A. Rule of REDOX reaction

What is Redox Reaction?

Redox is one kind of _____ reaction which is very _____ in our daily life.

Example:

Batteries, _____

Red ox represents **2 chemical reactions** _____ and _____

Redox: _____ and _____ MUST occur at the same time.

Remark: **These 2 terms "Oxidation" and "Reduction" are quite misleading**

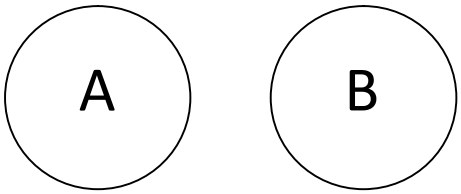
"Oxidation" may not related to Oxygen, "Reduction" is gaining electron during the reaction

Very Basic Principle of Redox!

2 chemical species: A and B: **A tends to lose electron, B tends to gain electrons**

When A meets B, _____ Reaction occurs

A: Some Rich Men like to _____ money.
B: Some Women like to _____ money.

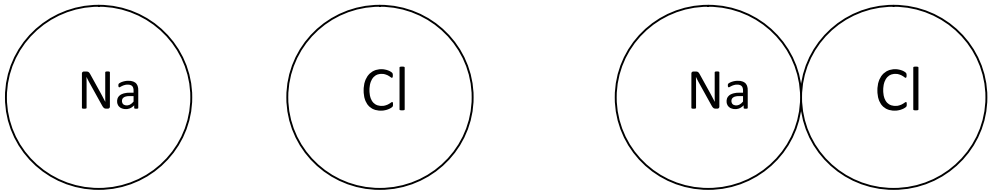


Electron Flows		
Charge of species		
Is oxidized / reduced?		
Reducing agent (RA) Oxidizing agent(OA)		
Oxidation number (Charge of AN atom)		
Type of Reaction		

More Example:

2 atoms: Na and Cl : **Na tends to _____ electron, Cl tends to _____ electrons**

When Na meets Cl , _____ Reaction occurs



Electron Flows		
Charge of species		
Is oxidized / reduced?		
Reducing agent (RA) Oxidizing agent(OA)		
Oxidation number (Charge of AN atom)		
Type of Reaction		

$$Fe + Cu^{2+} \rightarrow Fe^{2+} + Cu$$

	Fe	Cu^{2+}
Electron Flows		
Charge of species		
Is oxidized / reduced?		
Reducing agent (RA) Oxidizing agent(OA)		
Oxidation number (Charge of AN atom)		
Type of Reaction		

Half equations

Extraction of metals

ZnO + ___ ->

	ZnO->	C->
Charge of species		
Oxidation number (Charge of AN atom)		
Is oxidized / reduced?		
Reducing agent (RA) Oxidizing agent(OA)		
Type of Reaction		

Rules for the determination of oxidation number

1. The oxidation number of an **element** is *zero*.
2. The O.N. of an element in a **simple ion** is equal to the ***ionic charge***.
3. The O.N. of **OXYGEN** in most compounds is _____.
4. The O.N. of **HYDROGEN** in most compounds is _____.
5. The O.N. of ALL ATOMS in any **compounds** *add up* to _____.
6. The O.N. of ALL ATOMS in a **polyatomic ion** add up to the _____ of the ion.

Priority of atom:

K :

Na:

F:

H:

O:

Classwork:

Ar P_4 Na^+ Hg^{2+} Fe_2O_3 N_2O $H_2S_2O_7$ C_2H_4 NH_3

CO_3^{2-} NH_4^+ MnO_4^- SO_4^{2-} CrO_4^{2-} $Cr_2O_7^{2-}$ NO_3^- NaH H_2O_2

B. Common Reducing agents and Oxidizing agents

Common Strong Oxidizing Agents (O.A.)

Oxidizing agent	Main change / colour change	Ionic half-equation / change in O.N.
Acidified* potassium permanganate solution	->	
Acidified* potassium dichromate solution	->	
Dilute nitric acid	$NO_3^-{}_{(aq)}$ -> $NO_{(g)}$	
Concentrated nitric acid	$NO_3^-{}_{(aq)}$ -> $NO_{2(g)}$	
Concentrated sulphuric acid	$SO_4^{2-}{}_{(aq)}$ -> $SO_{2(g)}$	
Hydrogen ion	$H^+{}_{(aq)}$ -> $H_{2(g)}$	
Chlorine	$Cl_{2(g)}$ -> $Cl^-{}_{(aq)}$	
Bromine (in aqueous solution)	$Br_{2(aq)}$ -> $Br^-{}_{(aq)}$	
Ions of metals low in the M.R.S.		

2012 DSE

6. What is the oxidation number of Cu in $Cu(NH_3)_4Cl_2$?

A. 0
B. +2
C. +4
D. +6

Common Strong Reducing Agents (R.A.)

Reducing agent	Main change / colour change	Ionic half-equation/change in O.N.
Metals high in the M.R.S.		
Sulphur dioxide	$SO_{2(g)} \rightarrow SO_4^{2-}{}_{(aq)}$	
Sulphites	$SO_3^{2-}{}_{(aq)} \rightarrow SO_4^{2-}{}_{(aq)}$	
Iron(II) salts	$Fe^{2+}{}_{(aq)} \rightarrow Fe^{3+}{}_{(aq)}$	
Thiosulphate ions	$S_2O_3^{2-}{}_{(aq)} \rightarrow S_4O_6^{2-}{}_{(aq)}$	
Oxalate ions	$C_2O_4^{2-}{}_{(aq)} \rightarrow CO_{2(g)}$	
Hydroxide ions	$OH^-{}_{(aq)} \rightarrow$	
Iodides	$I^-{}_{(aq)} \rightarrow I_{2(s)}$	

2015 DSE

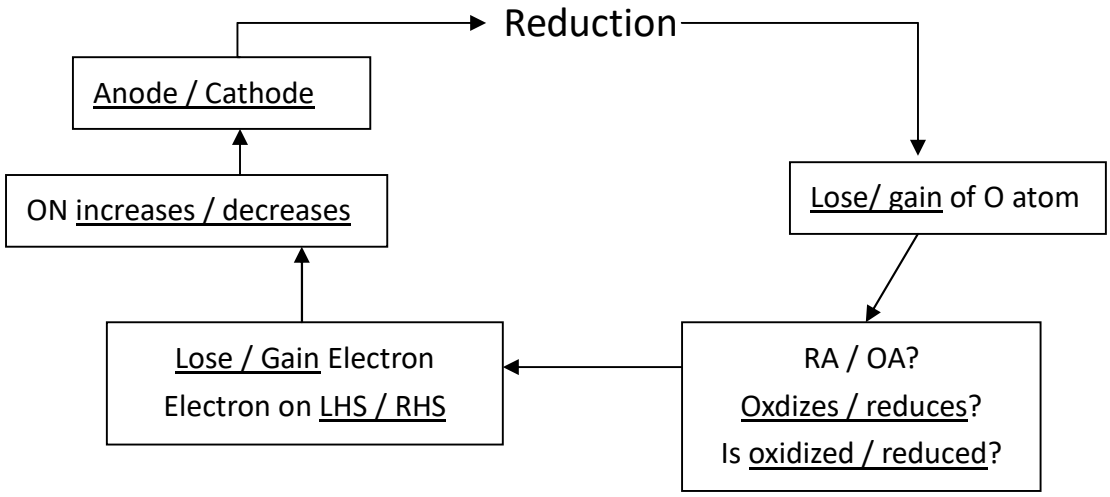
6. The conversion of nitrogen gas to nitric acid involves the following steps :

$$N_2 \xrightarrow{\textit{Step 1}} NH_3 \xrightarrow{\textit{Step 2}} NO \xrightarrow{\textit{Step 3}} NO_2 \xrightarrow{\textit{Step 4}} HNO_3$$

In which step is nitrogen reduced ?

A. *Step 1*
B. *Step 2*
C. *Step 3*
D. *Step 4*

Classwork:



Chemical Species	OA / RA?
$K_2Cr_2O_7 / H^+$	
Na_2SO_3	
KI	
$Cu(NO_3)_2$	
Na_2SO_4	
Conc. H_2SO_4	
$NaMnO_4 / H^+$	
$FeSO_4$	
Conc. HCl	
Dil. HNO_3	
$AgNO_3$	
$ZnCO_3$	

C. Overall equation

Write chemical equations for the following reactions using half-equation method:

1. **Iron** reacts with **copper(II) sulphate solution**.

2. **Chlorine** gas is bubbled into **potassium iodide solution**

3. **Zinc** reacts with **concentrated sulphuric acid**.

4. **Sulphur dioxide** gas is bubbled into **acidified potassium permanganate solution**.

5. **Sodium sulphite solution** is added to **acidified potassium dichromate solution**.

D. Acid and O.A.

Property	Acid and O.A.	Metal	Reaction
	v. dilute HCl	+ Zn	
		+ Cu	
	Dilute HCl	+ Zn	Faster / Slower
		+ Cu	
	Concentrated HCl	+ Zn	Faster / Slower
		+ Cu	
	v. dilute HNO_3	+ Zn	
		+ Cu	
	dilute HNO_3	+ Zn	
		+ Cu	
	concentrated HNO_3	+ Zn	
		+ Cu	
	v. dilute H_2SO_4	+ Zn	
		+ Cu	
	Dilute H_2SO_4	+ Zn	Faster / Slower
		+ Cu	
	Concentrated H_2SO_4	+ Zn	
		+ Cu	



2017 DSE

23. What would be observed when a few drops of concentrated nitric acid is added to KI(aq) ?

(1) A brown solution is formed.
(2) A brown precipitate is formed.
(3) A reddish brown gas is released.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

20

13 DSE

22. Which of the following reagents can be used to distinguish between sodium sulphite and sodium sulphate ?

(1) iron(II) chloride solution
(2) acidified potassium permanganate solution
(3) concentrated nitric acid

A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

2014 DSE

5. Concentrated acids are common reagents found in laboratories.

(c) Explain how concentrated sulphuric acid, concentrated nitric acid and concentrated ethanoic acid can be distinguished by using copper granules.

(b) Acidified potassium permanganate solution is added to sodium sulphite solution.

(i) State the expected colour change.

(ii) For the reaction leading to the colour change,

(1) state the name of the type of reaction; and

(2) write the ionic equation for the reaction.

17. An aqueous solution of potassium iodide turns yellow with time due to the following reaction :

$4KI(aq) + 2CO_2(g) + O_2(g) \rightarrow 2K_2CO_3(aq) + 2I_2(aq)$

Which of the following statements concerning the above reaction is / are correct ?

(1) KI(aq) is oxidised by $O_2(g)$.
(2) KI(aq) is oxidised by $CO_2(g)$.
(3) The yellow colour is due to the $K_2CO_3(aq)$ formed.

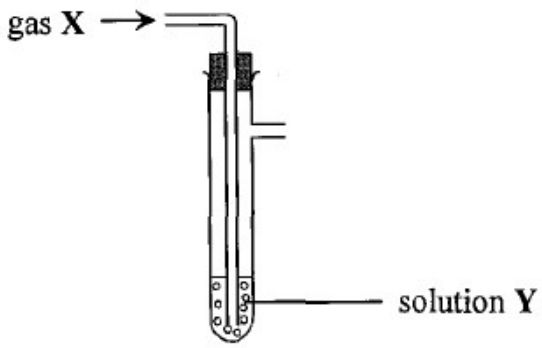
A. (1) only
B. (2) only
C. (1) and (3) only
D. (2) and (3) only

2016 DSE

11. In which of the following compounds does nitrogen have the highest oxidation number ?

A. NF_3
B. N_2H_4
C. $NaNH_2$
D. $HONH_2$

13. Gas **X** is bubbled steadily into solution **Y** as shown in the diagram below :



In which of the following combinations would NOT have a visible change in solution **Y** ?

	gas **X**	solution **Y**
A.	$Cl_2(g)$	KI(aq)
B.	$O_2(g)$	$FeSO_4(aq)$
C.	$CO_2(g)$	acidified $KMnO_4(aq)$
D.	$SO_2(g)$	acidified $Na_2Cr_2O_7(aq)$

14. Which of the following is NOT a redox reaction ?

A. $2AgBr(s) \rightarrow 2Ag(s) + Br_2(g)$
B. $SO_2(g) + 2H_2S(g) \rightarrow 3S(s) + 2H_2O(l)$
C. $2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$
D. $Ca(HCO_3)_2(aq) \rightarrow CaCO_3(s) + H_2O(l) + CO_2(g)$

2017 DSE

23. What would be observed when a few drops of concentrated nitric acid is added to KI(aq) ?

(1) A brown solution is formed.
(2) A brown precipitate is formed.
(3) A reddish brown gas is released.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

2018 DSE

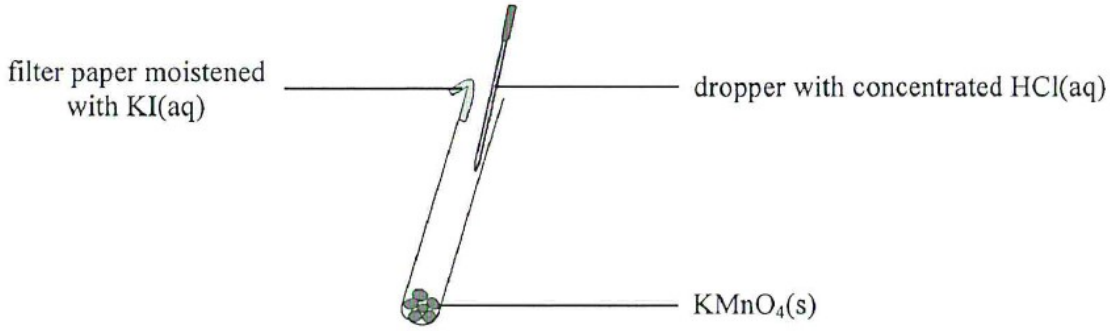
10. Which of the following reagents does NOT react with copper ?

A. 2 M H_2SO_4
B. 2 M HNO_3
C. 16 M H_2SO_4
D. 16 M HNO_3

12. Which of the following is NOT a redox reaction ?

A. $2Mg + SO_2 \rightarrow 2MgO + S$
B. $CaCO_3 + SiO_2 \rightarrow CaSiO_3 + CO_2$
C. $Cu_2O + H_2SO_4 \rightarrow CuSO_4 + Cu + H_2O$
D. $3CuS + 8HNO_3 \rightarrow 3CuSO_4 + 8NO + 4H_2O$

8. Refer to the experimental set-up as shown below.



(a) HCl is a strong acid. What is meant by the term 'strong acid' ?

(1 mark)

(b) When concentrated HCl(aq) is dropped into $KMnO_4(s)$, a yellowish green gas is formed.

(i) What is the yellowish green gas ?

(ii) Explain whether the reaction forming the yellowish green gas is a redox reaction.

(2 marks)

(c) With the aid of an ionic equation, state the expected observation when the yellowish green gas reaches the filter paper.

(2 marks)

(d) In consideration of laboratory safety, explain where the experiment should be performed.

(1 mark)