
	INDIAN SCHOOL AL WADI AL KABIR	
Class: XII	Department: SCIENCE 2022 – 23 SUBJECT :CHEMISTRY	Date of submission: 30.09.2022
Worksheet No: 05 WITH ANSWERS	Chapter: d and f BLOCK ELEMENTS	Note: A4 FILE FORMAT
NAME OF THE STUDENT	CLASS & SEC:	ROLL NO.

- Lanthanoid contraction is caused due to
 - the appreciable/large shielding on outer electrons by 4f electrons from the nuclear charge.
 - the appreciable shielding on outer electrons by 5d electrons from the nuclear charge.
 - the same effective nuclear charge from Ce to Lu.
 - the poor shielding on outer electrons by 4f electrons from the nuclear charge.
- CrO_4^{2-} (yellow) changes to $\text{Cr}_2\text{O}_7^{2-}$ (orange) in $\text{pH} = x$ and $\text{pH} = y$ respectively
 - 6 and 8
 - 6 and 5
 - 8 and 6
 - 7 and 7
- Which of the following does not show variable oxidation state?
 - Fe
 - Mn
 - Cu
 - Zn
- The pair having similar magnetic moment is
 - Ti^{3+} , V^{3+}
 - Cr^{3+} , Mn^{2+}
 - Mn^{2+} , Fe^{3+}
 - Fe^{2+} , Mn^{2+}
- Which is colourless in water?
 - Ti^{3+}
 - V^{3+}
 - Cr^{3+}
 - Sc^{3+}
- Which among the following is the most basic hydroxide?
 - $\text{Ce}(\text{OH})_3$
 - $\text{Lu}(\text{OH})_3$

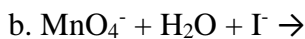
- c. $\text{Yb}(\text{OH})_3$
d. $\text{Tb}(\text{OH})_3$
7. Which among the following statements is incorrect regarding interstitial compounds?
a. They retain metallic conductivity.
b. They are chemically reactive.
c. They are much harder than the pure metal.
d. They have higher melting points than the pure metal.
8. Assertion: Separation of Zr and Hf is difficult.
Reason: Zr and Hf lie in the same group of the periodic table.
a. Assertion and reason are correct and Reason is the correct explanation of Assertion.
b. Assertion and reason are correct and Reason is the correct explanation of Assertion.
c. Assertion is correct but reason is wrong.
d. Assertion is wrong but reason is correct
9. Assertion: Cu cannot liberate hydrogen from acids.
Reason: Because it has positive electrode potential.
a. Assertion and reason are correct and Reason is the correct explanation of Assertion.
b. Assertion and reason are correct and Reason is the correct explanation of Assertion.
c. Assertion is correct but reason is wrong.
d. Assertion is wrong but reason is correct.
10. Assertion: Actinoids form relatively fewer stable complexes as compared to lanthanoids.
Reason: Actinoids can utilize their 5f orbitals along with 6d orbitals in bonding in comparison to lanthanoids usage of 4f orbitals for bonding.
a. Assertion and reason are correct and Reason is the correct explanation of Assertion.
b. Assertion and reason are correct and Reason is the correct explanation of Assertion.
c. Assertion is correct but reason is wrong.
d. Assertion is wrong but reason is correct.

1 MARK QUESTIONS

11. The +3 oxidation of Lanthanum ($Z = 57$), Gadolinium ($Z = 64$) and Lutetium ($Z = 71$) are especially stable. Why?
12. The first ionization enthalpies of 5d – series elements is higher than those of 3d and 4d series elements. Why?
13. What are interstitial compounds? Give an example.
14. Permanganate titrations in presence of hydrochloric acid are unsatisfactory. Give reason.

2 MARKS QUESTIONS

15. Complete and balance the following chemical equations.
a. $\text{Fe}^{2+} + \text{MnO}_4^- + \text{H}^+ \rightarrow$



16. Justify the following statements.

- Transition metals and the majority of their compounds act as good catalysts.
- From element to element, actinoid contraction is greater than lanthanoid contraction.

17. a. Titanium shows a magnetic moment of 1.73 BM in its compound. What is the oxidation number of Ti in the compound?

- Calculate the number of moles of KMnO_4 that is needed to react completely with one mole of sulphite ion in acidic medium.

3 MARKS QUESTIONS

18. The elements of the 3d transition series are given as:

Sc Ti V Cr Mn Fe Co Ni Cu Zn

Answer the following:

- Which element has the highest m.p and why?
- Which element is a strong oxidizing agent in +3 oxidation state and why?
- Which element is soft and why?

19. Account for the following statements.

- $\text{La}(\text{OH})_3$ is more basic than $\text{Lu}(\text{OH})_3$.
- Zn^{2+} salts are white.
- $\text{Cu}(\text{I})$ compounds are unstable in aqueous solution and undergo disproportionation.

20. Observe the table given below belonging to 3d series, their first, second, third ionization enthalpy and $E^\circ \text{M}^{2+}/\text{M}$ and $E^\circ \text{M}^{3+}/\text{M}^{2+}$ and answer the questions that follow based on table and related concepts/

Element	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
I st ionisation enthalpy	631	656	650	652	717	762	758	736	745	905 kJ ml ⁻¹
II nd ionisation enthalpy	1245	1320	1376	1635	1513	1564	1648	1757	1962	1736
III rd ionisation enthalpy	2451	2721	2874	2995	3258	2964	3238	3401	3561	3839
$E^\circ_{\text{M}^{2+}/\text{M}}$ in volts	–	–1.63V	–1.18V	–0.91V	–1.18V	–0.44V	–0.28V	–0.25V	+0.34V	–0.76V
$E^\circ_{\text{M}^{3+}/\text{M}^{2+}}$ in volts	–	–0.37V	–0.26V	–0.41V	+1.57V	+0.77V	+1.97V	–	–	–

- Zinc has highest first ionization enthalpy? Give reason.
- Why is $E^\circ \text{Mn}^{2+}/\text{Mn} = -1.18\text{V}$?
- Why is Mn^{3+} good oxidizing agent and $E^\circ \text{Mn}^{3+}/\text{Mn}^{2+} = 1.57\text{V}$?

5 MARKS QUESTIONS

21. Answer the following:

- Compare the chemistry of the actinoids with that of lanthanoids with reference to
 - Electronic configuration
 - Oxidation states
 - Chemical reactivity
- Name a member of the lanthanoid series which is well known to exhibit +4 oxidation state.
- Out of Mn^{3+} and Cr^{3+} , which is more paramagnetic and why?
(Atomic nos. Mn = 25, Cr = 24)

22. When chromite ore FeCr_2O_4 is fused with Na_2CO_3 in presence of air, a yellow coloured compound (A) is obtained which on acidification with dilute sulphuric acid gives a compound (B). Compound (B) on reaction with KCl forms an orange coloured crystalline compound (C).
- Write the formulae of the compounds (A), (B) and (C).
 - Write the reactions involved.
 - Write one use of compound (C).

PASSAGE BASED QUESTIONS

Read the given passage and answer the questions that follow:

The d-block of the periodic table contains the elements of the groups 3 to 12 and are known as transition elements. In general, the electronic configuration of these elements is $(n - 1) d^{1-10} ns^{1-2}$. The d-orbitals of the penultimate energy level in their atoms receive electrons giving rise to the three rows of the transition metals i.e., 3d, 4d and 5d series. However, Zn, Cd and Hg are not regarded as transition elements. Transition elements exhibit certain characteristic properties like variable oxidation states, complex formation, formation of coloured ions, alloys, catalytic activity etc. Transition metals are hard (except Zn, Cd and Hg) and have a high melting point.

- Zn, Cd and Hg non-transition elements. Explain.
- Which transition metal of 3d series does not show variable oxidation state?
- Why do transition metals and their compounds show catalytic activity?
- Why is Cu^{2+} ion coloured while Zn^{2+} ion is colourless?
- Transition metals can form alloys. Give reason.

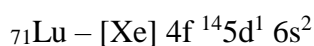
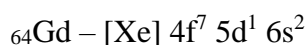
BOARD QUESTIONS

- Complete the following equations.
 - $\text{Cr}_2\text{O}_7^{2-} + 2\text{OH}^- \rightarrow$
 - $\text{MnO}_4^- + 4\text{H}^+ + 3\text{e}^- \rightarrow$
 - $\text{CrO}_4^{2-} + \text{H}^+ \rightarrow$
- Name the element of 3d transition series which shows maximum number of oxidation states. Why does it show so?
- Which metal in the first transition series (3d series) exhibits +1 oxidation state most frequently and why?
 - Which of the following cations are coloured in aqueous solutions and why?
 Sc^{3+} , V^{3+} , Ti^{4+} , Mn^{2+}
 (At. Nos. Sc = 21, V = 23, Ti = 22, Mn = 25)
- Generally there is an increase in density of elements from titanium ($Z = 22$) to copper ($Z = 29$) in the first series of transition elements.
- Assertion: Highest oxidation states of d-block metals are usually seen in oxides and oxo anions.
Reason: Oxygen is capable of forming $p\pi - d\pi$ bonds with transition metals

ANSWERS

- d
- c

3. d
4. c
5. d
6. a
7. b
8. b
9. a
10. d
- 11.

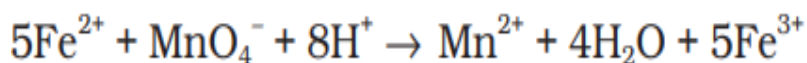


If three electrons lost, La will have stable Xe configuration, Gd will have half filled stability, Lu will have completely filled f^{14} electrons.

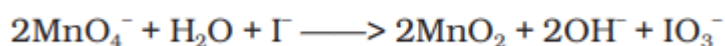
12. Because of weak shielding by 4f electrons, the first ionisation energy of 5d elements is higher than that of 3d elements. This is owing to the greater effective nuclear charge acting on outer valence electrons.
13. Interstitial compounds are formed when very small atoms, such as hydrogen, nitrogen, and carbon, become trapped inside the crystal lattices of metals. These chemicals are usually non-stoichiometric and not ionic or covalent.
Eg. $\text{VH}_{0.56}$ and $\text{TiH}_{1.7}$

14. Because hydrochloric acid is oxidised to chlorine, permanganate titrations in the presence of the acid are unreliable.

15. a.



- b.



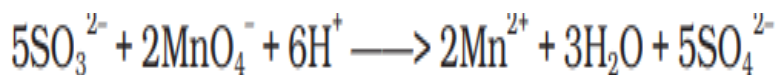
16. a. Transition metals and their compounds are effective catalysts because of their ability to exhibit changing oxidation states and form complexes, as well as the fact that they give a suitable surface for reaction to occur. For example, in the contact process, vanadium oxide is used, while in Haber's Process, finely split iron is used.

b. Due to inadequate shielding by 5f-electrons in actinoids compared to 4f-electrons in lanthanoids, actinoid contraction is higher than lanthanoid contraction from element to element.

17. a. Magnetic moment is 1.73 BM. Hence one unpaired electron.



b.



No of moles is 2/5 moles

18. i. Cr, 6 unpaired electrons, metallic bonds

ii. Mn, to attain d^5 half-filled configuration

iii. Zn, no unpaired electrons, no metallic bonds.

19. a. Lu smaller size- Lanthanoid contraction, stronger bonds with OH^- .

b. no unpaired electrons, no d d transition.

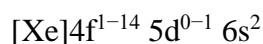
c. Cu^+ is more unstable in aqueous solution than Cu^{2+} because, while copper's 2nd I.E. is considerable, Cu^{2+} hydrations enthalpy is significantly lower than Cu^+ , and so it more than compensates for copper's 2nd I.E. As a result, many Cu^+ complexes in aqueous solution are unstable and disproportionate.

20. a. It is because Zn has completely filled '4s' orbital which is stable

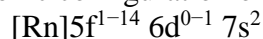
b. It is due to low enthalpy of atomization, sublimation enthalpy, ionization enthalpy.

c. It is because it can gain one electron easily to form $\text{Mn}^{2+}(3d^5)$ which is more stable

21. (i) Electronic configuration: The electronic configuration of lanthanoids is



The electronic configuration of actinoids is



(ii) Oxidation states

Oxidation states: Due to the wide energy difference between the 4f and 5d subshells, lanthanoids have +2 and +4 oxidation states in addition to the +3 oxidation state. Due of the narrow energy difference between the 5f and 6d subshells, actinoids have a high variety of oxidation states.

(iii) Chemical reactivity.

Lanthanoids with high electropositivity exhibit chemical reactivity that is almost identical. Actinoids (electropositive and highly reactive) are more reactive than lanthanides (especially in finely split form).

b. Ce – $[\text{Xe}] 4f^1 5d^1 6s^2$

c. Cr-3 unpaired electrons

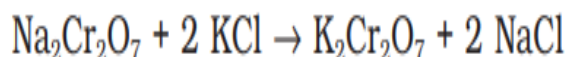
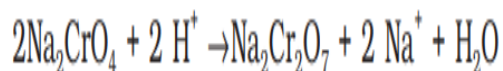
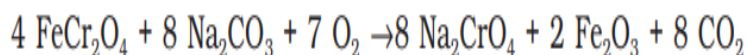
Mn – 4 unpaired electrons Mn^{3+} is more paramagnetic

22. a. (A) – Na_2CrO_4

(B) - $\text{Na}_2\text{Cr}_2\text{O}_7$

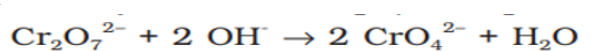
(C) – $\text{K}_2\text{Cr}_2\text{O}_7$

b.

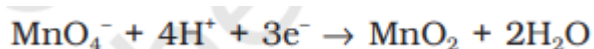


- c.
C is used as a strong oxidising agent in acidic medium in volumetric analysis.
23. completely filled d orbitals in ground state as well as ionic state.
24. Sc
25. It is because they show variable oxidation state, can form intermediate complexes and have large surface area for adsorption of gases.
26. It is because Cu^{2+} has one unpaired electron and undergoes d-d transition by absorbing light from visible region and radiate blue colour, whereas Zn^{2+} is colourless due to absence of unpaired
27. similar atomic radii. 15% of each other

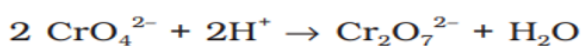
28. i



ii.



iii.



29. Mn because it has five unpaired electrons and 2 electrons in s-orbital which can take part in bond formation, therefore, it shows maximum number of oxidation states. (s+d electrons).
30. a. Copper exhibits +1 oxidation state frequently due to stable electronic configuration.
b. V^{3+} and Mn^{2+} are coloured, due to the presence of unpaired electrons, they can undergo d-d transitions.
Others are colourless due to the absence of unpaired electrons and cannot undergo d-d transitions.
31. It is because atomic mass increases more than atomic volume, therefore, density increases from titanium ($Z = 22$) to copper ($Z = 29$).
32. a. Assertion and reason are correct and Reason is the correct explanation of Assertion.

Prepared by Ms. Jasmin Joseph	Checked by:HOD - Science
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