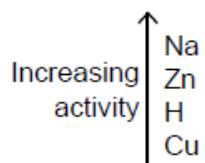
B

## Examiners report

[N/A]

Which of the following does **not** react with dilute  $\text{HCl}(\text{aq})$ ?

Extract from activity series



- A.  $\text{Na}_2\text{CO}_3$
- B. Cu

- C. Zn
- D. CuO

## Markscheme

B

## Examiners report

[N/A]

---

What is the reaction type and major product at the **anode** (positive electrode) when molten sodium chloride is electrolysed using platinum electrodes?

	Reaction type	Product
A.	reduction	Cl <sub>2</sub>
B.	oxidation	Cl <sub>2</sub>
C.	reduction	Na
D.	oxidation	Na

## Markscheme

B

## Examiners report

[N/A]

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