

# BioMedical Admissions Test (BMAT)

## Section 2: Chemistry

### Questions by Topic

#### C5 - Oxidation, Reduction and Redox

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## C5: Oxidation, Reduction and Redox - Question by Topic

(Mark Scheme and explanations at the end)

1 Which of the following is not true of oxidation and reduction.

- A One definition of reduction is the loss of oxygen.
- B Reduction is the gain of electrons.
- C Oxidation is the gain of oxygen.
- D Oxidation is the loss of electrons
- E None of the above

2 The following compounds each contain oxygen.

In which of the following compounds is the oxidation state of oxygen not -2?

- 1 MgO
- 2 Na<sub>2</sub>O
- 3 H<sub>2</sub>O<sub>2</sub>
- 4 OF<sub>2</sub>

- A 1 and 2 only
- B 2 and 3 only
- C 3 and 4 only
- D None of the compounds

3 The following statements are each reactions.

Which of the following reactions are redox reactions?

- 1  $2 \text{Na} + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2$
- 2  $\text{Zn} + \text{CuSO}_4 \rightarrow \text{Cu} + \text{ZnSO}_4$
- 3  $\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}$

- A 1 only
- B 2 only
- C 3 only
- D 1 and 2 only
- E 1 and 3 only
- F 2 and 3 only
- G All of the above





Which of the following correctly describes the reaction above?

	Reducing agent	Oxidising Agent	Oxidation state of Ca in $\text{CaCl}_2$
<b>A</b>	Ca	Zn	+2
<b>B</b>	Zn	Ca	+2
<b>C</b>	Ca	$\text{Zn}^{2+}$	+2
<b>D</b>	Ca	$\text{Zn}^{2+}$	0
<b>E</b>	Zn	$\text{Ca}^{2+}$	0

5 Which of the following statements about oxidation states are not always true?

- 1 Atoms have an oxidation state of zero.
- 2 The overall charge on an ion of multiple atoms is the same as the ionic charge.
- 3 Group 1 metals in a compound have an oxidation state of +1.
- 4 Hydrogen has an oxidation state of +1.

- A** 1 only  
**B** 2 only  
**C** 3 only  
**D** 4 only  
**E** All of the above are always true.





- 6 An ion  $X^+$  forms coloured ions, has uses as a catalyst, and forms multiple stable ions. Which of the following statements about the ion  $X^+$  are true?
- 1 It is a metal ion.
  - 2 It can form dative covalent bonds with non-metal elements.
  - 3 It is an ion of an element that is a member of the alkali metals.
  - 4 It is an ion of an element that is a member of the transition metals.
  - 5 It is an ion of an element that is a member of the halogens.
  - 6 The group of elements from which it comes can form ions with charges between  $1^+$  and  $4^+$
  - 7 The group of elements from which it comes can form ions with charges between  $1^+$  and  $7^+$
- A 1 and 3  
B 5 and 6  
C 1, 2 and 3  
D 1, 2 and 4  
E 1, 3, 4 and 6  
F 1, 2, 4 and 7  
G 1, 2, 3 and 5
- 7 A student is reacting chlorine gas with an iron salt. The solution changes colour from green to yellow. What is the oxidised and reduced in this reaction, and which metal ion is present in the product?
- A Chlorine is the oxidising agent, iron is the reducing agent,  $Fe^{3+}$   
B Chlorine is reduced, iron is oxidised,  $Fe^{2+}$   
C Chlorine is the reducing agent, iron is the oxidising agent,  $Fe^{2+}$   
D Chlorine is oxidised, iron is reduced,  $Fe^{3+}$   
E Chlorine is the reducing agent, iron is the oxidising agent,  $Fe^{3+}$





## Answers and Explanations

1 **E is the answer.**

Each of the statements is a correct definition of either oxidation or reduction. For oxidation and reduction in terms of oxygen oxidation is gain of oxygen and reduction is loss of oxygen. For oxidation and reduction in terms of electrons, the acronym to remember is OILRIG.

Oxidation

Is

Loss

Reduction

Is

Gain

2 **C is the answer.** Peroxides and compounds with fluorine are two exceptions where oxygen does not have an oxidation state of -2. In peroxides it is -1 and in the fluorine compounds it is +2.

**Compound 1** – Oxygen has the oxidation state -2

**Compound 2** – Oxygen has the oxidation state -2

**Compound 3** – Oxygen has the oxidation state -1

**Compound 4** – Oxygen has the oxidation state +2

3 **D is the answer.** Only 1 and 2 are redox reactions as both reduction and oxidation occur.

**Statement 1** is a redox reaction because 2Na are each oxidised from 0 to +1 and 2H are reduced from +1 to a 0 oxidation state.

**Statement 2** is a redox reaction because Zinc is oxidised from an oxidation state of 0 to +2 and copper is reduced from an oxidation state of +2 to 0.

**Statement 3** is a neutralisation reaction rather than a redox reaction as neither oxidation or reduction occurs.





4 **C is the answer.**

This is because Ca provides 2 electrons for the Zn ion to be reduced and so is the **reducing agent** and the Zn ion is thus the **oxidising agent**. Group 2 metal ions always have the oxidation state +2 in compounds so the oxidation state is +2.

5 **D is the answer.**

This is because Hydrogen has an oxidation state of -1 in metal hydrides.

**A – C** are each valid statements no matter the compounds.

6 **F is the answer**

The properties listed identify ion  $X^+$  as a member of the transition metals. These metals can form ions with charges between 1+ and 7+. They can also form metal complexes with non metal ligands.

7 **A is the answer**

The oxidising agent (chlorine) is reduced, and the reducing agent (iron) is oxidised to leave an  $Fe^{3+}$  ion. Remember OIL RIG - oxidation is loss, reduction is gain (of electrons). Iron exists as two stable ions +2 and +3. If the iron ion is oxidised the charge must become more positive as it loses electrons, the +3 ion cannot become more positive so it must be the end product and +2 must be the starting product.

