Reactivity Series

Introduction

Reactivity of elements

> The atoms of the elements in the periodic table react with each other to form new compounds (except noble gases). The atoms react due to its tendency to lose, gain or share electrons.

> **Metals:** The atoms of metal will always lose electrons to form positive ions called cations. If the atom readily loses electron at room temperature it is said to be reactive metal than the metal whose atom does not readily lose electron at the room temperature.

> **Non-Metals:** The atoms of non-metals gains or shares electrons to form negative ions called anions, the atoms of non-metals if readily gains electrons it is said to be more reactive.

> **Speed of reaction:** We can calculate the speed of reaction of metals by allowing them to react with water at room temperature and collect the hydrogen gas obtained. If the temperature of water, the amount of metal and the amount of water is kept constant, the rate of reactivity can be calculated.

Why displacement reaction?

> To arrange the metals in the increasing or decreasing order of their reactivity one of the commonly used experiment is by checking their displacement rate. This is a reliable technique used, because aluminium is actually a reactive metal but due to the protective coating of aluminium oxide on it, the results may show that aluminium's reactivity rate is slow.

> Hence the displacement reaction is used to arrange the metals in the reactivity series.

Metal Displacement Reactions

> A more reactive metal will displace (take the place of) a less reactive metal in a metal salt solution.

Non-Metal Displacement Reactions

> This is similar to the metal displacement reactions. In case of halogens, more reactive non-metal will displace the less reactive one from its place.

Metal displacement

> For example, in a given chemical reaction:

$$Fe\,(s) + CuSO_4\,(aq) \rightarrow FeSO_4\,(aq) + Cu(s)$$

$$\text{Iron} + \text{Copper (II) sulphate} \rightarrow \text{Iron sulphate} + \text{Copper}$$

> Copper (II) sulphate is blue in colour. When iron nail is dipped in this solution, reaction

takes place and blue colour disappears and turns greenish and the iron metal gets coated with pink-brown copper metal.
> A more reactive metal will always displace a less reactive metal.
> If a less reactive metal is added to a more reactive metal salt solution then there will be no reaction.
> For example, iron is less reactive than zinc.
Iron + Zinc sulphate —> No reaction.
> In displacement reactions, the metals compete for the non-metal anion. Here, in the above reaction it is S042- ion.
> The order of the metals in the reactivity series can be worked out by using these type of reactions.

Reactivity series
> The arrangement of metals in decreasing order of their reactivity is called reactivity series or activity series of metals.

Mnemonic	Element	Symbol	Reactivity
Put	Potassium	K	As you can see these metals (excluding carbon, as carbon is used for the reduction of metal from metal oxide ore, all metals below carbon are reduced by it) are above hydrogen in the reactivity series so they react with acids and displace hydrogen gas. Metal + Acid —> Metal salt + Hydrogen
Some	Sodium	Na	
Light	Lithium	Li	
Color	Calcium	Ca	
Metal	Magnesium	Mg	
Around	Aluminium	Al	
Carbon	Carbon	C	
Zone	Zinc	Zn	
In	Iron	Fe	
The	Tin	Sn	
Light	Lead	Pb	

Here	Hydrogen	H	H^+ ions are responsible for acidic properties.
Comes	Copper	Cu	These elements are below hydrogen so they do not react with acids. (Acids contain H^+ ions) **Exception:** Copper reacts with concentrated nitric acid, the nitrate ions oxidize copper.
Metals	Mercury	Hg	
Silver	Silver	Ag	
Gold	Gold	Au	
Platinum	Platinum	Pt	

Note: When metals react with nitric acid they do not release hydrogen gas (except magnesium and manganese) because nitric acid acts as a strong oxidizing agent.

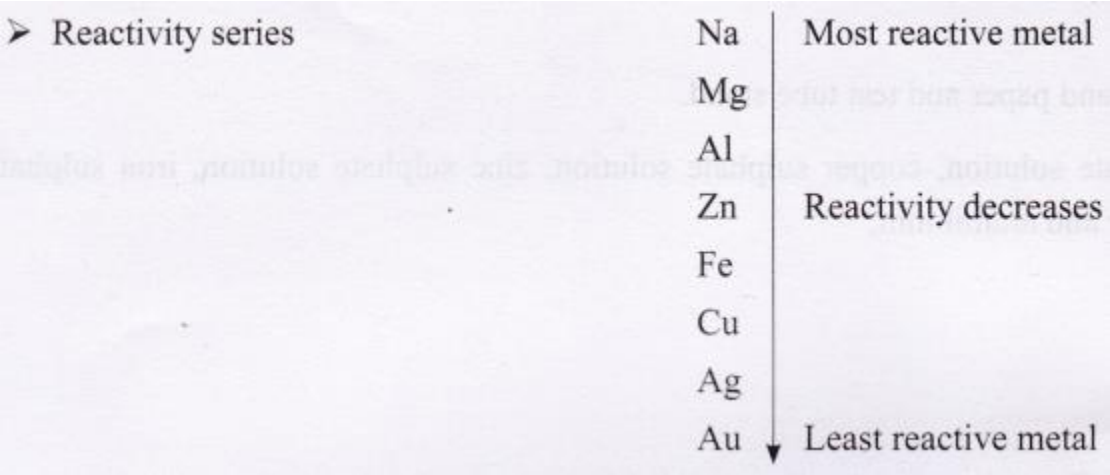
EXPERIMENT 4

Aim

(i) To observe the action ofZn, Fe, Cu and Al metals on the following salt solutions:
(a) $ZnSO_4$(aq.)
(b) $FeSO_4$(aq.)
(c) $CuSO_4$ (aq.)
(d) $Al_2(SO_4)_3$(aq.)
(ii) Arrange Zn, Fe, Cu and Al metals in the decreasing order of reactivity based on the above result.

Theory

> **Reactivity series:** The arrangement of metals in decreasing order of their reactivity is called reactivity series. The most reactive metal displaces the less reactive metal from its salt solution.



> Metal salts are coloured

➢ For e.g.	$ZnSO_4$	⟶ white salt	—	colourless solution
	$FeSO_4$	⟶ light green salt	—	green solution
	$CuSO_4$	⟶ blue salt	—	blue solution
	$Al_2(SO_4)_3$	⟶ white salt	—	colourless solution

> Reaction of Metals with Salt Solution

(i) Salt solution $CuSO_4$.

$$2Al(s) + 3CuSO_4(aq) \longrightarrow Al_2(SO_4)_3(aq) + 3Cu(s)$$
$$Zn(s) + CuSO_4(aq) \longrightarrow ZnSO_4(aq) + Cu(s)$$
$$Fe(s) + CuSO_4(aq) \longrightarrow FeSO_4(aq) + Cu(s)$$
$$Cu(s) + CuSO_4(aq) \longrightarrow \text{No reaction}$$

As Al, Zn and Fe can displace Cu from its salt solution hence, all three are more reactive than Cu.

(ii) Salt solution $FeSO_4$.

$$2Al(s) + 3FeSO_4(aq) \longrightarrow Al_2(SO_4)_3(aq) + 3Fe(s)$$
$$Zn(s) + FeSO_4(aq) \longrightarrow ZnSO_4(aq) + Fe(s)$$
$$Fe(s) + FeSO_4(aq) \longrightarrow \text{No reaction}$$
$$Cu(s) + FeSO_4(aq) \longrightarrow \text{No reaction}$$

As Zn and Al can displace Fe from its salt solution hence, Zn and A1 are more reactive than Fe but Cu is less reactive than Fe.

(iii) Salt solution $ZnSO_4$.

$$2Al(s) + 3ZnSO_4(aq) \longrightarrow Al_2(SO_4)_3(aq) + Zn(s)$$
$$Zn(s) + ZnSO_4(aq) \longrightarrow \text{No reaction}$$
$$Fe(s) + ZnSO_4(aq) \longrightarrow \text{No reaction}$$
$$Cu(s) + ZnSO_4(aq) \longrightarrow \text{No reaction}$$

As only Al metal displaces Zn from its salt solution hence, Al is the most reactive metal among Al, Zn, Fe and Cu.

Al > Zn > Fe > Cu.

Materials Required

Four clean test tubes, marker, a piece of sand paper and test tube stand.

Chemicals required: Aluminium sulphate solution, copper sulphate solution, zinc

sulphate solution, iron sulphate solution, metal strips of iron, zinc; copper and aluminium.

Procedure

> Reaction with $CuSO_4$ solution:

1. Take four clean test tubes.
2. With a marker label them as A, B, C and D.
3. Take copper sulphate solution in each test tube.
4. Dip a small, clean piece of aluminium, zinc, iron and copper metals in test tubes A, B, C and D respectively.
5. Record your observations.

Metal Solution	Test Tube	Metal	Experiment	Observation	Inference
$CuSO_4$	A	Al	$Al + CuSO_4$	Blue solution of $CuSO_4$ becomes colourless.	Al is more reactive
	B	Zn	$Zn + CuSO_4$	Blue solution of $CuSO_4$ becomes colourless.	Zn is more reactive
	C	Fe	$Fe + CuSO_4$	Blue solution becomes green.	Fe is more reactive
	D	Cu	$Cu + CuSO_4$	No change.	Equilibrium

Conclusion: Al, Zn and Fe metals are more reactive than Cu. Hence, Cu is the least reactive metal among the given four metals.

> Reaction with $FeSO_4$ solution:

1. Take four clean test tubes, labelled as A, B, C, and D.
2. Take $FeSO_4$ (aq) solution in each test tube.
3. Dip small, clean pieces of aluminium, zinc, iron and copper metals in test tube A, B, C and D respectively.
4. Record your observations.

Metal Solution	Test Tube	Metal	Experiment	Observation	Inference
$FeSO_4$	A	Al	$Al + FeSO_4$	Green solution becomes colourless.	Al is more reactive than Fe
	B	Zn	$Zn + FeSO_4$	Green solution becomes colourless.	Zn is more reactive than Fe
	C	Fe	$Fe + FeSO_4$	No change.	Equilibrium
	D	Cu	$Cu + FeSO_4$	No change.	Cu is less reactive than Fe

Conclusion: Al and Zn metals are more reactive than Fe and Cu.

> Reaction with $ZnSO_4$ solution:

1. Take test tubes A, B, C, and D, clean them.
2. Add $ZnSO_4$ solution in each test tube.
3. Dip small, clean pieces of Al, Zn, Fe and Cu metal in test tube A, B, C and D respectively.
4. Record your observations.

Metal Solution	Test Tube	Metal	Experiment	Observation	Inference
$ZnSO_4$	A	Al	$Al + ZnSO_4$	Reaction seen	Al is more reactive than Cu
	B	Zn	$Zn + ZnSO_4$	No reaction.	Equilibrium
	C	Fe	$Fe + ZnSO_4$	No reaction.	Fe is less reactive than Zn
	D	Cu	$Cu + ZnSO_4$	No reaction.	Cu is less reactive than Zn

Conclusion: Al metal is more reactive than Zn metal.

> Reaction with $Al_2(SO_4)_3$ solution:

1. Take test tubes A, B, C, and D and clean them.
2. Add $Al_2(SO_4)_3$ solution in each test tube.
3. Dip small, clean pieces of Al, Zn, Fe and Cu metal in test tubes A, B, C and D respectively.
4. Record your observations.

Metal Solution	Test Tube	Metal	Experiment	Observation	Inference
$Al_2(SO_4)_3$	A	Al	$Al + Al_2(SO_4)_3$	No reaction.	Equilibrium
	B	Zn	$Zn + Al_2(SO_4)_3$	No reaction.	Zn is less reactive than Al
	C	Fe	$Fe + Al_2(SO_4)_3$	No reaction.	Fe is less reactive than Al
	D	Cu	$Cu + Al_2(SO_4)_3$	No reaction.	Cu is less reactive than Al

Conclusion: Al metal is not displaced by any of the given metals i.e. Al, Zn, Fe and Cu.

Hence, Al metal is the most reactive metal among the given metals.

1. Al is not displaced by any of the four metals from its salt solution, hence, Al is at the top of the reactivity series.
2. Al can displace Zn from its salt solution but no other metal could displace it. Hence, the reactivity order is Al > Zn.
3. Al and Zn metals can displace Fe metal from its salt solution but Cu cannot.

Hence, the arrangement of metals in decreasing reactivity order is
Al > Zn > Fe > Cu.

I. $CuSO_4$ solution in each test tube.

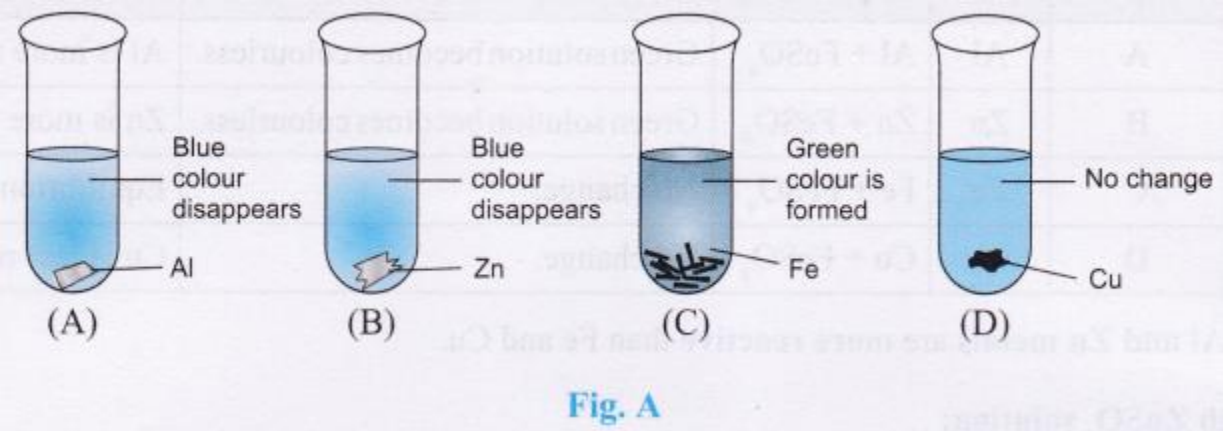


Fig. A

II. $FeSO_4$ solution in each test tube.

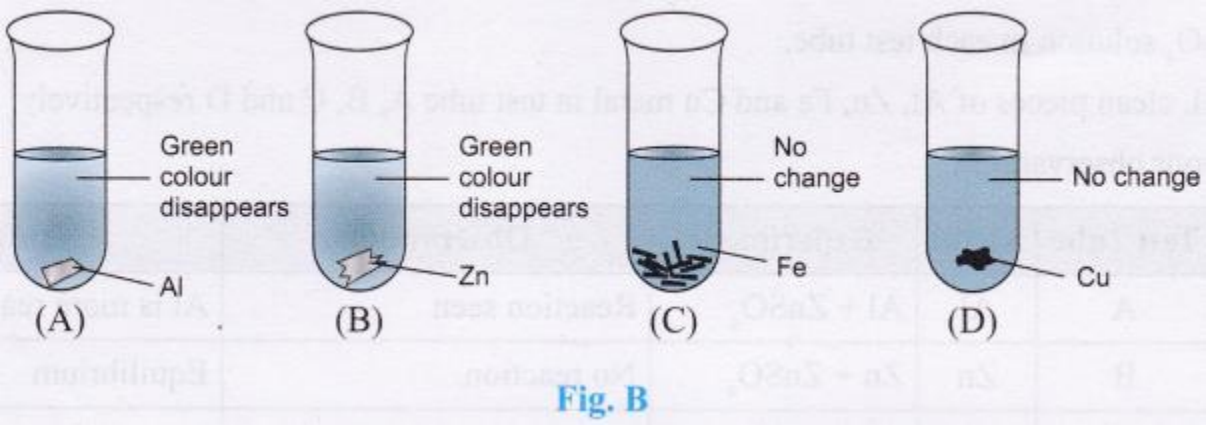


Fig. B

III. $ZnSO_4$ solution in each test test tube.

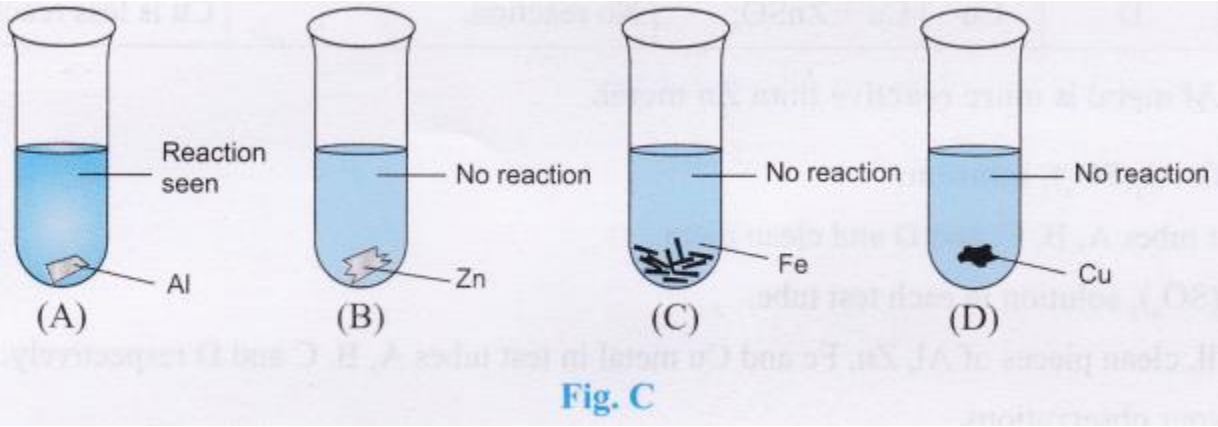


Fig. C

IV. $Al_2(SO_4)_3$ solution in each test tube.

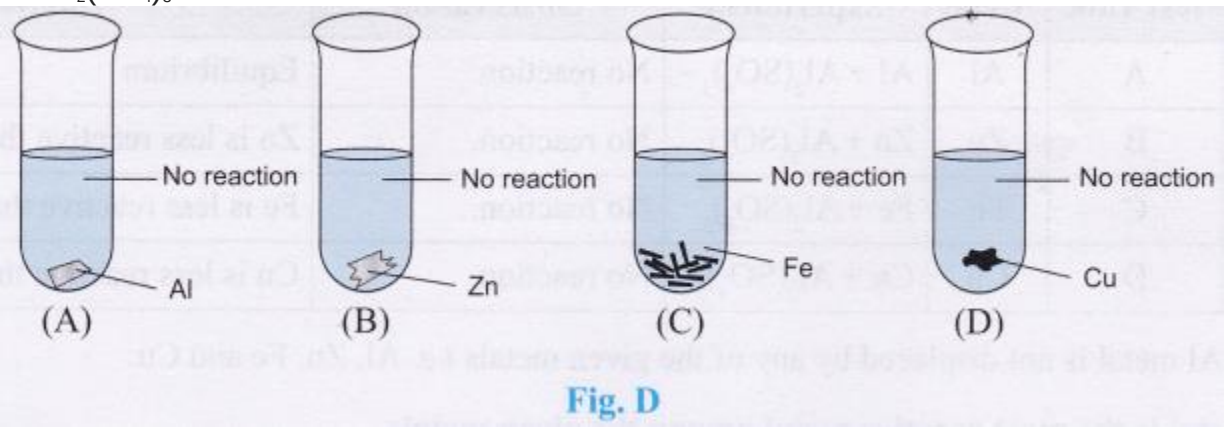


Fig. D

Precautions

1. Clean the metals by rubbing them with a piece of sand paper before dipping them in the salt solutions.
2. Wash the test tubes after every set of observations of interaction of a particular metal with the four salt solution.
3. Use very little amount of saturated solution of copper sulphate, aluminium sulphate, iron sulphate and zinc sulphate.

4. Use very small pieces of metal every time.
5. Do not touch any chemical.

Viva Voce

Question 1:
What is the colour of copper sulphate solution?
Answer:
The colour of copper sulphate solution is blue.

Question 2:
What is the colour of iron sulphate solution?
Answer:
The colour of iron sulphate solution is green.

Question 3:
When we add Fe in $FeSO_4$ solution, no change is seen. Why?
Answer:
It is because Fe does not react with $FeSO_4$ solution.

Question 4:
Name one metal which when added to blue $CuSO_4$ solution changes it to green colour.

Answer:
Iron metal reacts with blue-coloured copper sulphate solution and changes it into green colour.

Question 5:
What is the colour of $Al_2(SO_4)_3$ solution?
Answer:
$Al_2(SO_4)_3$ solution is colourless.

Question 6:
Complete the given chemical equation $Fe(s) + CuSO_4(aq) \longrightarrow$
Answer:
$Fe(s) + CuSO_4(aq) \longrightarrow FeSO_4(aq) + Cu(s)$

Practical Based Questions

Question 1:
What is the activity series of metals?
Answer:

The arrangement of metals in the decreasing order of their reactivity is called activity series of metals.

Question 2:
What is displacement reaction?
Answer:
When a more reactive metal displaces the less reactive metal from its salt solution, it is called displacement reaction.

Question 3:
What happens when a piece of zinc metal is introduced into a freshly prepared solution of ferrous sulphate?
Answer:
The colour of ferrous sulphate solution is green and when zinc is added to it the colour fades and becomes colourless.

Question 4:
What happens when Fe (Iron) metal is added to blue colour copper sulphate solution?
Answer:
Iron metal reacts with copper sulphate solution to displace copper and form iron sulphate that is green in colour.
$Fe(s) + CuSO_4(aq) \longrightarrow FeSO_4(aq) + Cu(s)$

Question 5:
What happens when A1 metal is added to copper sulphate solution?
Answer:
Al metal reacts with copper sulphate solution to form aluminium sulphate and copper metal is displaced.

Question 6:
Name the least reactive metal among the following: Fe, Zn, Al.
Answer:
Fe is the least reactive metal among Fe, Zn, and AT

Question 7:
What will happen if Fe metal is added to $ZnSO_4$ solution?
Answer:
No reaction will take place, as Fe metal is less reactive than Zn.

Question 8:
Arrange the given metals in the reactivity series:
Mg, Zn, Cu, Fe, Al
Answer:

The reactivity series of metals is
Mg > Al > Zn > Fe > Cu

Question 9:
Name some metals that will react with aluminium sulphate solution, i.e., $Al_2(SO_4)_3$.
Answer:
Metals like calcium, sodium and magnesium will react with aluminium sulphate solution.

Question 10:
When you keep aluminium strip in $FeSO_4$ solution, what change is seen?
Answer:
Aluminium is more reactive than Fe hence it displaces Fe from FeS04 and green colour of $FeSO_4$disappears.

Question 11:
Why is Fe metal more reactive than copper metal?
Answer:
Fe readily loses electrons as compared to copper. Hence, it is more reactive than copper metal.

Question 12:
How can you test that a given sample contains water or not?
Answer:
On heating copper sulphate crystals the blue colour of copper slowly changes to light blue and then colourless. The water droplets are collected on the inner part of the test tube.

Question 14:
It is regarded that each molecule of copper sulphate crystals at room temperature contains five water molecules as water of crystallisation. Do you see any difference in them? (**Hint:** Look at the dehydration reaction of copper sulphate)
Answer:
In one molecule of copper sulphate, five water molecules are present to form crystal. The blue colour of the crystals is due to these five water molecules. But, in anhydrous copper sulphate the water molecules are not present.

NCERT Lab Manual Questions

Question 1:
Why does the colour of copper sulphate solution change, when an iron nail is dipped in it?
Answer:
The iron nail reacts with copper sulphate displace copper and form iron sulphate . Due

to the displacement reaction the blue colour of copper sulphate changes to green colour of iron sulphate.

Question 2:
How would you devise the procedure to show that Mg > Fe > Cu in reactivity series? What is the basic principle involved in this Experiment?
Answer:
I will react each metal (Mg, Fe and Cu) with the salt solutions of Mg, Fe and Cu. The metal that will displace two metal ions from the salt solutions will be the most reactive and the one which will not show any colour change in the solutions is the least reactive.
Principle: The most reactive metal will displace the less reactive metal.

Question 3:
Why does the following reaction takes place?
$2I^-(aq) + Cl_2(aq) \longrightarrow 2I^-(aq) + I_2$ (solvated)
Answer:
This is the displacement reaction seen among halogens. Chlorine is more reactive than iodine and hence it displaces iodide ion.

Question 4:
In the following reaction, A and B are metals. BX is a salt of metal B.
$A + BX \longrightarrow AX + B$
Which one of the two metals is more reactive? Give reason.
Answer:
Metal A is more reactive than B, because metal A displaces metal B from its salt solution.

Question 5:
Name any two metals that are more reactive than iron.
Answer:
Zinc and magnesium.

Question 6:
Why did the colour of copper (II) sulphate solution, change, when zinc metal was dipped in it?
Answer:
Zinc is more reactive than copper and displaces copper from its solution. Hence, the blue colour of copper sulphate solution becomes colourless.

Question 7:
What is your observation when copper is added in iron (II) sulphate solution?
Answer:
Copper is less reactive than iron and cannot displace iron from iron sulphate solution and there is no colour change.

Question 8:
Why can we safely preserve iron (II) sulphate in a copper vessel whereas the same can't be safely preserved in zinc vessel?
Answer:
Copper is less reactive than iron and cannot react with iron sulphate. Whereas zinc is more reactive than iron and hence it can react with iron sulphate.

Multiple Choice Questions (MCQs)

Questions based on Procedural and Manipulative Skills
1. When an iron strip was placed in the copper sulphate solution, the time required for the colour of the solution to change from blue to green will be less if:
(a) it is cooled
(b) it is shaken
(c) it is kept undisturbed
(d) it is heated.

2. The colour of zinc sulphate solution is
(a) white
(b) green
(c) yellow
(d) colourless.

3. Which of the following reaction will not occur?
(a) Al + $ZnSO_4$
(b) Zn + $ZnSO_4$
(c) Cu + $ZnSO_4$
(d) Mg + $ZnSO_4$.

4. Which of the following reaction will take place?
(a) Fe + $FeSO_4$
(b) Cu + $FeSO_4$
(c) Au + $FeSO_4$
(d) Mg + $ZnSO_4$.

5. To show that zinc is more reactive than copper, the correct procedure is to
(a) prepare copper sulphate solution and dip a zinc strip in it.
(b) prepare copper sulphate solution and dip a copper strip in it.
(c) heat zinc and copper strips.
(d) add dilute nitric acid on both the strips.

6. On adding iron strip in copper sulphate solution, the reaction takes long time, to make it happen fast we can:

(a) add more iron strips
(b) add more copper sulphate solution
(c) heat the container of reactants
(d) heat iron and add in copper sulphate.

7. You are given two test tubes A and B, with solutions ZnS04 and A12(S04)3, both are colourless. To identify the solutions,
(a) add Zn in test tube A and B
(b) add A1 in test tube A and B
(c) first add Zn and then A1 in test tubes A and B
(d) all the above are correct.

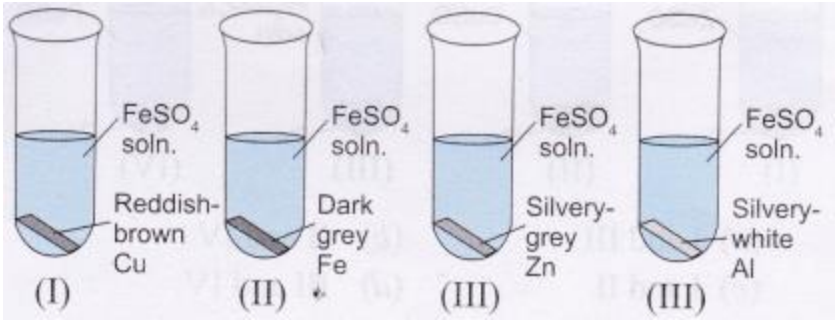
8. Two metals which can displace iron from its solution are:
(a) copper and zinc
(b) zinc and tin
(c) silver and aluminium
(d) zinc and aluminium.

9. P + QR → PQ + R. In the above reaction,
(a) Q displaces P
(b) R is displaced by P
(c) P displaces Q
(d) R displaces Q.

10. Two beakers A and B contain Iron (II) sulphate solution. In the beaker A is placed a small piece of copper and in the beaker B is placed a small piece of zinc. It is found that a grey deposit forms on the zinc but not on the copper. From these observations it can be concluded.
(a) Zinc is most active metal followed by iron and copper.
(b) Zinc is most active metal followed by copper and then iron.
(c) Iron is most active metal followed by zinc and then copper.
(d) Iron is most active metal followed by copper and then zinc.

Questions based on Observational Skills

11. A student took Cu, Fe, Zn and Al strips separately in four test tubes labelled I, II, III and IV respectively. He added 10 mL of freshly prepared ferrous sulphate solution to each test tube as shown below:



Black residue would be obtained in test tubes:
(a) I and II (b) I and III
(c) II and III (d) III and IV.

12. Aluminium powder was added to a solution of copper sulphate. The colour of the solution changed from:
(a) colourless to blue
(b) blue to colourless
(c) light green to blue
(d) reddish-brown to light green.

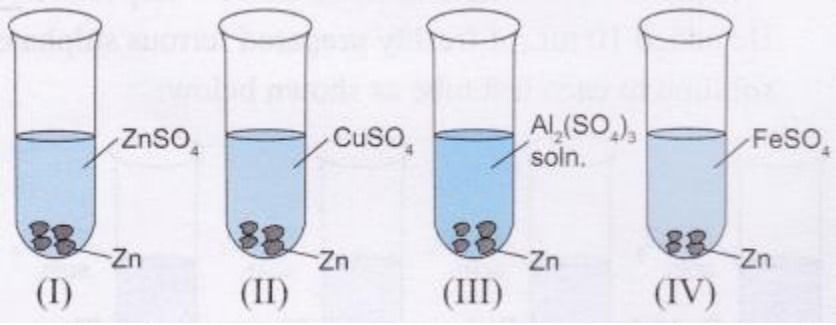
13. The colour of the coating obtained on a zinc rod on dipping in aqueous copper sulphate solution will be
(a) blue (b) brown
(c) white (d) green.

14. Which one is not observed when aluminium is added to a solution of copper sulphate?
(a) The solution is blue in the beginning.
(b) The final solution becomes colourless.
(c) The final solution becomes light green.
(d) A brown mass is deposited on the surface of aluminium.

15. Copper turnings were added to colourless salt solution. After 10 minutes it was observed that the colourless solution turned to a coloured solution and a shiny metal deposition appears. The colour of the solution and that of the metal would respectively be
(a) yellow and Zn (b) green and Fe (c) red and Sn (d) blue and Ag.

16. Iron filings were added to an aqueous solution of copper sulphate. After some time, on observation, it was found that the colour of the solution has changed from
(a) blue to pale green (b) blue to dark green (c) blue to colourless (d) blue to reddish-brown.

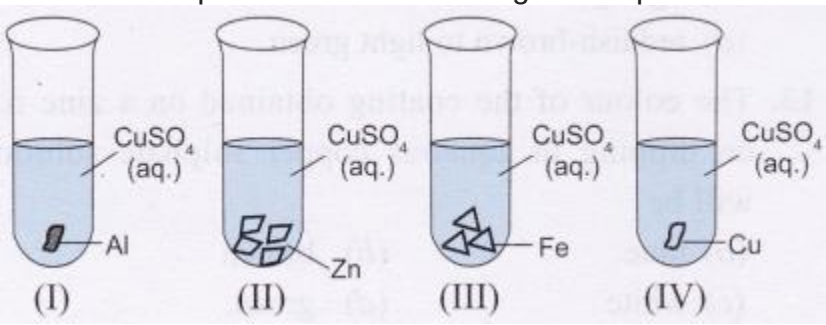
17. Zinc granules were added to zinc sulphate, copper sulphate, aluminium sulphate and iron sulphate solutions as shown below. You would observe the deposition of metal on zinc in test tubes



(a) I and III (b) II and IV
(c) I and II (d) III and IV.

18. A student added a piece of zinc metal in four different test tubes containing different solutions. In which test tube he observed no change?
(a) Test tube with $CuSO_4$ solution
(b) Test tube with $AgNO_3$ solution
(c) Test tube with $ZnSO_4$ solution
(d) Test tube with $FeSO_4$ solution.

19. A student performed the following four experiments:



He would find the formation of solid deposition on metal in experiments
(a) II, III (b) I, III
(c) I, II, III (d) II, III, IV.

20. A piece of granulated zinc was dropped into copper sulphate solution. After some time, the colour of the solution changed from
(a) light green to blue
(b) blue to colourless
(c) light green to colourless
(d) blue to yellow.

21. A strip of copper was placed in a beaker containing zinc sulphate solution. On observing the strip the next day, it was noticed that
(a) the copper strip remained as it was
(b) the copper strip became thinner
(c) the copper strip became thicker
(d) the colour of the strip changed.

22. When a few crystals of copper sulphate are dissolved in water, the colour of the solution obtained would be:
(a) green (b) red
(c) blue (d) brown.

23. Iron filings were added to a solution of copper sulphate. After 10 minutes, it was observed that blue colour of the solution changes and a layer gets deposited on iron filings. The colour of the solution and that of the coating would respectively be
(a) yellow and green
(b) brown and blue
(c) red and greenish-blue
(d) green and reddish-brown.

24. Iron spoon was placed in a glass container holding zinc sulphate solution. What is the right observation?
(a) Zinc sulphate will become green.
(b) Glass container will get cracks.
(c) Iron spoon will get holes in it.
(d) Iron spoon will not show any change.

25. When an aluminium strip is kept immersed in freshly prepared ferrous sulphate solution taken in a test tube, the change observed is
(a) the green solution slowly turns blue.
(b) the lower end of the test tube becomes slightly warm.
(c) a colourless gas with a smell of burning sulphur is observed.
(d) light green solution changes to blue.

26. Solutions of $FeSO_4$, $ZnSO_4$, $CuSO_4$ and $Al_2(SO_4)_3$ solutions were separately taken in four test tubes and some iron nails were placed in each of the solutions. After a few minutes, it would be observed that the colour of
(a) all the four solutions changed.
(b) solution of $ZnSO_4$, $CuSO_4$ and $Al_2(SO_4)_3$ changed and that of $FeSO_4$ did not change.
(c) solution of $ZnSO_4$ and $Al_2(SO_4)_3$ only changed.
(d) copper sulphate solution only changed.

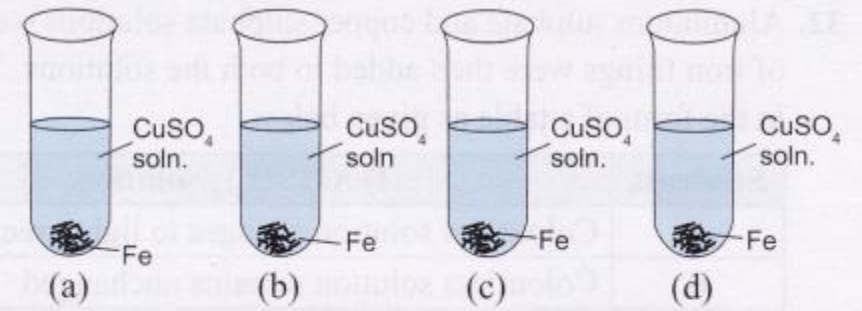
27. When you place iron nail in copper sulphate solution, the reddish brown coating formed on the nail is

(a) soft and dull.
(b) hard and flaky.
(c) smooth and shining
(d) rough and granular.

Questions based on Reporting and Interpretation Skills

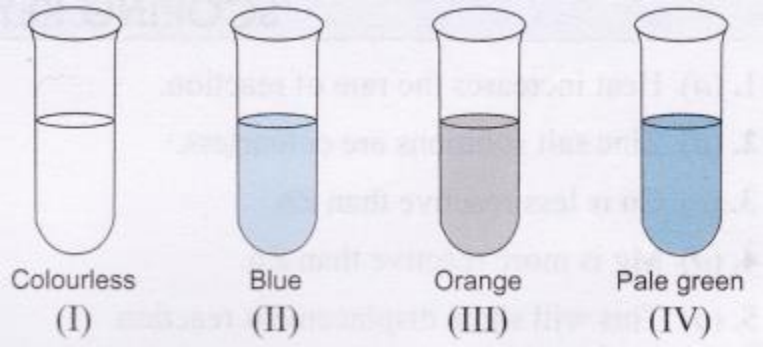
28. 10 mL of freshly prepared iron sulphate was taken in each of four test tubes. Strips of copper, iron, zinc and aluminium were introduced, each metal in a different test tube. A black residue was obtained in two of them.
The right pair of metals forming the precipitates is
(a) Copper and zinc
(b) aluminium and copper
(c) iron and aluminium
(d) zinc and aluminium

29. Four students were assigned separately the experiment of interaction of an iron nail with a solution of copper sulphate. Each group recorded the observations as [given below in the table. Which group of students recorded the observations correctly?

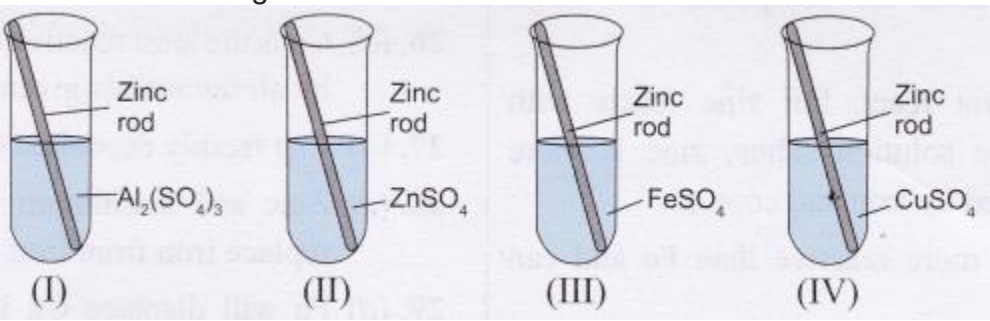


Group of Students	Initial colour of soln.	Final colour of soln.	Change in iron nail
(*a*)	Blue	Colourless	Grey coat
(*b*)	Green	Green	Brown coat
(*c*)	Blue	Blue	Brown coat
(*d*)	Blue	Light green	Brown coat

30. A student took four test tubes containing solutions of different colours marked I, II, III, and IV as shown below. The test tubes containing copper sulphate solution and ferrous sulphate solution could be the tubes:



31. Four students A, B, C and D noted the initial colour of the solutions in test tubes I. II, III and IV. After inserting
zinc rod in each solution and leaving it undisturbed for two hours, they noted the colour of each solution again.



They recorded their observations in the form of table given below:

Students	Colour of solution	I	II	III	IV
A	Initial	Colourless	Colourless	Light green	Blue
	Final	Colourless	Colourless	Colourless	Colourless
B	Initial	Colourless	Light yellow	Light green	Blue
	Final	Colourless	Colourless	Light green	Colourless
C	Initial	Colourless	Colourless	Light green	Blue
	Final	Light blue	Colourless	Colourless	Light blue
D	Initial	Light green	Colourless	Light green	Blue
	Final	Colourless	Colourless	Dark green	Colourless

Which student noted the colour change in all the four test tubes correctly?
(a) A (b) B (c) C (d) D.

32. Aluminium sulphate and copper sulphate solutions were taken in two test tubes I and II respectively. A few pieces of iron filings were then added to both the solutions. The four students A, B, C and D recorded their observations in the form of a table as given below.

Students	(I) Al2(SO4)3 Solution	(II) Copper Sulphate Solution
A	Colourless solution changes to light green	Blue colour of the solution is retained.
B	Colourless solution remains unchanged	Blue solution changes to green.
C	Colourless solution changes to light blue	Blue colour changes to light green.
D	Colourless solution remains unchanged	Blue colour of the solution fades away.

The correct set of observations have been recorded by student
(a) A (b) B (c) C (d) D.

ANSWERS

1. (d)	2. (d)	3. (c)	4. (d)	5. (a)	6. (c)	7. (d)	8. (d)	9. (b)	10. (a)
11. (d)	12. (b)	13. (b)	14. (c)	15. (d)	16. (a)	17. (b)	18. (c)	19. (c)	20. (b)
21. (a)	22. (c)	23. (d)	24. (d)	25. (b)	26. (d)	27. (a)	28. (d)	29. (d)	30. (d)
31. (a)	32. (b)								

Scoring Key With Explanaion

1. (d) Heat increases the rate of reaction.
2. (d) Zinc salt solutions are colourless.
3. (c) Cu is less reactive than Zn.
4. (d) Mg is more reactive than Zn.
5. (a) This will show displacement reaction.
6. (c) Increase in temperature speeds up the reaction.
7. (d) All tests will help in identifying the solutions.
8. (d) Both are more reactive than Fe.
9. (b) R is removed from the compound and exists freely.
10. (a) Copper does not react, but zinc reacts with ferrous sulphate solution.
Thus, zinc is more reactive followed by iron and copper.
11. (d) Zn and Al are more reactive than Fe and can displace it.
12. (b) Copper salt is blue in colour and aluminium salts are colourless.
13. (b) Cu is displaced by Zn which is brown in colour.
14. (c) Aluminium salt is colourless and not green in colour.
15. (d) Copper is more reactive than Ag.
16. (a) Fe displaces copper ions.
17. (b) Zinc is more reactive than Cu and Fe.
18. (c) Equilibrium is seen.
19. (c) As per reactivity series.
20. (b) Zinc salt solutions are not coloured.

21. (a) Copper is less reactive than zinc.
22. (c) Cu salt is blue coloured.
23. (d) Ferrous salts are green.
24. (d) Iron is less reactive than Zn.
25. (b) It shows thermite reaction and heat is evolved.
26. (d) Cu is the least reactive metal and can be displaced by all the metals given.
27. (a) The freshly deposited copper is soft and dull.
28. (d) Zinc and alufninium being more reactive will replace iron from iron sulphate.
29. (d) Fe will displace Cu ions to give green colour solution and Cu metal is brown coated.
30. (d) Copper sulphate is blue and ferrous sulphate is green in colour.
31. (a) In first two test tubes, the metal will not react but in other two it will react.
32. (b) Fe is less reactive than Al but more reactive than Cu. Hence, displacement reaction will occur.