

# JEE Main Chemistry Previous Year Questions With Solutions on D and F Block

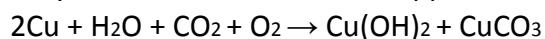
## IIT-PAL@PRUTOR

**1. Copper becomes green when exposed to moist air for a long period. This is due to:-**

- (1) the formation of a layer of cupric oxide on the surface of copper.
- (2) the formation of basic copper sulphate layer on the surface of the metal
- (3) the formation of a layer of cupric hydroxide on the surface of copper.
- (4) the formation of a layer of basic carbonate of copper on the surface of copper.

**Solution:**

copper becomes green when exposed to moist air for a long period of time because of the formation of a layer of basic carbonate of copper on the surface of copper.



Hence option (4) is the answer.

**2. Which one of the following exhibits the largest number of oxidation states?**

- (1) Mn(25)
- (2) V(23)
- (3) Cr (24)
- (4) Ti (22)

**Solution:**

Manganese can show 6 oxidation states from +2 to +7. It has 5 unpaired electrons in 3d orbitals and 2 electrons in the 4s orbitals.

Hence option (1) is the answer.

**3. The type of isomerism present in nitro- pentamine chromium (III) chloride is**

- (1) optical
- (2) linkage
- (3) ionization
- (4) polymerisation

**Solution:**

The nitro group can attach to metal through nitrogen as (-NO<sub>2</sub>) or through oxygen as nitrito (-ONO). So isomerism in nitro-pentamine chromium (III) chloride is linkage isomerism.

Hence option (2) is the answer.

**4. Iron exhibits +2 and +3 oxidation states. Which of the following statements about iron is incorrect?**

- (1) Ferrous compounds are more easily hydrolysed than the corresponding ferric compounds.
- (2) Ferrous oxide is more basic in nature than the ferric oxide.
- (3) Ferrous compounds are relatively more ionic than the corresponding ferric compounds.
- (4) Ferrous compounds are less volatile than the corresponding ferric compounds.

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### Solution:

Ferrous oxide is more basic in nature than ferric oxide. Ferrous compounds are less volatile since the ferrous compounds are more ionic. Ferric compounds are relatively more ionic than the corresponding ferrous compounds. So the statement (1) is incorrect.

Hence option (1) is the answer.

### 5. Potassium dichromate when heated with concentrated sulphuric acid and a soluble chloride, gives brown-red vapours of:

- (1)  $\text{CrO}_3$
- (2)  $\text{Cr}_2\text{O}_3$
- (3)  $\text{CrCl}_3$
- (4)  $\text{CrO}_2\text{Cl}_2$

### Solution:



Potassium dichromate when heated with concentrated sulphuric acid and a soluble chloride, gives brown-red vapours of  $\text{CrO}_2\text{Cl}_2$

Hence option (4) is the answer.

### 6. The actinoids exhibit more number of oxidation states in general than the lanthanoids. This is because

- (1) the 5f orbitals extend further from the nucleus than the 4f orbitals
- (2) the 5f orbitals are more buried than the 4f orbitals
- (3) there is a similarity between 4f and 5f orbitals in their angular part of the wave function
- (4) the actinoids are more reactive than the lanthanoids.

### Solution:

Since the distance between the nucleus and 5f orbitals is more than the distance between the nucleus and 4f orbitals, the hold of the nucleus on valence electron decreases in actinides. So actinoids exhibit more number of oxidation states in general.

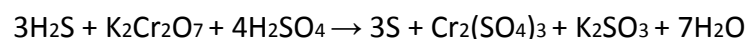
Hence option (1) is the answer.

### 7. Which of the following is not formed when $\text{H}_2\text{S}$ reacts with acidic $\text{K}_2\text{Cr}_2\text{O}_7$ solution?

- (1)  $\text{K}_2\text{SO}_4$
- (2)  $\text{Cr}_2(\text{SO}_4)_3$
- (3) S
- (4)  $\text{CrSO}_4$

### Solution:

When  $\text{H}_2\text{S}$  reacts with acidic  $\text{K}_2\text{Cr}_2\text{O}_7$  solution



Hence option (4) is the answer.

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### 8. The lanthanide contraction is responsible for the fact that

- (1) Zr and Y have about the same radius
- (2) Zr and Nb have a similar oxidation state
- (3) Zr and Hf have about the same radius
- (4) Zr and Zn have the same oxidation state.

#### Solution:

The pairs of elements such as Zr-Hf, Mo-W, Nb-Ta, etc possess almost the same properties. Due to lanthanide contraction, in each vertical column of transition elements, the elements of second and third transition series resemble each other more closely than the elements of first and second transition series on account of lanthanide contraction.

Hence option (3) is the answer.

### 9. Which of the following statements is false?

- (1) has a Cr – O – Cr bond
- (2) is tetrahedral in shape
- (3)  $\text{Na}_2\text{Cr}_2\text{O}_7$  is a primary standard in volumetry
- (4)  $\text{Na}_2\text{Cr}_2\text{O}_7$  is less soluble than  $\text{K}_2\text{Cr}_2\text{O}_7$

#### Solution:

$\text{Na}_2\text{Cr}_2\text{O}_7$  is a secondary standard in volumetry.  $\text{Na}_2\text{Cr}_2\text{O}_7$  is more soluble than  $\text{K}_2\text{Cr}_2\text{O}_7$

Hence option (3) and (4) is the answer.

### 10. In context with the transition elements, which of the following statements is incorrect?

- (1) In the highest oxidation states of the first five transition elements (Sc to Mn), all the 4s and 3d electrons are used for bonding.
- (2) Once the d5 configuration is exceeded, the tendency to involve all the 3d electrons in bonding decreases.
- (3) In addition to the normal oxidation states, the zero oxidation state is also shown by these elements in complexes.
- (4) In the highest oxidation states, the transition metal show basic character and form cationic complexes.

#### Solution:

In highest oxidation states, transition metals form anionic complexes. So statement (4) is incorrect. Hence option (4) is the answer.

### 11. The element that usually does not show variable oxidation states is

- (a) V
- (b) Ti
- (c) Cu

(d) Sc

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### Solution:

Sc usually does not show variable oxidation states.  
Hence option (4) is the answer.

### 12. The pair that has similar atomic radii is

- (1) Mn and Re
- (2) Ti and Hf
- (3) Sc and Ni
- (4) Mo and W

### Solution:

Because of lanthanoid contraction, the atomic radii of the elements of the second and third transition series are nearly the same. Hence option (4) is the answer.

**13. In the context of the lanthanoids, which of the following statement is not correct?** (1) There is a gradual decrease in the radii of the members with increasing atomic number in the series. (2) All the members exhibit a +3 oxidation state.

- (3) Because of similar properties, the separation of lanthanoids is not easy.
- (4) Availability of 4f electrons results in the formation of compounds in +4 state for all the members of the series.

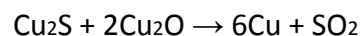
### Solution:

Availability of 4f electrons does not result in the formation of compounds in +4 state for all the members of the series. Statement (4) is wrong.  
Hence option (4) is the answer.

### 14. Heating mixture of Cu<sub>2</sub>O and Cu<sub>2</sub>S will give

- (a) Cu + SO<sub>2</sub>
- (b) Cu + SO<sub>3</sub>
- (c) CuO + CuS
- (d) Cu<sub>2</sub>SO<sub>3</sub>

### Solution:



Hence option (1) is the answer.

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**15. Knowing that the chemistry of lanthanoids (Ln) is dominated by its +3 oxidation state, which of the following statements is incorrect?**

- (1) Because of the large size of the Ln(III) ions, the bonding in its compounds is predominantly ionic in character.
- (2) The ionic sizes of Ln(III) decrease in general with increasing atomic number.
- (3) Ln(III) compounds are generally colourless.
- (4) Ln(III) hydroxides are mainly basic in character.

**Solution:**

$\text{Ln}^{3+}$  compounds are usually coloured in the solid-state as well as in an aqueous solution. Colour appears because of the presence of unpaired f-electrons which undergo f-f transition. Hence option (3) is the answer.

**16. The atomic numbers of vanadium (V), chromium (Cr), manganese (Mn) and iron (Fe) are respectively 23, 24, 25 and 26. Which one of these may be expected to have the highest second ionisation enthalpy?**

- (1) V
- (2) Cr
- (3) Mn
- (4) Fe

**Solution:**

The second ionisation potential values of Cu and Cr are sufficiently higher than those of neighbouring elements. This is due to the electronic configuration of  $\text{Cu}^+$  which is  $3d^{10}$  and of  $\text{Cr}^+$  which is  $3d^5$ . Hence option (2) is the answer.

