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1. (3) Arrange the following elements in the order of increasing electron affinity: Cl, He, K, S, Li
2. (3) Knowing the atomic radii of C (0.77 Å), Si (1.18 Å), Cl (0.99 Å) and Al (1.43 Å), arrange the following single bonds in the order of increasing bond length: C–Si, C–Al, C–Cl, Si–Cl, Al–Cl.



3. (3) Circle all dative bonds in the following species:

4. (4) Determine the formal oxidation states for all atoms in the following molecules and ions:
- CaH₂ OS: Ca _____ H _____
- SOCl₂ OS: S _____ O _____ Cl _____
- [H₃Si₂O₃]²⁻ OS: H _____ Si _____ O _____
- F₃B-NH₂ OS: F _____ B _____ N _____ H _____
- Li[AlCl₂H₂] OS: Li _____ Al _____ Cl _____ H _____

5. (6) Use VSEPR rules to predict the structure and shape of the following molecules. Prepare clear structural drawings showing all atoms, bonds, as well as lone pairs on the central atom (if present). Do NOT show any other electrons. Name the shapes.

[BeCl₂F]²⁻ [] ClO₂ BrF₅

Molecular shape:

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UNIT 16 ELECTROCHEMISTRY REVISION (KCU)

OXIDATION NUMBERS, OXIDATION AND REDUCTION

1. Assign oxidation numbers to each element in the following:

a. MnO ₂	b. NO ₂	c. Cl ₂
Mn + 2(2) = 0 Mn + 2(+2) = 0 Mn + -4 = 0 Δ: Mn = +4 and O = -2	N + 2(2) = 0 N + 2(+2) = 0 N + -4 = 0 Δ: N = +4 and O = -2	2Cl = 0 Δ: Cl = 0
d. ClO ₄	e. SO ₄ ²⁻	f. Fe ₂ O ₃
Cl + 4O = +1 Cl + 4(+2) = +1 Cl + -4 = -3 Δ: Cl = +7 and O = -2	S + 4O = +2 S + 4(+2) = +2 S + -8 = -2 Δ: S = +6 and O = -2	Reverse cross-over Fe = +3 and O = -2 or 2Fe + 3O = +0 2Fe + 3(+2) = +0 2Fe + -6 = +0 Δ: Fe = +6 and O = -2
g. H ₃ PO ₄	h. HPO ₄ ²⁻	i. CH ₄
3H + P + 4O = 0 3(+1) + P + 4(+2) = 0 +3 + P + +8 = +0 Δ: P = +5, H = +1 and O = -2	H + P + 4O = +2 +1 + P + 4(+2) = +2 P = +5 Δ: P = +5, H = +1 and O = -2	C + 4H = +0 C + 4(+1) = +0 C = +4 Δ: C = +4 and O = -2
j. CO ₂	k. H ₂ O ₂	l. Cu ²⁺
C + 2O = +6 C + 2(+2) = +6 C + -4 = 0 Δ: C = +4 and O = -2	2H + 2O = +2 2(+1) + 2O = +2 2 = +2O Δ: 2O = -2 O = -1 and H = +1 (An exception to O = -2)	2Cu = +2 Δ: Cu = +2
m. Ag ⁺	n. Cr ₂ O ₇ ²⁻	o. IO ₃ ⁻
Ag = 0	Cr = +6 = -2 2Cr = +12 = -2 2Cr = +16 = -2 Δ: 2Cr = +34 Cr = +7 and O = -2	I + 3O = -3 I + 3(+2) = -3 I = -6 Δ: I = +5 and O = -2
p. Mn ²⁺	q. NO ₃ ⁻	r. SO ₃ ²⁻
Mn = +2	N + 3O = +1 N + 3(+2) = +1 N = -6 = -1 Δ: N = +5 and O = -2	S + 3O = +2 S + 3(+2) = +2 S = -6 = -2 Δ: S = +4 and O = -2
s. SO ₃ ²⁻	t. NO ₂	u. NO ₂ ⁻
S + 2O = +6 S + 2(+2) = +6 S = -4 = 0 Δ: S = +4 and O = -2	N + 2O = +2 N + 2(+2) = +2 N = -4 = 0 Δ: N = +4 and O = -2	N + O = 0 N = -2 = 0 Δ: N = +2 and O = -2
v. I ⁻	w. Al ³⁺	x. H ₂ S
I = -1	Al = +3	2H = +2 2(+1) + S = +0 +2 + S = 0 Δ: S = -2 and H = +1

PDF

WORKSHEET: Redox reactions

1. Define the process of oxidation in terms of:

- a) transfer (gain or loss) of oxygen _____
- b) transfer (gain or loss) of electrons _____
- c) transfer (gain or loss) of hydrogen _____
- d) decrease or increase in oxidation number _____

2. Define the process of reduction in terms of:

- a) transfer (gain or loss) of oxygen _____
- b) transfer (gain or loss) of electrons _____
- c) transfer (gain or loss) of hydrogen _____
- d) decrease or increase in oxidation number _____

3. a) Complete the half equations by balancing it and identify each half reaction as either an oxidation (O) or reduction (R) reaction.

(i)	Na (s)	\rightarrow	Na ⁺ (aq)	(ii)	Mg ²⁺ (aq)	\rightarrow	Mg (s)
(iii)	Fe (s)	\rightarrow	Fe ³⁺ (aq)	(iv)	Cl (aq)	\rightarrow	Cl ₂ (g)
v)	K(s)	\rightarrow	K ⁺ (aq)	vi)	O ₂ (g)	\rightarrow	O ²⁻ (aq)
vii)	F ⁻ (aq)	\rightarrow	F ₂ (g)	viii)	Cu ²⁺ (aq)	\rightarrow	Cu (s)
ix)	S (s)	\rightarrow	S ²⁻ (aq)	x)	H ₂ (g)	\rightarrow	H ⁺ (aq)

4. Consider the incomplete reaction (partial ionic equation) given below:



i) Give the two half equations for this reaction; oxidation + reduction

ii) Identify the chemical substance (species) that has undergone oxidation

iii) Identify the chemical substance (species) that has undergone reduction

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Vedantu

ELECTROCHEMISTRY

1. ELECTROCHEMISTRY

Electrochemistry is the study of production of electricity from the conversion of chemical energy into electrical energy or the use of electrical energy to bring about non-spontaneous chemical transformation.

2. ELECTROCHEMICAL CELLS

A spontaneous chemical reaction is the one which can take place on its own without any external intervention. It is this energy that the system decreases. It is this energy that gets converted to electrical energy. The reverse process is also possible in which we can make non-spontaneous processes to occur by the use of electrical energy. These inter conversions are carried out in equipments called Electrochemical Cells.

3. TYPES

Electrochemical Cells are of two types:

3.1 Galvanic Cells

Converts chemical energy into electrical energy

3.2 Electrolytic Cells

Converts electrical energy into chemical energy

4. GALVANIC CELLS

Cell energy is released from a spontaneous chemical process or reaction and it is converted to electric current. For example, Daniell Cell is a Galvanic Cell in which Zinc and Copper are used for the redox reaction to take place.

Zn (s) + Cu²⁺ (aq) \rightarrow Zn²⁺ (aq) + Cu (s)

Oxidation Half: Zn (s) \rightarrow Zn²⁺ (aq) + 2e⁻

Reduction Half: Cu²⁺ (aq) + 2e⁻ \rightarrow Cu (s)

Zn is the reducing agent and Cu²⁺ is the oxidising agent. The half cells are also known as Electrodes. The oxidising half is known as Anode and the reduced half is cathode. Electron flow from anode to cathode is:

the external circuit. Anode is assigned negative polarity and cathode is assigned positive polarity. In Daniell Cell, Zn acts as the anode and Cu acts as the cathode.

5. ELECTROLYTIC CELLS

These electrodes are dipped in an electrolytic solution containing cations and anions. On supplying current the ions move towards the electrodes with their respective polarity and simultaneous reduction and oxidation takes place.

5.1 Preferential Discharge of ions

Where there are more than one cation or anion the process of discharge becomes competitive in nature. Discharge of an ion depends upon its position in the second ion series present the discharge of the ion will take place first which requires the energy:

6. ELECTRODE POTENTIAL

It may be defined as the tendency of an electrode, when it is placed in contact with its own solution or in pure electrolyte, to give up electrons or to receive extra electrons.

The electrode potential will be named as oxidation or reduction potential depending upon whether oxidation or reduction has taken place:

$$M(s) \rightleftharpoons M^{n+} (aq) + ne^-$$

$$M^{n+} (aq) + ne^- \rightleftharpoons M(s)$$

6.1 Characteristics

(a) Both oxidation and reduction potentials are equal in magnitude but opposite in sign.

(b) It is not a thermodynamic property, so values of E are not additive.

7. STANDARD ELECTRODE POTENTIAL (E)

It may be defined as the electrode potential of an electrode determined relative to standard hydrogen electrode under standard conditions. The standard conditions taken are:

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