Chemistry · Chemical Analysis

Detection of Cations

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Multiple choice questions — 70 questions

1 Dilute HCl acid is used to detect the ions .....

(A) Ag^{+} , Ca^{2+} , CO_3^{2-}
(B) Fe^{2+} , Pb^{2+} , S^{2-}
(C) Ag^{+} , Hg^{+} , SO_4^{2-}
(D) Pb^{2+} , Hg^{+} , $S_2O_3^{2-}$

2 A mercury(I) nitrate solution can be distinguished from a potassium nitrite solution using .....

(A) NaCl (B) $PbCl_2$ (C) NH_4NO_3 (D) KNO_3

3 A clear solution forms when hydrochloric acid is added to the salt .....

(A) Ag_2CO_3 (B) $Pb(CO_3)_2$ (C) Hg_2CO_3 (D) $CuCO_3$

4 The ion that can be detected using dilute HCl acid is .....

(A) SO_4^{2-} (B) Fe^{2+} (C) PO_4^{3-} (D) Pb^{2+}

5 We have a solution containing a mixture of the anions SO_4^{2-} , Cl^{-}
Which cation, when added to this mixture, precipitates one of these two anions?

(A) Pb^{2+} (B) Ba^{2+} (C) NH_4^{+} (D) Mg^{2+}

6 HCl(aq) is used to detect the cation of the confirmatory reagent of each of the following anions, except .....

(A) PO_4^{3-} (B) SO_4^{2-} (C) NO_3^{-} (D) I^{-}

7 Which of the following salts are soluble in water?

(A) $PbCl_2$: insoluble ; $Pb(NO_3)_2$: soluble ; PbS : insoluble
(B) $PbCl_2$: insoluble ; $Pb(NO_3)_2$: soluble ; PbS : soluble
(C) $PbCl_2$: soluble ; $Pb(NO_3)_2$: insoluble ; PbS : insoluble
(D) $PbCl_2$: soluble ; $Pb(NO_3)_2$: insoluble ; PbS : soluble

8 Dilute hydrochloric acid was added to a solid salt and a gas was given off; passing it into lead(II) acetate solution forms a black precipitate, and when hydrochloric acid is added to the black precipitate it turns into a white precipitate.

The chemical formula of the white precipitate formed is .....

(A) $CaCl_2$ (B) $PbCl_2$ (C) $HgCl_2$ (D) $AgCl$

9 Dilute hydrochloric acid was added to a solution containing the ions Cu^{2+} , Mn^{2+} , Ba^{2+} , Pb^{2+}, and precipitate (X) formed. After separating this precipitate, sulphuric acid was added to the remaining solution and precipitate (Y) formed.

Which of the following is correct?

(A) Precipitate (X) : $PbCl_2$, precipitate (Y) : $BaSO_4$

(B) Precipitate (X) : $BaCl_2$, precipitate (Y) : $PbSO_4$

(C) Precipitate (X) : $PbCl_2$, precipitate (Y) : $MnSO_4$

(D) Precipitate (X) : $MnCl_2$, precipitate (Y) : $CuSO_4$

10 A solution of NaX(aq) reacted with a solution of AgY(aq), forming a solution and a yellow precipitate.

What are the names of the two groups to which the cation and the anion of the precipitate formed belong, respectively?

(A) Analytical group II , dilute H_2SO_4 acid group.

(B) Analytical group I , dilute HCl acid group.

(C) Analytical group V , $BaCl_2$ solution group.

(D) Analytical group I , conc. H_2SO_4 acid group.

11 The two ions of the solution of the compound used in purifying drinking water can each be detected separately using .....

(A) $NH_4OH(aq)$, $HCl(aq)$ (B) $(NH_4)_2CO_3(aq)$, $H_2S(g)$

(C) $CaCl_2(aq)$, $H_2S(g)$ (D) $(CH_3COO)_2Pb(aq)$, $HCl(aq)$

12 All the following salt solutions form a black precipitate when H_2S gas is passed into them, except .....

(A) $AgNO_3$ (B) $(CH_3COO)_2Pb$ (C) $Cu(NO_3)_2$ (D) $NaCl$

13 The precipitates formed when H_2S gas is passed into a solution containing the ions Cu^{2+} , Pb^{2+} , K^+ are .....

(A) PbS , CuS (B) CuS , K_2S (C) PbS , K_2S (D) CuS , Pb

14 Which of the following pairs of cations can be used to separate the sulphide anion?

(A) Ag^+ , K^+ (B) Ag^+ , Cu^{2+} (C) Cu^{2+} , Na^+ (D) K^+ , Na^+

15 An aqueous solution contains a mixture of the ions Cu^{2+} , Ag^+

What must be added to this solution to precipitate one of the two ions but not the other?

(A) $H_2S(aq)$ (B) HCl(aq) (C) $HNO_3(aq)$ (D) $Na_2CO_3(aq)$

16 When testing for the cation of a salt solution, it was found that it does not form a precipitate with the SO_4^{2-} anion but forms a precipitate with the S^{2-} anion.

What is the symbol of this cation?

(A) Ba^{2+} (B) NH_4^+ (C) Ca^{2+} (D) Cu^{2+}

17 A fixed amount of $CuSO_4(aq)$ was added separately to three tubes containing equal amounts of $BaCl_2(aq)$, KCl(aq) , $Na_2S(aq)$. In which of the following cases does a precipitate form?

(A) In the case of Na_2S only.
(B) In the cases of $BaCl_2$, Na_2S only.
(C) In the cases of $BaCl_2$, KCl only.
(D) A precipitate forms in all cases.

18 Which of the following gives the suitable experiments for detecting a copper(II) sulphate solution?

(A) Adding HCl acid : right ; adding H_2S in an acidic medium : right ; adding $Ba(NO_3)_2$ solution : wrong

(B) Adding HCl acid : right ; adding H_2S in an acidic medium : wrong ; adding $Ba(NO_3)_2$ solution : right

(C) Adding HCl acid : wrong ; adding H_2S in an acidic medium : right ; adding $Ba(NO_3)_2$ solution : wrong

(D) Adding HCl acid : wrong ; adding H_2S in an acidic medium : right ; adding $Ba(NO_3)_2$ solution : right

19 When the following ions are mixed in water:

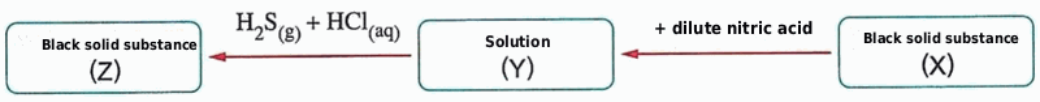
NO_3^- , CO_3^{2-} , Cl^- , Cu^{2+} , Ba^{2+} , K^+ , Pb^{2+} , Ag^+ , NH_4^+

the number of compounds that may form as precipitates is .....

(A) 5 (B) 6 (C) 7 (D) 8

20 From the following chart:

Which of the following is correct?



(A) Substance (X) : CuO , solution (Y) : $Cu(NO_3)_2$, substance (Z) : CuS

(B) Substance (X) : CuS , solution (Y) : $Cu(NO_2)_2$, substance (Z) : $CuCl_2$

(C) Substance (X) : FeO , solution (Y) : $Fe(NO_3)_2$, substance (Z) : $FeCl_2$

(D) Substance (X) : Fe_3O_4 , solution (Y) : $Fe(NO_2)_2$, substance (Z) : FeS

21 The following cations can be separated as precipitates, except .....

(A) Ag^+ (B) Na^+ (C) Fe^{3+} (D) Cu^{2+}

22 When a solution of iron(II) sulphate is exposed to the air for a long enough time, and then sodium hydroxide solution is added to it, ... takes place.

(A) reduction then precipitation (B) precipitation then oxidation

(C) oxidation then precipitation (D) precipitation then reduction

23 From the following information:

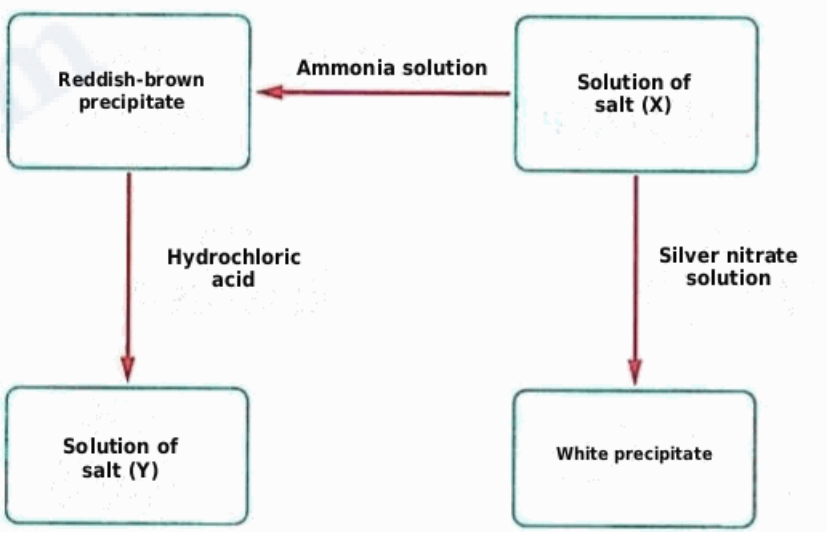
- Cation (X): precipitates as the compound XCl_2
- Cation (Y): precipitates as the compound $Y(OH)_2$
- Cation (Z): precipitates as the compound ZS

These cations are arranged in ascending order of their analytical groups as follows .....

(A) X then Y then Z (B) X then Z then Y (C) Z then X then Y (D) Y then X then Z

24 From the opposite chart:

Which of the following represents each of (X) , (Y)?



(A) (X) : iron(II) chloride , (Y) : iron(II) chloride.

(B) (X) : iron(II) iodide , (Y) : iron(II) chloride.

(C) (X) : iron(III) chloride , (Y) : iron(III) chloride.

(D) (X) : iron(III) iodide , (Y) : iron(III) chloride.

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25 Gas (X):

• its aqueous solution reacts with $FeCl_3$ solution, forming a reddish-brown precipitate that dissolves in compound (Y).

• it reacts with gas (Z), forming white clouds.

Which of the following is correct?

(A) Gas (X) : NH_3 , compound (Y) : nitric acid , gas (Z) : HCl

(B) Gas (X) : NH_3 , compound (Y) : sodium hydroxide , gas (Z) : NH_4Cl

(C) Gas (X) : SO_3 , compound (Y) : sodium hydroxide , gas (Z) : CO

(D) Gas (X) : SO_3 , compound (Y) : nitric acid , gas (Z) : NH_3

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26 Two identical samples of an unknown salt: hot conc. sulphuric acid was added to the first sample and reddish-brown fumes were given off, and ammonium hydroxide solution was added to the solution of the second sample and a greenish-white precipitate formed.

What is the chemical formula of this salt?

(A) $Fe(NO_3)_2$ (B) $Fe(NO_2)_3$ (C) $Ca(NO_3)_2$ (D) $Ca(NO_2)_2$

---

27 Excess sodium hydroxide solution was added slowly to iron(II) sulphate solution. All the following are correct, except .....

(A) A greenish-white precipitate forms.

(B) A gas with a pungent smell is given off that turns moist red litmus paper blue.

(C) The colour of the precipitate in the container turns reddish-brown after some time.

(D) The precipitate formed dissolves in hydrochloric acid.

---

28 A solid substance (X) is used as a red colour in paints. Which of the following represents the way to detect the cation of substance (X)?

(A) Dissolving substance (X) in water, then adding $NH_4OH(aq)$

(B) Dissolving substance (X) in water, then adding $HNO_3(aq)$

(C) Reacting substance (X) with $H_2SO_4(aq)$, then adding $(NH_4)_2CO_3(aq)$

(D) Reacting substance (X) with hot $H_2SO_4(l)$, then adding $KOH(aq)$

---

29 The following table shows some properties of the compounds $Fe(NO_3)_2$, $Al(NO_3)_3$:

• product of the reaction of $Fe(NO_3)_2$ with sodium hydroxide solution: (X)

• product of the reaction of $Al(NO_3)_3$ with sodium hydroxide solution: (Y)

Which of the following is correct?

(A) (X) : greenish-white precipitate , (Y) : white precipitate that dissolves in $NH_4OH(aq)$

(B) (X) : reddish-brown precipitate , (Y) : black precipitate.

(C) (X) : reddish-brown precipitate , (Y) : white precipitate that turns black on heating.

(D) (X) : greenish-white precipitate , (Y) : white precipitate that does not dissolve in $NH_4OH(aq)$

---

30 An iron(III) chloride solution was divided into three equal samples, then the following was added to sample:

- (1): $AgNO_3$ solution
- (2): $Ba(NO_3)_2$ solution
- (3): excess NaOH solution

Which of the following gives the correct observations for the three samples?

(A) (1) : no precipitate forms , (2) : a precipitate forms , (3) : a reddish-brown precipitate forms.

(B) (1) : no precipitate forms , (2) : no precipitate forms , (3) : a precipitate forms then disappears.

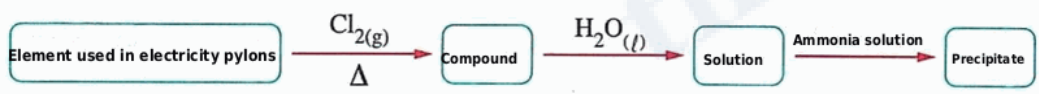
(C) (1) : a white precipitate forms , (2) : no precipitate forms , (3) : a reddish-brown precipitate forms.

(D) (1) : a white precipitate forms , (2) : a precipitate forms , (3) : a precipitate forms then disappears.

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31 From the following chart:

The colour of the precipitate formed is .....



(A) white. (B) reddish-brown. (C) greenish-white. (D) black.

---

32 From the following chart:

The cation of the precipitate formed is .....



(A) Ca^{2+} (B) Al^{3+} (C) Fe^{2+} (D) Fe^{3+}

---

33 When drops of NaOH solution are added to the products of the reaction of magnetic iron oxide with hot conc. sulphuric acid, ... forms.

(A) a greenish-white precipitate only

(B) two precipitates, one of which dissolves in dilute HCl acid

(C) a reddish-brown precipitate only

(D) two precipitates, both of which dissolve in dilute HCl acid

34 When compound (X) is dissolved in distilled water, a solution forms, and when ammonium hydroxide solution is added to the solution of compound (X), a reddish-brown precipitate forms.

Compound (X) is .....

(A) iron(II) chloride.
(B) iron(II) sulphate.
(C) iron(III) nitrate.
(D) iron(III) hydroxide.

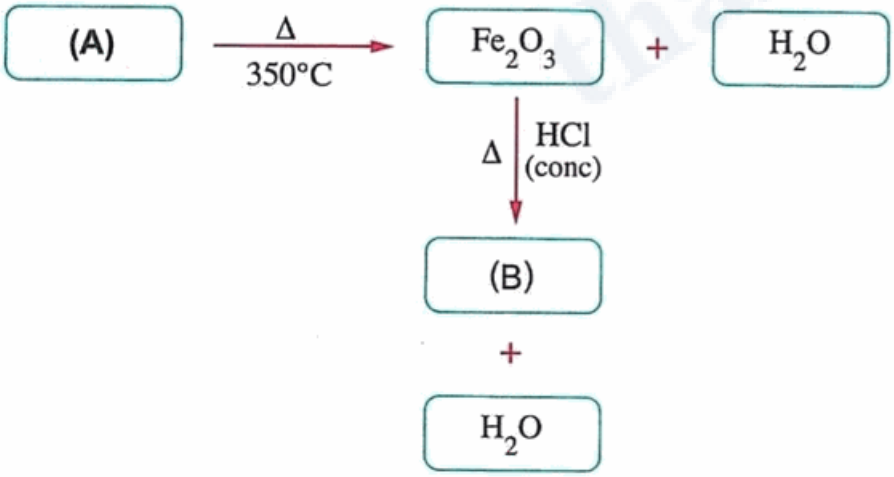
35 When dilute hydrochloric acid is added to salt (X), solution (Y) and gas (Z) form. When gas (Z) is passed into limewater for a short time a white precipitate forms, and when ammonia solution is added to solution (Y) a greenish-white precipitate forms when exposed to air.

Salt (X) is .....

(A) iron(II) chloride.
(B) iron(II) carbonate.
(C) calcium carbonate.
(D) calcium chloride.

36 From the opposite chart:

Which of the following is correct for both compounds (A) , (B)?



(A) Both dissolve in water.
(B) Both react with hydrochloric acid.
(C) Both react with ammonia solution.
(D) Both contain Fe^{3+} cations.

37 The anion and the cation of a salt can both decolourise acidified potassium permanganate solution.

What is the possible chemical formula of this salt?

(A) $Fe(NO_2)_3$
(B) $Cu(NO_3)_2$
(C) $Fe(NO_2)_2$
(D) $Cu(NO_2)_2$

38 A solid substance (X) does not dissolve in water; a gas is given off from it both on strong heating and on reacting with sulphuric acid.

Substance (X) is .....

(A) iron(III) hydroxide.
(B) iron(II) carbonate.
(C) aluminium hydroxide.
(D) sodium carbonate.

39 Using the following, where (X , Y , A) are hypothetical symbols for atomic groups or elements:

Which of the following is correct?



(A) (X^{m-}) : sulphite , (A^{n+}) : Fe^{2+}
(B) (X^{m-}) : nitrite , (A^{n+}) : Fe^{3+}
(C) (Y^{m-}) : nitrate , $(A^{(n+1)+})$: Fe^{3+}
(D) (Y^{m-}) : nitrate , $(A^{(n+1)+})$: Fe^{2+}

40 When potassium hydroxide solution is added to solution (X), a precipitate forms that dissolves in excess KOH(aq), and when barium chloride solution is added to the same solution (X), precipitate (Y) forms.

What is solution (X), and what is the colour of precipitate (Y)?

(A) (X) : $CaCl_2$, (Y) : white.
(B) (X) : $Al_2(SO_4)_3$, (Y) : white.
(C) (X) : $FeCl_2$, (Y) : greenish-white.
(D) (X) : $Al_2(SO_4)_3$, (Y) : reddish-brown.

41 The mixture of iron(II) hydroxide, aluminium hydroxide and iron(III) hydroxide can be turned into a clear solution by adding excess .....

(A) NaOH(aq) (B) HCl(aq) (C) NH_4OH(aq) (D) H_2O(l)

42 The following two experiments were carried out on solution (X):

• sodium hydroxide solution was added to a sample of it, and a white precipitate formed that dissolves in excess NaOH

• silver nitrate solution was added to another sample of it, and a white precipitate formed.

From the above observations, we conclude that solution (X) contains the ions .....

(A) I^- , Al^{3+} (B) NO_3^- , Fe^{2+} (C) Cl^- , Cu^{2+} (D) Cl^- , Al^{3+}

43 The two salts lead(II) chloride and aluminium chloride can be distinguished using .....

(A) water.
(B) nitric acid.
(C) ammonium nitrate solution.
(D) water containing CO_2

44 Which of the following happens when excess ammonium hydroxide solution is added to aluminium chloride solution?

(A) A white gelatinous precipitate forms and quickly dissolves.
(B) No reaction is observed.
(C) A white gelatinous precipitate forms.
(D) A deep blue solution forms.

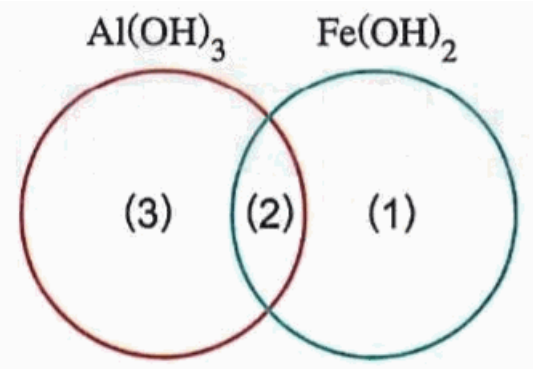
45 Solid substance (X) dissolves in sulphuric acid, forming a colourless solution (Y) and a gas that burns with a pop. When NaOH solution is added to solution (Y), a white precipitate forms that dissolves in excess NaOH(aq), and when barium nitrate solution is added to solution (Y), substance (Z) forms.

What is the name of substance (X), and what are the colour and formula of substance (Z)?

(A) Aluminium , a white precipitate of $BaSO_4$
(B) Calcium , a white precipitate of $Ba(NO_3)_2$
(C) Aluminium sulphate , an aqueous solution of $BaSO_4$
(D) Calcium sulphate , an aqueous solution of $BaCl_2$

46 From the opposite Venn diagram:

Which of the following represents each of the properties (1) , (2) , (3)?



(A) (1) : dissolves in HCl acid , (2) : dissolves in NaOH , (3) : changes colour in air

(B) (1) : dissolves in HCl acid , (2) : changes colour in air , (3) : dissolves in NaOH

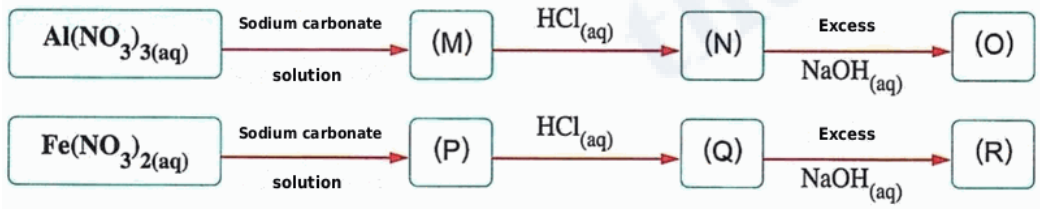
(C) (1) : changes colour in air , (2) : dissolves in HCl acid , (3) : dissolves in NaOH

(D) (1) : dissolves in NaOH , (2) : dissolves in HCl acid , (3) : changes colour in air

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47 From the following two charts:

The number of compounds that do not dissolve in water is .....

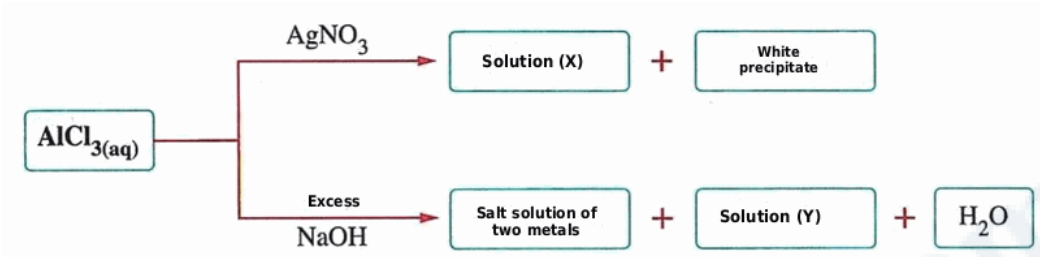


(A) 2 (B) 3 (C) 4 (D) 5

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48 From the following chart:

Which of the following is used to distinguish between the two solutions (X) , (Y)?



(A) H_2SO_3 (B) $Pb(NO_3)_2$ (C) $CaCl_2$ (D) $(NH_4)_2SO_4$

---

49 Which of the following substances reacts with both hydrochloric acid and sodium hydroxide solutions?

(A) NH_4OH (B) $Fe(OH)_3$ (C) $Fe(OH)_2$ (D) $Al(OH)_3$

50 If:

• the chloride of cation (X) does not dissolve in water, while the acetate of (X) dissolves in water.

• the chloride of cation (Y) dissolves in water and the hydroxide of (Y) dissolves in NaOH

then all the following are correct, except .....

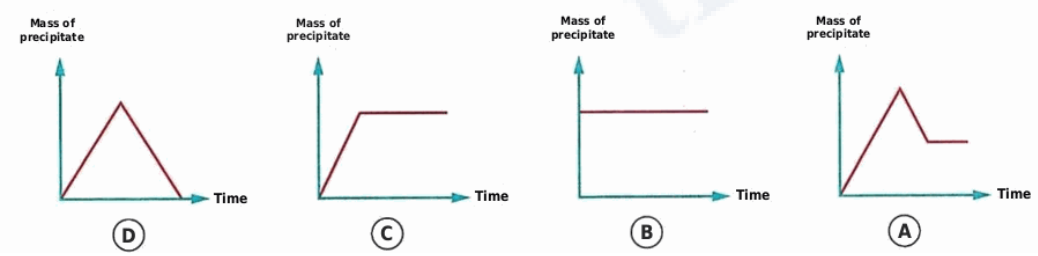
(A) The sulphate of (X) dissolves in water.

(B) The sulphate of (Y) dissolves in water.

(C) The charge of cation (X) is less than that of cation (Y).

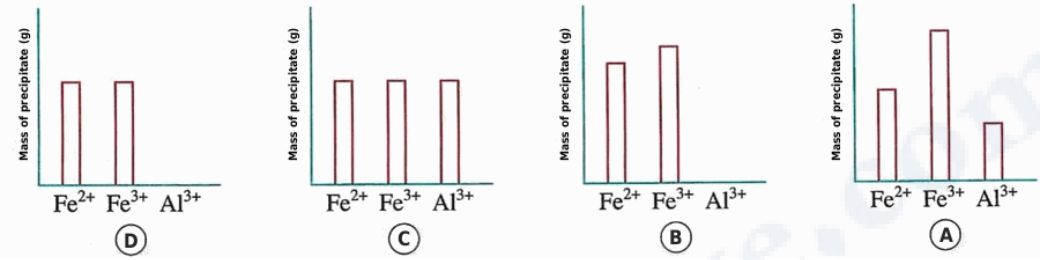
(D) (X) , (Y) are not in the same analytical group.

51 7 mol of sodium hydroxide solution were added to 2 mol of aluminium chloride solution. Which of the following graphs shows the change in the mass of the precipitate formed with time?



(A) Graph (A) (B) Graph (B) (C) Graph (C) (D) Graph (D)

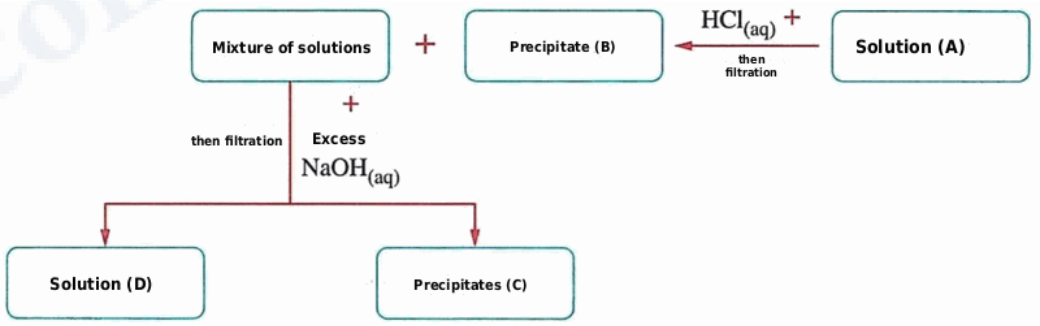
52 Which graph shows the masses of the precipitates formed when excess NaOH solution is added to three different solutions of the ions $Fe^{2+}(aq)$, $Fe^{3+}(aq)$, $Al^{3+}(aq)$, each containing 1 g of its ions?



(A) Graph (A) (B) Graph (B) (C) Graph (C) (D) Graph (D)

53 Solution (A) contains a mixture of the nitrates of the cations (Fe^{3+} , Ag^{+} , Fe^{2+} , Al^{3+}); the experiments shown in the following chart were carried out on it:

Which of the following represents each of the precipitates (B) , (C) and the cations of solution (D)?



(A) Precipitate (B) : $FeCl_2$; precipitates (C) : $Fe(OH)_3$, $Al(OH)_3$; cations of solution (D) : Na^{+}

(B) Precipitate (B) : $FeCl_2$; precipitates (C) : $Fe(OH)_2$, $Al(OH)_3$; cations of solution (D) : Na^{+} , Ag^{+}

(C) Precipitate (B) : AgCl ; precipitates (C) : $Fe(OH)_2$, $Fe(OH)_3$; cations of solution (D) : Na^{+}

(D) Precipitate (B) : AgCl ; precipitates (C) : $Fe(OH)_2$, $Fe(OH)_3$; cations of solution (D) : Na^{+} , Al^{3+}

---

54 An aluminium chloride solution was divided into three test tubes.

Which of the following shows the three suitable reagents for detecting aluminium chloride solution?

(A) First tube : NaOH solution ; second tube : NH_4OH solution ; third tube : dilute HCl acid

(B) First tube : NaOH solution ; second tube : dilute HNO_3 acid and $AgNO_3$ solution ; third tube : dilute HCl acid

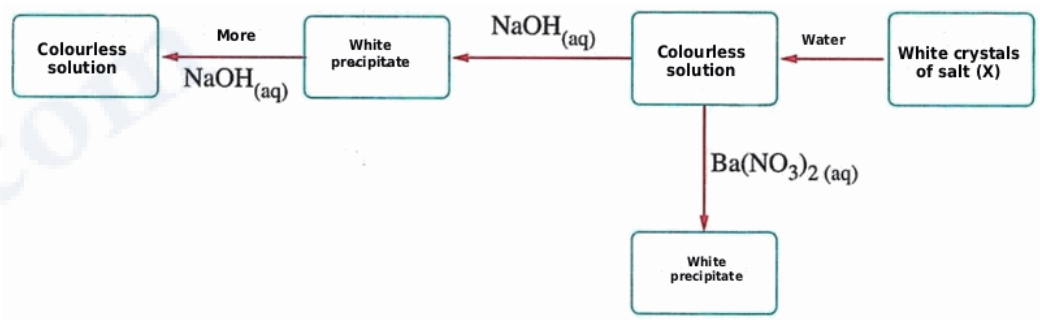
(C) First tube : NH_4OH solution ; second tube : dilute HNO_3 acid and $AgNO_3$ solution ; third tube : $Ba(NO_3)_2$ solution

(D) First tube : NaOH solution ; second tube : NH_4OH solution ; third tube : $AgNO_3$ solution

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55 From the following chart:

Salt (X) is .....

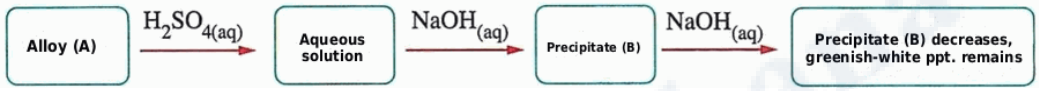


(A) aluminium chloride.
(B) sodium sulphate.
(C) zinc chloride.
(D) aluminium sulphate.

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56 A series of reactions was carried out on alloy (A), made of two metals, as shown in the following chart:

The two metals that make up alloy (A) are .....

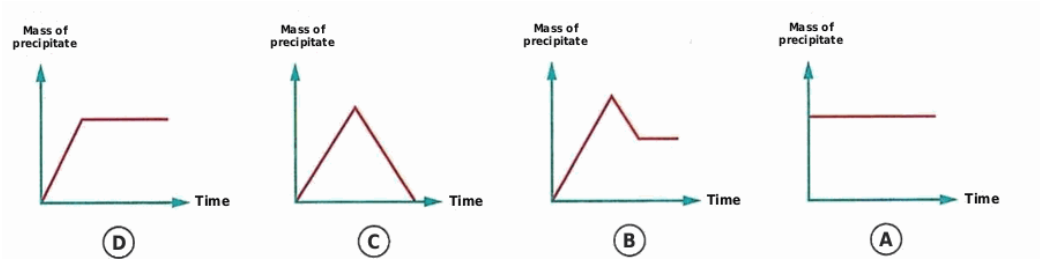


(A) copper and aluminium.
(B) copper and iron.
(C) iron and aluminium.
(D) zinc and lead.

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57 4 mol of sodium hydroxide solution were added to 1 mol of aluminium sulphate.

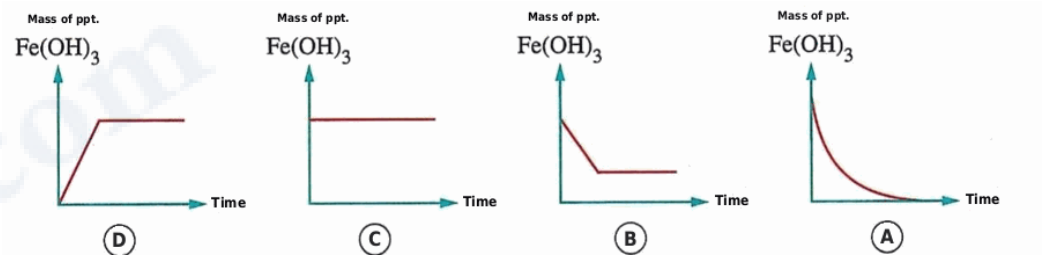
Which of the following graphs shows the mass of the precipitate with time?



(A) Graph (A)
(B) Graph (B)
(C) Graph (C)
(D) Graph (D)

---

58 0.3 mol of sodium hydroxide solution was added to 0.1 mol of iron(III) hydroxide.
Which of the following represents the mass of iron(III) hydroxide?



(A) Graph (A) (B) Graph (B) (C) Graph (C) (D) Graph (D)

59 The cations that form a white precipitate with the sulphate anion are .....

(A) Na^+ , Ba^{2+} (B) Ca^{2+} , NH_4^+ (C) Ca^{2+} , Ba^{2+} (D) Al^{3+} , Fe^{2+}

60 All the following pairs of cations can be separated from each other using sodium carbonate solution, except .....

(A) Hg^+ , NH_4^+ (B) Mg^{2+} , K^+ (C) Na^+ , Cu^{2+} (D) Ca^{2+} , Pb^{2+}

61 When $CaCl_2$ solution is mixed with $Al_2(SO_4)_3$ solution .....

(A) $AlCl_3$ precipitates
(B) a $CaSO_4$ solution forms
(C) $CaSO_4$, $AlCl_3$ precipitate
(D) an $AlCl_3$ solution forms and $CaSO_4$ precipitates

62 Solution (X) reacts with each of the following two solutions separately, forming a white precipitate:

- silver nitrate solution.
- sodium sulphate solution.

What is the possible name of solution (X)?

(A) aluminium chloride. (B) sodium chloride.
(C) calcium chloride. (D) iron(III) chloride.

63 A solution containing Pb^{2+} ions can be distinguished from a solution containing Ca^{2+} ions using .....

(A) dilute nitric acid.
(B) potassium chloride solution.
(C) sodium sulphate solution.
(D) dilute sulphuric acid.

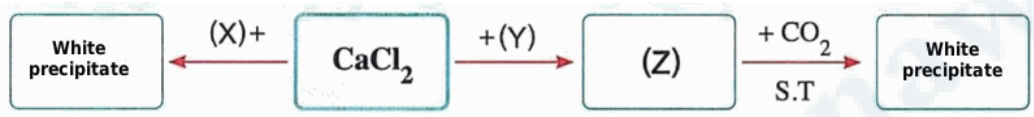
64 If hot conc. sulphuric acid is added to salt (X), a white precipitate forms and reddish-brown fumes are given off.

Salt (X) is .....

(A) calcium carbonate.
(B) calcium nitrate.
(C) iron(II) carbonate.
(D) iron(III) nitrate.

65 From the following chart:

Which of the following is correct?



(A) Substance (X) : H_2SO_4 , substance (Y) : $Ca(OH)_2$, substance (Z) : NaOH
(B) Substance (X) : $CaCO_3$, substance (Y) : NaOH , substance (Z) : $CaSO_4$
(C) Substance (X) : H_2SO_4 , substance (Y) : NaOH , substance (Z) : $Ca(OH)_2$
(D) Substance (X) : $CaSO_4$, substance (Y) : $Ca(OH)_2$, substance (Z) : $CaCO_3$

66 Ammonium carbonate solution was added to a solution of salt (A), and a white precipitate (B) formed.

What is the effect of adding dilute HCl acid to precipitate (B), and what colour do the cations of salt (A) give in the dry test?

(A) A gas is given off that turns clear limewater milky, and the cation gives a golden yellow colour.
(B) The precipitate dissolves and the non-luminous zone of the Bunsen flame turns brick red.
(C) Carbon dioxide gas is given off and the cation gives a violet colour.
(D) The precipitate does not dissolve and the non-luminous zone of the Bunsen flame turns brick red.

67 From the following table:

Which pairs of cations in column (A) can be separated from each other in their aqueous solution using the reagents shown in column (B)?

(B)	(A)	
Ammonia solution	Al^{3+} , Fe^{3+}	(1)
Dilute hydrochloric acid	Ag^{+} , Cu^{2+}	(2)
Dilute hydrochloric acid	Ca^{2+} , K^{+}	(3)
Dilute hydrochloric acid, then passing H_2S gas	Cu^{2+} , Na^{+}	(4)

(A) (1) , (2) (B) (1) , (3) (C) (2) , (3) (D) (2) , (4)

68 From the following chart:

Which of the following is correct?



(A) Substances (B) , (C) contain trivalent cations.

(B) The cation of substance (D) gives the non-luminous zone of the Bunsen flame a brick red colour.

(C) The solution of substance (B) contains Ag^{+} ions.

(D) Solution (A) is used to precipitate the cations of analytical group I.

69 A sample of a calcium salt was tested separately with chloride ions, with sulphate ions and with the flame test.

Which of the following shows the results obtained under suitable conditions?

(A) With chloride ions : a precipitate forms ; with sulphate ions : no precipitate forms ; flame test : a green colour forms

(B) With chloride ions : no precipitate forms ; with sulphate ions : a precipitate forms ; flame test : a brick red colour forms

(C) With chloride ions : a precipitate forms ; with sulphate ions : no precipitate forms ; flame test : a brick red colour forms

(D) With chloride ions : no precipitate forms ; with sulphate ions : a precipitate forms ; flame test : a green colour forms

70 A solution contains the following cations:

Fe^{2+} , Mn^{2+} , Ag^{+} , Hg^{+} , Ca^{2+}

It was treated with HCl acid, so the solution now contains the ions .....

(A) Ag^{+} , Hg^{+} , Ca^{2+}

(B) Fe^{2+} , Ag^{+}

(C) Hg^{+} , Mn^{2+}

(D) Fe^{2+} , Mn^{2+} , Ca^{2+}

Essay questions — 10 questions

1 Lead(II) nitrate solution reacts with sodium bromide solution, forming precipitate (1):

(1) State the number of the analytical group of the cation of precipitate (1).

(2) What are the colour and formula of precipitate (2) formed by adding the silver cation to the anion of precipitate (1)?

2 When sodium chloride solution is added to a solution of salt (X), a white precipitate forms, and when conc. sulphuric acid is added to the same solid salt with heating, reddish-brown fumes are given off.

Deduce the name of salt (X).

3 When dilute hydrochloric acid is added to salt (X), reddish-brown fumes are given off at the mouth of the tube, and when dilute sulphuric acid is added to a solution of the same salt, a white precipitate forms of a divalent cation from the cations of analytical group I.

Deduce the name of salt (X).

4 What happens, «without writing reaction equations», when you add:

(1) NaOH solution to iron(II) nitrate solution.

(2) hot conc. H_2SO_4 to potassium iodide salt.

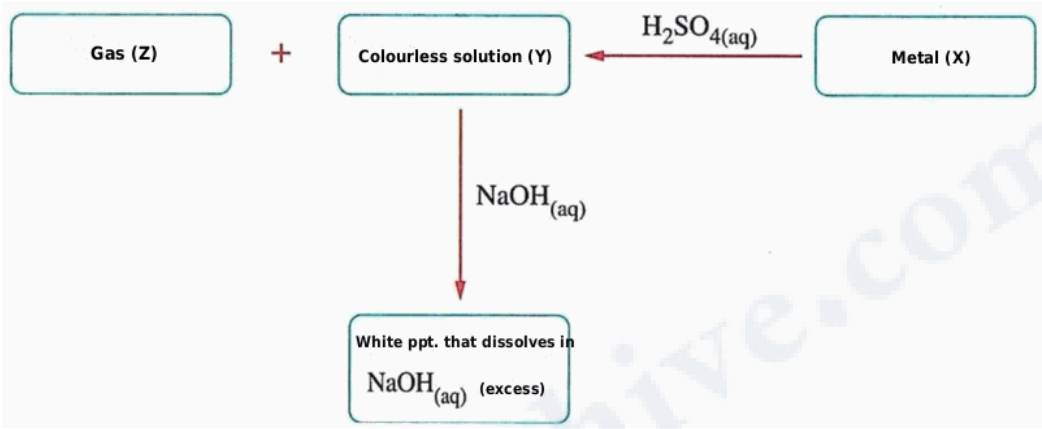
5 The following chart shows some chemical reactions:

(1) Deduce:

(a) the symbol of metal (X).

(b) the chemical formula of solution (Y).

(2) Show, with a symbolic equation, the effect of passing gas (Z) over magnetic iron oxide (at 650°C).



6 When dilute hydrochloric acid is added to solid salt (X), a gas is given off that blackens a paper moistened with lead(II) acetate solution, and when solid salt (X) is put in a Bunsen flame, the flame turns brick red.

Deduce the name of salt (X).

---

7 • When lead(II) acetate solution is added to a solution of salt (X), a white precipitate forms.

• When ammonia solution is added to a solution of salt (X), a white gelatinous precipitate forms.

Deduce the name of salt (X).

---

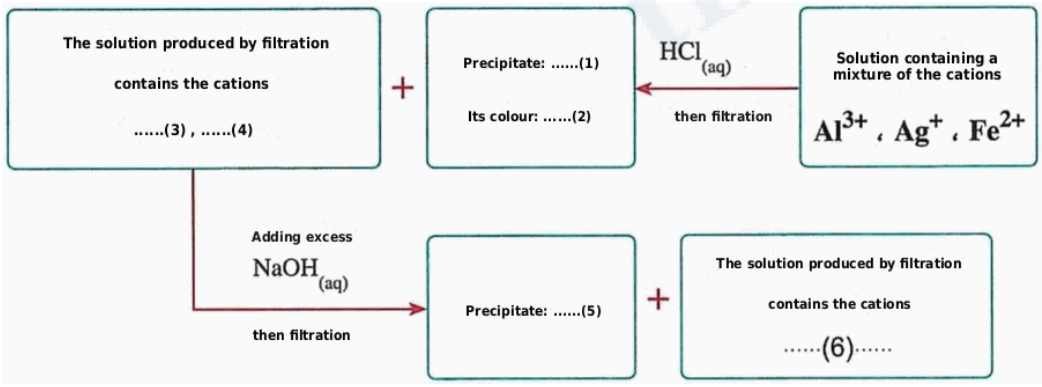
8 You have a solution containing the cations $Fe^{2+}(aq)$, $Ca^{2+}(aq)$, $Pb^{2+}(aq)$; it was divided into two parts:

(1) Which of these cations precipitates when dilute HCl acid is added to the first part of the solution?

(2) Which of the two remaining cations does not precipitate when ammonium hydroxide solution is added to the other part of the solution?

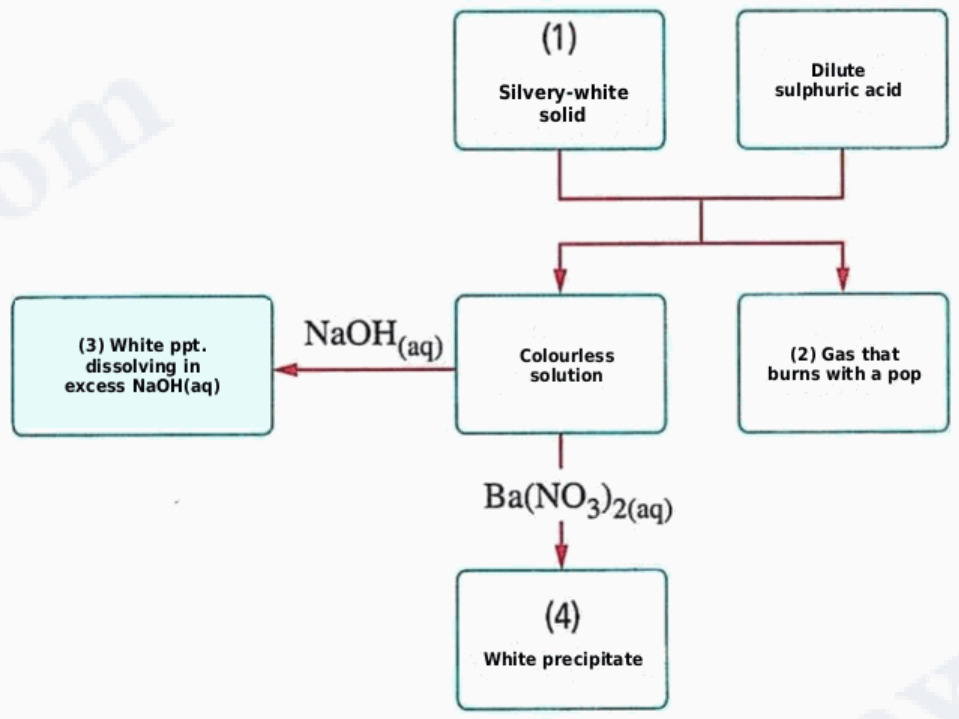
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9 Complete the blanks of the following chart with what suits them:



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10 From the following chart, deduce the names of each of the substances $(1) : (4)$.

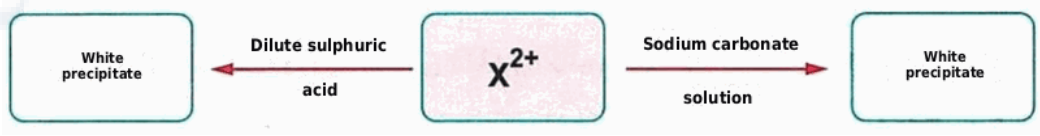


Past exam questions — 43 questions

1 From the following chart:

Which of the following represents the cation (X^{2+})?

(Sample exam 2026)



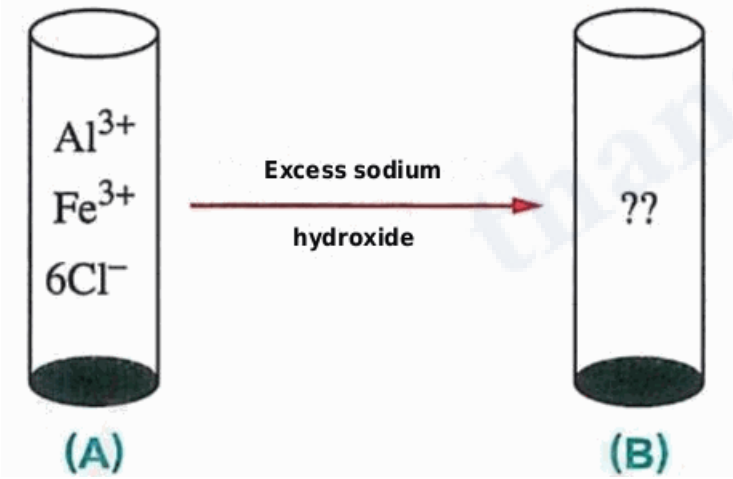
(A) Ca^{2+} (B) Cu^{2+} (C) Mg^{2+} (D) Fe^{2+}

---

2 From the experiment shown in the figure:

Which of the following represents some of the contents of test tube (B)?

(Sample exam 2026)



(A) $Cl^-(aq)$, $AlO_2^-(aq)$, $Na^+(aq)$, $Al^{3+}(aq)$

(B) $Cl^-(aq)$, $AlO_2^-(aq)$, $Fe^{3+}(aq)$, $Al(OH)_3(s)$

(C) $AlO_2^-(aq)$, $Al^{3+}(aq)$, $Fe^{3+}(aq)$, $Fe(OH)_3(s)$

(D) $Cl^-(aq)$, $AlO_2^-(aq)$, $Na^+(aq)$, $Fe(OH)_3(s)$

---

3 Both ions of which of the following salts can be detected using the reagent of the confirmatory test of one of the cations of analytical group V?

(Sample exam 2026)

(A) $MgCl_2$ (B) $Fe_2(SO_3)_3$ (C) $Pb(NO_2)_2$ (D) $Ba_3(PO_4)_2$

---

4 Hydrochloric acid was added to a solid salt and a gas was given off that forms a black precipitate when passed into acidified copper nitrate solution.
Which of the following represents the solid salt?
(Sample exam 2026)

(A) sodium nitrite.
(B) potassium sulphide.
(C) sodium sulphite.
(D) sodium bicarbonate.

---

5 Which of the following solutions can be used to separate $Fe(OH)_2$ from a mixture of it with $Al(OH)_3$?
(Sample exam 2026)

(A) NaOH(aq) (B) NH_4OH(aq) (C) NaCl(aq) (D) HCl(aq)

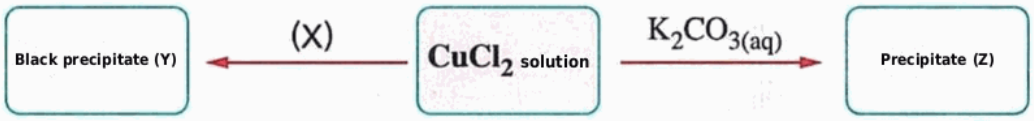
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6 A mixture of the nitrates of copper(II), lead(II) and calcium.
Which of the following gives the correct order of substances that can be added to this mixture to separate each cation on its own?
(Sample exam 2026)

(A) sodium carbonate solution, then passing hydrogen sulphide gas.
(B) dilute sulphuric acid, then silver nitrate solution.
(C) hydrochloric acid, then sulphuric acid.
(D) hydrochloric acid, then sodium carbonate solution.

---

7 From the following chart:
Which of the following represents the substances (X) , (Y) , (Z)?
(Sample exam 2026)



(A) Substance (X) : $AgNO_3$(aq) , precipitate (Y) : AgCl(s) , precipitate (Z) : KCl(s)
(B) Substance (X) : HCl(aq) + H_2S(g) , precipitate (Y) : $CuCl_2$(s) , precipitate (Z) : $CuCO_3$(s)
(C) Substance (X) : HCl(aq) + H_2S(g) , precipitate (Y) : CuS(s) , precipitate (Z) : $CuCO_3$(s)
(D) Substance (X) : Na_2S(aq) , precipitate (Y) : NaCl(s) , precipitate (Z) : KCl(s)

---

8 A solution contains the ions (Cu^{2+} , K^{+} , Ag^{+})

Which of the following gives the colour of the precipitate likely to form when excess HCl solution is added, then (H_2S) gas is passed through this solution?

(Sample exam 2026)

(A) A black precipitate.

(B) A white precipitate.

(C) A mixture of a white and a black precipitate.

(D) No precipitate forms.

---

9 Two salts (A , B): the acid of salt (A) is used to detect the cation of salt (B), and the acid of salt (B) is used to detect the anion of salt (A).

Which of the following represents the two salts (A) , (B)?

(Sample exam 2026)

(A) Salt (A) : KCl , salt (B) : $CuSO_4$

(B) Salt (A) : Hg_2SO_4 , salt (B) : KCl

(C) Salt (A) : KCl , salt (B) : $PbSO_4$

(D) Salt (A) : K_2SO_4 , salt (B) : $NaNO_3$

---

10 A solution contains the cations (Cu^{2+} , Pb^{2+} , Ca^{2+})

Which of the following can be added to the above solution to obtain a solution containing only the copper cation?

(Sample exam 2026)

(A) Dilute sulphuric acid.

(B) Sodium carbonate solution.

(C) Sodium nitrate solution.

(D) Dilute hydrochloric acid.

---

11 Which of the solutions of the following compounds forms a precipitate with $Pb(NO_3)_2(aq)$ but does not form a precipitate with $Ba(NO_3)_2(aq)$?

(Sample exam 2026)

(A) Na_2SO_4

(B) CH_3COONa

(C) NaCl

(D) Na_2CO_3

---

12 A solution contains the cations (Ag^{+} , Cu^{2+} , Pb^{2+} , Ca^{2+})
Which of the following gives the correct order of the steps needed to obtain a solution containing only the copper cation?
(Sample exam 2026)

(A) Adding hydrochloric acid – filtration – adding hydrogen sulphide gas – filtration.
(B) Adding hydrogen sulphide gas – filtration – adding hydrochloric acid – filtration.
(C) Adding sulphuric acid – filtration – adding sodium sulphide solution – filtration.
(D) Adding sodium chloride solution – filtration – adding magnesium sulphate solution – filtration.

---

13 Which of the following solutions can be added to a solution containing the cations (Al^{3+} , Fe^{2+} , Ca^{2+})
to precipitate only one of these cations?
(Sample exam 2026)

(A) Sodium carbonate.
(B) Excess sodium hydroxide.
(C) Excess ammonium hydroxide.
(D) Potassium chloride.

---

14 Which of the following does not distinguish between the main reagent for the cations of analytical group I and that of analytical group III?
(1st session 2025)

(A) Iron(II) chloride solution.
(B) Aluminium sulphate solution.
(C) Iron(III) sulphate solution.
(D) Sodium chloride solution.

---

15 When lead(II) acetate solution is added to a solution of salt (X), a white precipitate forms, and when ammonia solution is added to a solution of salt (X), a greenish-white precipitate forms.
Which of the following choices represents salt (X)?
(1st session 2025)

(A) $FeSO_4$
(B) $Fe_2(SO_4)_3$
(C) $Fe(NO_3)_2$
(D) $Fe(HCO_3)_3$

---

16 Both ions of salt (X) can be detected using reagent (Y).
Which of the following choices represents salt (X) and reagent (Y)?
(1st session 2025)

(A) Salt (X) potassium chloride, reagent (Y) conc. sulphuric acid.
(B) Salt (X) silver nitrate, reagent (Y) dilute hydrochloric acid.
(C) Salt (X) aluminium chloride, reagent (Y) sodium hydroxide solution.
(D) Salt (X) iron(III) sulphate, reagent (Y) barium hydroxide solution.

---

17 When conc. sulphuric acid is added to salt (X) with gentle heating, gas (Y) is given off and precipitate (Z) forms.
(X) , (Y) , (Z) are .....
(Sample exam 2025)

(A) Salt (X) : $Pb(NO_3)_2$, gas (Y) : NO_2 , precipitate (Z) : $PbSO_4$
(B) Salt (X) : Na_2CO_3 , gas (Y) : CO , precipitate (Z) : Na_2SO_4
(C) Salt (X) : KCl , gas (Y) : Cl_2 , precipitate (Z) : K_2SO_4
(D) Salt (X) : $CuBr_2$, gas (Y) : Br_2 , precipitate (Z) : $CuSO_4$

---

18 When brown iodine solution is added to salt (A), the brown colour of the iodine disappears, and when dilute sulphuric acid is added to another amount of the same solution of salt (A), a white precipitate forms. Salt (A) is .....
(Sample exam 2025)

(A) potassium sulphate.
(B) lead(II) thiosulphate.
(C) copper(II) sulphide.
(D) sodium nitrite.

---

19 A gas with a foul smell is passed into copper(II) chloride solution acidified with hydrochloric acid, then silver nitrate solution is added to the products of the reaction.
Which of the following choices is correct?
(2nd session 2024)

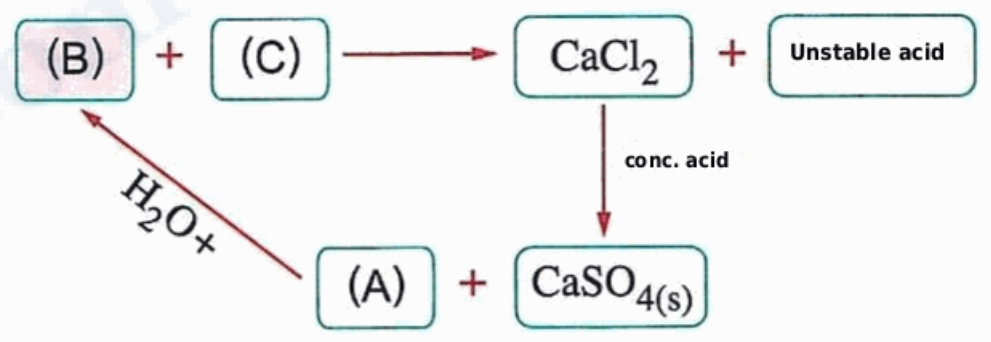
(A) A mixture of black precipitates forms.
(B) A mixture of a white precipitate and a black precipitate forms.
(C) A mixture of white precipitates forms.
(D) A mixture of a yellow precipitate and a black precipitate forms.

---

20 The following reactions take place under suitable conditions:

The two compounds (A) , (C) are .....

(2nd session 2023)



(A) Compound (A) : HCl(aq) , compound (C) : $Ca(OH)_2$

(B) Compound (A) : HCl(g) , compound (C) : $CaCO_3$

(C) Compound (A) : HCl(g) , compound (C) : $Ca(OH)_2$

(D) Compound (A) : HCl(aq) , compound (C) : $CaCO_3$

---

21 The solutions of the two salts $(NH_4)_2SO_4$, $MgSO_4$ can be distinguished by a solution of .....

(Trial exam / March 2023)

(A) $NaNO_3$ (B) KCl (C) Na_2CO_3 (D) $Ca(HCO_3)_2$

---

22 Which of the following pairs of cations can be separated from their solutions using sodium chloride solution?

(1st session 2024)

(A) Ca^{2+} / Cu^{2+} (B) Hg^{+} / Pb^{2+} (C) Mg^{2+} / Ca^{2+} (D) Cu^{2+} / Pb^{2+}

---

23 Dilute HCl acid is used to detect both .....

(Trial exam / June 2021)

(A) NO_2^- , Hg^+ (B) Br^- , Hg^+ (C) PO_4^{3-} , Pb^{2+} (D) SO_4^{2-} , Ag^+

---

24 Which of the following compounds is used to detect both ions of the salt lead nitrate?

(2nd session 2023)

(A) Nitric acid. (B) Hydrochloric acid.

(C) Sulphuric acid. (D) Carbonic acid.

---

25 When gas (X) is passed into an acidified solution of salt (Y), a black precipitate forms, and when silver nitrate solution is added to the solution of salt (Y), a white precipitate forms. Gas (X) and salt (Y) are .....
(2nd session 2023)

(A) Gas (X) : H_2S , salt (Y) : NaI
(B) Gas (X) : CO_2 , salt (Y) : $CuCl_2$
(C) Gas (X) : NO_2 , salt (Y) : $MgSO_4$
(D) Gas (X) : H_2S , salt (Y) : $CuCl_2$

26 When copper sulphate solution reacts with gas (A) in an acidic medium, a black precipitate forms, and when silver nitrate solution reacts with solution (B), a black precipitate also forms. (A) , (B) are .....
(1st session 2021)

(A) (A) : CO_2 , (B) : NaBr
(B) (A) : H_2S , (B) : NaI
(C) (A) : H_2S , (B) : Na_2S
(D) (A) : SO_2 , (B) : NaCl

27 When hydrogen sulphide gas is passed over copper(II) sulphate solution, the precipitate appears on .....
(2nd session 2021)

(A) adding NaOH solution
(B) increasing the pressure.
(C) adding dilute HCl.
(D) raising the temperature.

28 When hydrogen sulphide gas is passed into an acidic solution of a salt, a black precipitate forms, and when barium chloride solution is added to a solution of the same salt, a white precipitate forms. The salt is .....
(1st session 2022)

(A) Na_3PO_4 (B) $CuSO_4$ (C) $(NH_4)_3PO_4$ (D) $CuCl_2$

29 Which of the following: $BaCl_2(aq)$, NaOH(aq) , HCl(aq) is used to distinguish between aluminium sulphate solution and iron(II) chloride solution?
(2nd session 2023)

(A) $BaCl_2(aq)$, HCl(aq)
(B) NaOH(aq) only.
(C) HCl(aq) only.
(D) NaOH(aq) , $BaCl_2(aq)$

30 A student added ammonium hydroxide reagent to a solution of an iron(II) salt, and a precipitate formed whose colour was different from the expected colour.
The likely reason for this is that .....
(1st session 2021)

(A) the reagent used is wrong.
(B) the reagent is a strong base.
(C) the reaction needs heating.
(D) the salt is mixed with other salts.

31 Potassium hydroxide solution was added to a solution of iron(II) sulphate prepared a long time ago in a glass beaker, and a precipitate formed whose colour is .....
(2nd session 2022)

(A) gelatinous white. (B) greenish-white. (C) gelatinous green. (D) reddish-brown.

32 During an experiment to detect the cation of a salt (X), a little NaOH solution was added and a precipitate formed, then more of the reagent was added and the precipitate disappeared. The solution of salt (X) is .....
(2nd session 2021)

(A) $Al(NO_3)_3$ (B) $FeSO_4$ (C) $FeCl_3$ (D) $CuSO_4$

33 During an experiment to detect the cation of a salt, a little NaOH was added and a precipitate formed; on adding more NaOH, ... forms.
(Trial exam / June 2021)

(A) $NaAlO_2(aq)$ (B) $BaSO_4(s)$ (C) $NaNO_3(aq)$ (D) $Al(OH)_3(s)$

34 Ammonium carbonate solution is used to distinguish between all the following cations, except .....
(2nd session 2021)

(A) Na^+ , Ca^{2+} (B) K^+ , Mg^{2+} (C) Ca^{2+} , Mg^{2+} (D) K^+ , Fe^{2+}

35 You have the following compounds:

(1): aluminium chloride.

(2): iron(III) chloride.

(3): iron(II) chloride.

(4): hydrogen chloride.

Which of the above compounds can distinguish between sodium hydroxide and ammonium hydroxide solutions when the necessary conditions are available?

(Trial exam / May 2021)

(A) Compounds (1) , (2) , (3)

(B) Compounds (1) , (2) , (4)

(C) Compounds (2) , (3)

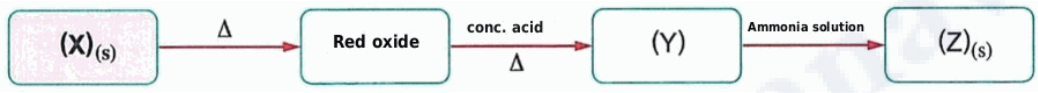
(D) Compounds (1) , (4)

---

36 From the following reaction chart:

The substances (X) , (Y) , (Z) are .....

(1st session 2022)



(A) (X) : $FeSO_4$, (Y) : $FeCl_2$, (Z) : $Fe(OH)_3$

(B) (X) : $FeCO_3$, (Y) : $FeCl_3$, (Z) : $Fe(OH)_2$

(C) (X) : $FeCO_3$, (Y) : $FeCl_2$, (Z) : $Fe(OH)_2$

(D) (X) : $FeSO_4$, (Y) : $FeCl_3$, (Z) : $Fe(OH)_3$

---

37 The following table shows some chemical compounds:

Which of the following choices is correct?

(1st session 2023)

(A)	(B)	(C)	(D)
$Al(NO_3)_3$	$FeSO_4$	NH_4OH	HCl

(A) (D) detects the anion of (B) and the anion of (A).

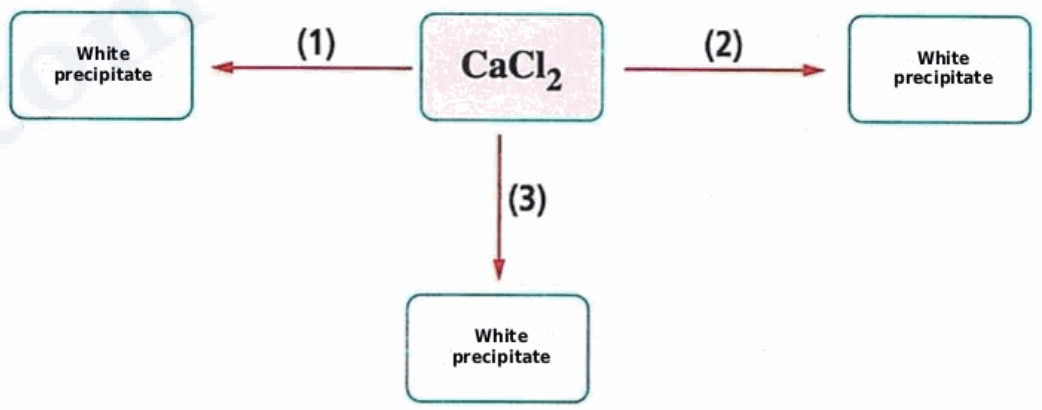
(B) (C) detects the cation of (B) and the cation of (A).

(C) (A) detects the anion of (D) and the anion of (C).

(D) (B) detects the cation of (C) and the anion of (D).

---

38 From the following chart, when the reactions are carried out under suitable conditions:
The compounds (1) , (2) , (3) are .....
(1st session 2023)



(A) Compound (1) : $Pb(NO_3)_2$, compound (2) : $NaHCO_3$, compound (3) : Na_2SO_4
(B) Compound (1) : Na_2SO_4 , compound (2) : NH_4NO_3 , compound (3) : K_2SO_4
(C) Compound (1) : $AgNO_3$, compound (2) : $(NH_4)_2CO_3$, compound (3) : Na_2SO_4
(D) Compound (1) : $AgNO_3$, compound (2) : K_2SO_4 , compound (3) : $KHCO_3$

39 Using the following table:
The two salts (A) , (B) are .....
(2nd session 2022)

Solution (B)	Solution (A)	Reagent
Colour disappears	Colour disappears	Acidified $KMnO_4$
Precipitate forms	No precipitate forms	$NaOH_{(aq)}$

(A) Salt (A) : $NaNO_2$, salt (B) : $FeSO_4$
(B) Salt (A) : $NaNO_3$, salt (B) : $FeSO_4$
(C) Salt (A) : $NaNO_2$, salt (B) : $Fe_2(SO_4)_3$
(D) Salt (A) : $NaNO_3$, salt (B) : $Fe_2(SO_4)_3$

40 Which of the following salts forms a precipitate and gives off a gas when hydrochloric acid is added to it under suitable conditions?
(Trial exam / March 2023)

(A) $NaNO_2$ (B) $AgNO_3$ (C) $HgNO_3$ (D) $Pb(NO_2)_2$

41 The following chart shows chemical reactions on some salts:

(1) Precipitate (B) is white and turns greenish-white on exposure to air.

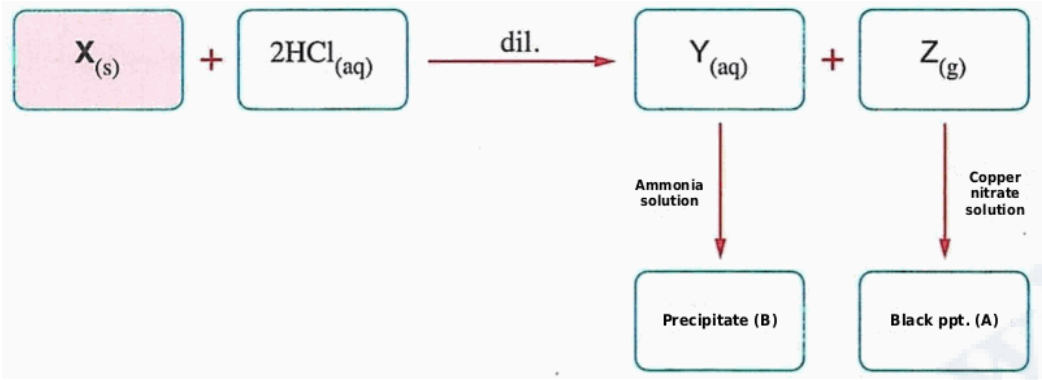
Write the chemical formulas of each of:

1– salt (X)

2– salt (Y)

(2) State the chemical name of each of the two precipitates (A) , (B).

(Sample exam 2026)



42 The opposite figure shows an experiment to detect the anion of salt (X) and the cation (Z). Study the figure well, then answer the following questions:

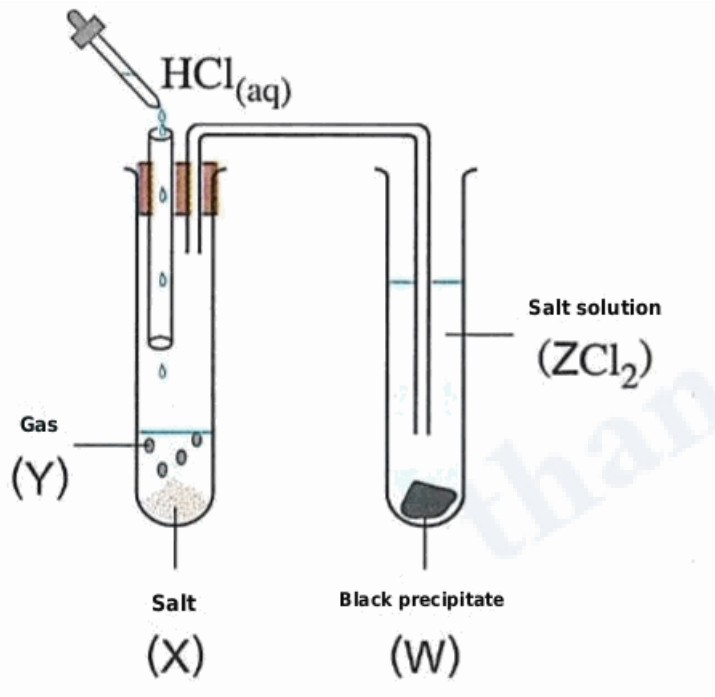
(1) Write the chemical formula of each of:

1– the salt (ZCl_2)

2– the black precipitate (W)

(2) Write the chemical formulas of two other salts, instead of the salt (ZCl_2), that each show the same observation, given that the anion of each of them is nitrate.

(Sample exam 2026)



43 In front of you are four test tubes containing solutions of different salts:

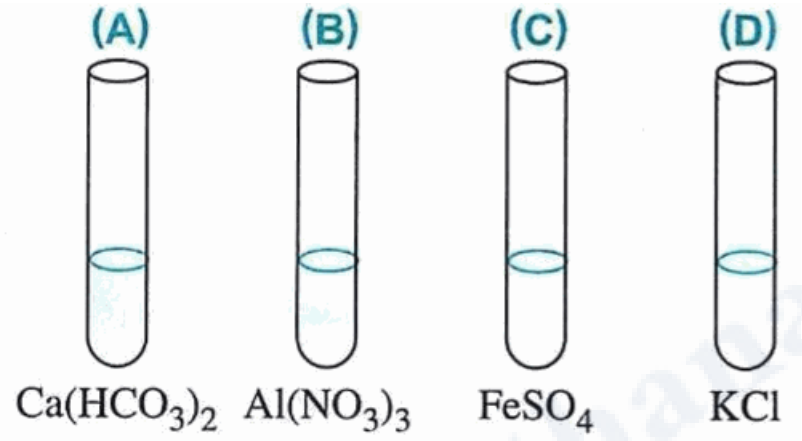
(1) Write the chemical name of the reagent used to distinguish between the solid salts of the four solutions in one experiment.

(2) Which of the four solutions gives a precipitate with excess sodium hydroxide?

(3) Which of the above solutions gives a gas and a precipitate when dilute sulphuric acid is added?

(4) Which of the above salts has a cation that cannot be detected with one of the usual reagents?

(Sample exam 2026)



Answer key and solutions

Multiple choice questions

1 D	2 A	3 D	4 D	5 B	6 C	7 A	8 B	9 A	10 D
11 C	12 D	13 A	14 B	15 B	16 D	17 B	18 D	19 B	20 A
21 B	22 C	23 B	24 C	25 A	26 A	27 B	28 D	29 D	30 C
31 B	32 C	33 D	34 C	35 B	36 D	37 C	38 B	39 C	40 B
41 B	42 D	43 A	44 C	45 A	46 C	47 B	48 B	49 D	50 A
51 A	52 B	53 C	54 D	55 D	56 C	57 D	58 C	59 C	60 D
61 D	62 C	63 B	64 B	65 C	66 B	67 D	68 B	69 B	70 D

1 **Answer (D)**

Dilute HCl precipitates the group I cations Ag^+, Hg^+ and Pb^{2+} as white chlorides.

It also detects the thiosulphate anion $S_2O_3^{2-}$, giving yellow sulphur and SO_2 gas.

2 **Answer (A)**

Mercury(I) nitrate solution gives a white precipitate of mercury(I) chloride with NaCl.

Potassium nitrite solution gives no precipitate with NaCl, so they can be distinguished.

3 **Answer (D)**

Ag_2CO_3, Hg_2CO_3 and $Pb(CO_3)_2$ give insoluble white chlorides with HCl.

$CuCO_3$ reacts with the acid to give soluble $CuCl_2$, so a clear solution forms.

4 **Answer (D)**

Pb^{2+} is a group I cation; it gives a white precipitate of $PbCl_2$ with dilute HCl.

5 **Answer (B)**

Ba^{2+} precipitates SO_4^{2-} as $BaSO_4$, while $BaCl_2$ dissolves.

Pb^{2+}, however, precipitates both anions together ($PbCl_2$ and $PbSO_4$).

6 **Answer (C)**

The confirmatory reagent of PO_4^{3-} and I^- contains Ag^+, and that of SO_4^{2-} contains Pb^{2+}; both are detected by HCl.

The confirmatory reagent of NO_3^- is $FeSO_4$, and its cation Fe^{2+} is not detected by HCl.

7 **Answer (A)**

$PbCl_2$ is sparingly soluble and PbS is insoluble, while $Pb(NO_3)_2$ dissolves in water.

8 **Answer (B)**

The gas that gives a black precipitate with lead(II) acetate is H_2S, so black PbS forms.

HCl converts PbS into white lead chloride $PbCl_2$.

9 **Answer (A)**

Dilute HCl precipitates Pb^{2+} as $PbCl_2$ (X).

After separating it, Ba^{2+} remains in the solution and gives a white precipitate of $BaSO_4$ with H_2SO_4 (Y).

10 **Answer (D)**

The yellow precipitate is AgI, so the cation Ag^+ is from analytical group I.

The anion I^- belongs to the conc. H_2SO_4 acid group.

11 **Answer (C)**

The compound used in purifying drinking water is $CuSO_4$.

Cu^{2+} is detected by H_2S, forming black CuS, and SO_4^{2-} is detected by adding $CaCl_2$, which precipitates white $CaSO_4$.

12 **Answer (D)**

Ag^+, Pb^{2+} and Cu^{2+} give black sulphides with H_2S.

The sodium cation Na^+ does not precipitate with H_2S.

13 **Answer (A)**

Cu^{2+} and Pb^{2+} give black CuS and PbS, while K^+ does not precipitate.

14 **Answer (B)**

Sulphide S^{2-} precipitates with cations that give insoluble sulphides, such as Ag^+ and Cu^{2+}.

The sulphides of K^+ and Na^+ are soluble.

15 **Answer (B)**

HCl precipitates only Ag^+ as AgCl, while Cu^{2+} stays dissolved ($CuCl_2$ is soluble).

H_2S precipitates both, so it does not distinguish them.

16 **Answer (D)**

The cation that gives no precipitate with SO_4^{2-} and a precipitate with S^{2-} is Cu^{2+} (black CuS).

Ba^{2+} gives $BaSO_4$, and NH_4^+ gives no precipitate with either.

17 **Answer (B)**

$CuSO_4$ with $BaCl_2$ gives white $BaSO_4$.

$CuSO_4$ with KCl gives no precipitate.

$CuSO_4$ with Na_2S gives black CuS.

So a precipitate forms in the cases of $BaCl_2$ and Na_2S only.

18 **Answer (D)**

Copper(II) sulphate gives no precipitate with HCl.

Cu^{2+} gives a black precipitate of CuS with H_2S in an acidic medium.

SO_4^{2-} gives a white precipitate of $BaSO_4$ with $Ba(NO_3)_2$.

19 **Answer (B)**

Carbonates: $CuCO_3$, $BaCO_3$, $PbCO_3$ and Ag_2CO_3 (4 precipitates).

Chlorides: $PbCl_2$ and AgCl (2 precipitates).

Total = 6 compounds.

20 **Answer (A)**

(X) is a black substance that dissolves in dilute HNO_3; it is CuO, so solution (Y) is $Cu(NO_3)_2$.

H_2S with a Cu^{2+} solution gives black CuS (Z).

21 **Answer (B)**

Ag^+, Cu^{2+} and Fe^{3+} can be precipitated, but the sodium cation Na^+ is not precipitated.

22 **Answer (C)**

Fe^{2+} is oxidised by the oxygen of the air to Fe^{3+} (oxidation).

Then NaOH gives a precipitate of $Fe(OH)_3$ (precipitation).

23 **Answer (B)**

(X) precipitates as the chloride XCl_2, so it is from group I (HCl).

(Z) precipitates as the sulphide ZS, so it is from group II (H_2S).

(Y) precipitates as the hydroxide $Y(OH)_2$, so it is from group III (NH_4OH).

24 **Answer (C)**

The reddish-brown precipitate with ammonia shows Fe^{3+} ($Fe(OH)_3$), and the white precipitate with $AgNO_3$ shows Cl^-.

So salt (X) is iron(III) chloride.

$Fe(OH)_3$ dissolves in HCl, giving iron(III) chloride (Y).

25 **Answer (A)**

Gas (X) is NH_3; it dissolves in water forming NH_4OH, which gives a reddish-brown precipitate of $Fe(OH)_3$ with $FeCl_3$.

$Fe(OH)_3$ dissolves in acids such as HNO_3.

NH_3 with HCl gives white clouds of NH_4Cl.

26 **Answer (A)**

Reddish-brown fumes of NO_2 with hot conc. H_2SO_4 show the nitrate anion.

The greenish-white precipitate with NH_4OH shows Fe^{2+}.

So the salt is $Fe(NO_3)_2$.

27 **Answer (B)**

NaOH with $FeSO_4$ gives greenish-white $Fe(OH)_2$, which is oxidised in air to reddish-brown $Fe(OH)_3$ and dissolves in HCl.

Ammonia gas is not given off, because the solution does not contain ammonium ions.

28 **Answer (D)**

The red oxide used in paints is Fe_2O_3, and it does not dissolve in water.

It is heated with conc. H_2SO_4 to form $Fe_2(SO_4)_3$, then KOH is added and reddish-brown $Fe(OH)_3$ precipitates.

29 **Answer (D)**

$Fe(OH)_2$ is greenish-white (X).

$Al(OH)_3$ is a white gelatinous precipitate that does not dissolve in ammonia solution (Y).

30 **Answer (C)**

$FeCl_3$ with $AgNO_3$ gives a white precipitate of AgCl.

$FeCl_3$ with $Ba(NO_3)_2$ gives no precipitate.

Excess NaOH gives reddish-brown $Fe(OH)_3$, which does not dissolve in the excess.

31 **Answer (B)**

The element in electricity pylons is iron; heating it with Cl_2 forms $FeCl_3$.

$FeCl_3$ with ammonia gives $Fe(OH)_3$, which is reddish-brown.

32 **Answer (C)**

Ammonia gas with water gives NH_4OH.

The greenish-white precipitate with the salt solution is $Fe(OH)_2$, so its cation is Fe^{2+}.

33 **Answer (D)**

Fe_3O_4 with hot conc. H_2SO_4 gives $FeSO_4$ and $Fe_2(SO_4)_3$.

NaOH precipitates $Fe(OH)_2$ and $Fe(OH)_3$ together, and both dissolve in dilute HCl.

34 **Answer (C)**

The reddish-brown precipitate with NH_4OH shows Fe^{3+}, and the compound dissolves in water.

Iron(III) nitrate dissolves in water, while iron(III) hydroxide does not.

35 **Answer (B)**

Gas (Z) turns limewater milky, so it is CO_2 and the salt is a carbonate.

The greenish-white precipitate with ammonia shows Fe^{2+}.

So the salt is iron(II) carbonate.

36 **Answer (D)**

(A) decomposes on heating into Fe_2O_3 and water, so it is $Fe(OH)_3$.

(B) is the product of the reaction of Fe_2O_3 with conc. HCl, so it is $FeCl_3$.

Both compounds contain the Fe^{3+} cation.

37 **Answer (C)**

What decolourises acidified $KMnO_4$ is a reducing substance.

The nitrite NO_2^- and the Fe^{2+} cation are both reducing, so the salt is $Fe(NO_2)_2$.

38 **Answer (B)**

The substance does not dissolve in water and gives off a gas on strong heating and with the acid.

Iron(II) carbonate $FeCO_3$ decomposes by heat and reacts with H_2SO_4, giving off CO_2.

39 **Answer (C)**

X^- decolourises acidified $KMnO_4$, so it is oxidised; it is nitrite, oxidised to nitrate Y^-.

Nitrate with H_2SO_4 and Fe^{2+} oxidises Fe^{2+} to Fe^{3+} (the brown ring reaction).

So Y^- is nitrate and $A^{(n+1)+}$ is Fe^{3+}.

40 **Answer (B)**

KOH solution gives a precipitate that dissolves in the excess; this is a property of $Al(OH)_3$.

$BaCl_2$ gives a white precipitate of $BaSO_4$ with sulphate.

So solution (X) is $Al_2(SO_4)_3$ and precipitate (Y) is white.

41 **Answer (B)**

Adding excess NaOH dissolves only $Al(OH)_3$, and the two iron hydroxides remain.

Excess HCl dissolves all three hydroxides, so a clear solution forms.

42 **Answer (D)**

A white precipitate with NaOH that dissolves in the excess shows Al^{3+}.

A white precipitate with $AgNO_3$ shows Cl^-.

43 **Answer (A)**

Aluminium chloride dissolves in water, while lead(II) chloride does not dissolve in cold water.

44 **Answer (C)**

Aluminium hydroxide does not dissolve in excess ammonia solution.

So a white gelatinous precipitate forms and remains.

45 **Answer (A)**

Substance (X) is a metal that reacts with H_2SO_4, giving off hydrogen, which burns with a pop.

The white precipitate with NaOH dissolves in the excess, so it is $Al(OH)_3$ and the metal is aluminium.

$Ba(NO_3)_2$ with sulphate gives a white precipitate of $BaSO_4$ (Z).

46 **Answer (C)**

(1) in $Fe(OH)_2$ only: it is oxidised in air and changes colour.

(2) common to both: both dissolve in HCl.

(3) in $Al(OH)_3$ only: it dissolves in NaOH.

47 **Answer (B)**

$Al(NO_3)_3$ with Na_2CO_3 gives (M) insoluble $Al(OH)_3$, then HCl gives (N) soluble $AlCl_3$, then excess NaOH gives (O) a soluble salt.

$Fe(NO_3)_2$ with Na_2CO_3 gives (P) insoluble $FeCO_3$, then HCl gives (Q) soluble $FeCl_2$, then NaOH gives (R) insoluble $Fe(OH)_2$.

Insoluble compounds: M , P , R

48 **Answer (B)**

(X) is $Al(NO_3)_3$ and (Y) is NaCl.

$Pb(NO_3)_2$ gives a white precipitate of $PbCl_2$ with NaCl, and gives no precipitate with $Al(NO_3)_3$.

49 **Answer (D)**

$Al(OH)_3$ is amphoteric, so it reacts with acids and with bases such as NaOH.

The other hydroxides react with the acid only.

50 **Answer (A)**

The chloride of (X) is insoluble and its acetate is soluble, so it is Pb^{2+}; the hydroxide of (Y) dissolves in NaOH, so it is Al^{3+}.

$PbSO_4$ does not dissolve in water, so statement (A) is wrong.

$Al_2(SO_4)_3$ dissolves, the charge of Pb^{2+} is less than that of Al^{3+}, and they are in two different groups.

51 **Answer (A)**

Every 3 mol of NaOH precipitate 1 mol of $Al(OH)_3$, so the first 6 mol precipitate 2 mol of $Al(OH)_3$.

The remaining 1 mol of NaOH dissolves 1 mol of the precipitate, so the mass drops to half and then stays constant.

Graph (A): rises, then falls, then stays constant.

52 **Answer (B)**

Mass of precipitate from 1 g of each ion: $Fe^{2+} \rightarrow Fe(OH)_2$ and $Fe^{3+} \rightarrow Fe(OH)_3$; the mass of the Fe^{3+} precipitate is larger.

Al^{3+} with excess NaOH gives no precipitate because it dissolves.

Graph (B)

53 **Answer (C)**

HCl precipitates Ag^+ as AgCl (B).

Excess NaOH gives $Fe(OH)_2$ and $Fe(OH)_3$ (the precipitates C), and $Al(OH)_3$ dissolves in the excess.

Solution (D) contains Na^+ (and aluminate ions).

54 **Answer (D)**

Al^{3+} is detected by NaOH or NH_4OH (a white gelatinous precipitate that dissolves in excess NaOH only).

Cl^- is detected by dilute HNO_3 and $AgNO_3$ (a white precipitate of AgCl).

Dilute HCl and NH_4OH together do not detect both aluminium and chloride.

55 **Answer (D)**

The solution is colourless, and NaOH gives a white precipitate that dissolves in the excess, so the cation is Al^{3+}.

$Ba(NO_3)_2$ gives a white precipitate, so the anion is SO_4^{2-}.

So the salt is aluminium sulphate.

56 **Answer (C)**

The alloy dissolves in H_2SO_4, then NaOH gives precipitate (B).

With more NaOH the amount of precipitate decreases because $Al(OH)_3$ dissolves, and greenish-white $Fe(OH)_2$ remains.

So the two metals are iron and aluminium.

57 **Answer (D)**

4 mol of NaOH is less than needed to precipitate all the aluminium (6 mol are needed).

So the precipitate increases until the NaOH is used up, then stays constant without dissolving.

Graph (D)

58 **Answer (C)**

$Fe(OH)_3$ does not react with NaOH and does not dissolve in it.

So its mass stays constant with time.

59 **Answer (C)**

Ca^{2+} and Ba^{2+} give white precipitates with sulphate ($CaSO_4$ and $BaSO_4$).

60 **Answer (D)**

Na_2CO_3 precipitates the carbonates of Hg^+, Mg^{2+} and Cu^{2+}, and does not precipitate the carbonates of NH_4^+, K^+ and Na^+.

Ca^{2+} and Pb^{2+} both give a carbonate precipitate, so they cannot be separated.

61 **Answer (D)**

$CaCl_2 + Al_2(SO_4)_3 \rightarrow CaSO_4 + AlCl_3$

$CaSO_4$ is sparingly soluble so it precipitates, and $AlCl_3$ dissolves in water.

62 **Answer (C)**

Solution (X) is a chloride, because it gives white AgCl with $AgNO_3$.

With Na_2SO_4 it gives a white sulphate precipitate, which happens with Ca^{2+} in $CaCl_2$.

63 **Answer (B)**

KCl precipitates Pb^{2+} as white $PbCl_2$.

No precipitate forms with Ca^{2+}, because $CaCl_2$ dissolves in water.

64 **Answer (B)**

Reddish-brown fumes (NO_2) given off with hot conc. H_2SO_4 show the nitrate anion.

The white precipitate is $CaSO_4$, so the salt is calcium nitrate.

65 **Answer (C)**

$CaCl_2$ with H_2SO_4 (X) gives a white precipitate of $CaSO_4$.

$CaCl_2$ with NaOH (Y) gives $Ca(OH)_2$ (Z), which is limewater.

Limewater with CO_2 gives a white precipitate of $CaCO_3$.

66 **Answer (B)**

$(NH_4)_2CO_3$ precipitates the carbonate of the cation (B), and it dissolves in dilute HCl giving off CO_2.

The cation that gives a brick red colour in the Bunsen flame is Ca^{2+}.

67 **Answer (D)**

(2) Dilute HCl precipitates Ag^+ as AgCl and does not precipitate Cu^{2+}.

(4) H_2S in an acidic medium precipitates Cu^{2+} as CuS and does not precipitate Na^+.

(1) Both cations precipitate with ammonia, and (3) neither precipitates with HCl.

68 **Answer (B)**

(C) is a solution containing sulphate, so with $Ca(NO_3)_2$ a white precipitate of $CaSO_4$ (D) forms.

The cation of (D) is Ca^{2+}, and it gives the flame a brick red colour.

69 **Answer (B)**

$CaCl_2$ is soluble, so no precipitate forms with chloride ions.

$CaSO_4$ is sparingly soluble, so a precipitate forms with sulphate ions.

Ca^{2+} gives a brick red colour in the flame test.

70 **Answer (D)**

HCl precipitates Ag^+ and Hg^+ as AgCl and Hg_2Cl_2.

Fe^{2+}, Mn^{2+} and Ca^{2+} remain in the solution.

Essay questions

1 **Model answer**

(1) The cation of lead(II) bromide is in analytical group I.

(2) Precipitate (2): silver bromide.

• Colour: yellowish white.

• Formula: AgBr

2 **Model answer**

Chloride ions form a white precipitate with silver cations.

∴ The cation of this salt: Ag^+

When conc. sulphuric acid is added to this salt with heating, reddish-brown fumes are given off.

∴ The anion of this salt: NO_3^-

So salt (X) is silver nitrate.

3 **Model answer**

When dilute hydrochloric acid is added to this salt, reddish-brown fumes are given off at the mouth of the tube.

∴ The anion of this salt: NO_2^-

When dilute sulphuric acid is added to a solution of this salt, a white precipitate of a divalent cation forms.

∴ The cation of this salt: Pb^{2+}

So salt (X) is lead(II) nitrite.

4 **Model answer**

(1) A greenish-white precipitate of iron(II) hydroxide forms.

(2) Violet iodine vapour and SO_2 gas with a pungent smell are given off.

5 **Model answer**

Aluminium (X) reacts with sulphuric acid, forming aluminium sulphate solution (Y) and hydrogen gas (Z).

(1) (a) Metal (X): Al

(b) Solution (Y): $Al_2(SO_4)_3$

(2) $Fe_3O_4(s) + H_2(g) \longrightarrow (650°C)\ 3FeO(s) + H_2O(v)$

6 **Model answer**

The gas that blackens a paper moistened with lead(II) acetate solution: H_2S

∴ The anion of the salt: S^{2-}

The cation that colours the Bunsen flame brick red: Ca^{2+}

∴ Salt (X): calcium sulphide.

7 **Model answer**

When lead(II) acetate solution is added to a solution of this salt, a white precipitate forms.

∴ The anion of this salt: SO_4^{2-}

When ammonia solution is added to a solution of this salt, a white gelatinous precipitate forms.

∴ The cation of this salt: Al^{3+}

So salt (X) is aluminium sulphate.

8 **Model answer**

(1) Pb^{2+} cations

(2) Ca^{2+} cations

9 **Model answer**

(1) AgCl

(2) White.

(3) Fe^{2+}

(4) Al^{3+}

(5) $Fe(OH)_2$

(6) Na^+

10 **Model answer**

- Substance (1): aluminium.
- Gas (2): hydrogen.
- Precipitate (3): aluminium hydroxide.
- Precipitate (4): barium sulphate.

Past exam questions

1	2	3	4	5	6	7	8	9	10
A	D	C	B	A	C	C	C	C	A
11	12	13	14	15	16	17	18	19	20
C	D	B	D	A	D	A	B	B	B
21	22	23	24	25	26	27	28	29	30
C	B	A	C	D	C	C	B	D	D
31	32	33	34	35	36	37	38	39	40
D	A	A	C	D	D	B	C	A	D
41	42	43							
—	—	—							

1 **Answer (A)**

The cation X^{2+} gives a white precipitate with sodium carbonate and with dilute H_2SO_4.
Ca^{2+} gives white $CaCO_3$ and $CaSO_4$, while Cu^{2+} gives bluish-green $CuCO_3$, Mg^{2+} gives soluble $MgSO_4$, and Fe^{2+} gives a greenish-white precipitate.

2 **Answer (D)**

Excess NaOH precipitates Fe^{3+} as $Fe(OH)_3$ and dissolves $Al(OH)_3$, forming aluminate AlO_2^-.
The tube contains Cl^-, Na^+, AlO_2^- and the precipitate $Fe(OH)_3$.

3 **Answer (C)**

The confirmatory reagent for Ba^{2+} is dilute H_2SO_4, which gives a white precipitate of $BaSO_4$.
In $Pb(NO_2)_2$ the acid detects Pb^{2+} by a white precipitate of $PbSO_4$, and NO_2^- by reddish-brown fumes of NO_2.

4 **Answer (B)**

The gas that gives a black precipitate (CuS) with acidified copper nitrate is H_2S.
The salt that gives H_2S with HCl is potassium sulphide.

5 **Answer (A)**

NaOH dissolves $Al(OH)_3$ because it is amphoteric, and $Fe(OH)_2$ stays undissolved.

HCl dissolves both hydroxides, NH_4OH does not dissolve $Al(OH)_3$, and NaCl has no effect.

6 **Answer (C)**

HCl precipitates Pb^{2+} as $PbCl_2$, and Cu^{2+} and Ca^{2+} remain in the solution.

H_2SO_4 precipitates Ca^{2+} as $CaSO_4$, and Cu^{2+} remains in the solution.

7 **Answer (C)**

$CuCl_2$ with HCl and H_2S gives a black precipitate of CuS (Y).

$CuCl_2$ with K_2CO_3 gives a precipitate of $CuCO_3$ (Z).

8 **Answer (C)**

Excess HCl precipitates Ag^+ as white AgCl.

After that, H_2S in an acidic medium precipitates Cu^{2+} as black CuS.

K^+ does not precipitate, so a mixture of a white and a black precipitate forms.

9 **Answer (C)**

Salt (A) is KCl; its acid HCl detects Pb^{2+} in salt (B) (a white precipitate of $PbCl_2$).

The acid of salt (B) $PbSO_4$ is conc. H_2SO_4, which detects Cl^- in salt (A) by giving off HCl gas.

10 **Answer (A)**

Dilute H_2SO_4 precipitates Pb^{2+} as $PbSO_4$ and Ca^{2+} as $CaSO_4$, and Cu^{2+} remains in the solution.

HCl precipitates only Pb^{2+}, and Ca^{2+} remains with Cu^{2+}.

11 **Answer (C)**

Pb^{2+} gives white $PbCl_2$ with the chloride ion, while $BaCl_2$ dissolves.

Na_2SO_4 and Na_2CO_3 precipitate both cations, and CH_3COONa precipitates neither.

12 **Answer (D)**

NaCl precipitates Ag^+ and Pb^{2+} as AgCl and $PbCl_2$, so we filter.

Then magnesium sulphate precipitates Ca^{2+} as $CaSO_4$, so we filter and Cu^{2+} remains in the solution.

Choices (A) and (B) precipitate the copper itself as CuS, so it does not remain in the solution.

13 **Answer (B)**

Excess NaOH precipitates only Fe^{2+} as $Fe(OH)_2$, because $Al(OH)_3$ dissolves in the excess and Ca^{2+} stays dissolved.

Excess NH_4OH precipitates Al^{3+} and Fe^{2+} together, Na_2CO_3 precipitates all three, and KCl precipitates nothing.

14 **Answer (D)**

The main reagent of group I is HCl and that of group III is NH_4OH.

Sodium chloride does not react with either, so it does not distinguish between them.

The other salts give a precipitate with NH_4OH and none with HCl.

15 **Answer (A)**

A white precipitate with lead acetate shows sulphate ($PbSO_4$).

A greenish-white precipitate with ammonia shows Fe^{2+}.

So the salt is $FeSO_4$.

16 **Answer (D)**

$Fe_2(SO_4)_3$ with $Ba(OH)_2$ gives white $BaSO_4$ (for the sulphate) and reddish-brown $Fe(OH)_3$ (for the iron).

So both its ions are detected together with one reagent.

17 **Answer (A)**

$Pb(NO_3)_2$ with conc. H_2SO_4 gives off reddish-brown NO_2 and forms a white precipitate of $PbSO_4$.

Na_2CO_3 gives CO_2, not CO; KCl gives HCl; and $CuBr_2$ gives no precipitate.

18 **Answer (B)**

The disappearance of the brown colour of iodine shows it is reduced by thiosulphate $S_2O_3^{2-}$.

The white precipitate with dilute H_2SO_4 is $PbSO_4$, so the salt is lead(II) thiosulphate.

19 **Answer (B)**

The foul-smelling gas is H_2S, and with acidified Cu^{2+} it gives black CuS.

Adding $AgNO_3$ forms white AgCl from the chloride, so a mixture of a white precipitate and a black precipitate forms.

20 **Answer (B)**

(C) is $CaCO_3$, because it reacts with acid (B) to give $CaCl_2$ and an unstable acid (H_2CO_3).

$CaCl_2$ with conc. H_2SO_4 gives $CaSO_4$ and HCl gas (A).

HCl gas with water gives HCl solution, which is (B).

21 **Answer (C)**

Na_2CO_3 gives a white precipitate of $MgCO_3$ with $MgSO_4$.

It gives no precipitate with $(NH_4)_2SO_4$, so they can be distinguished.

22 **Answer (B)**

NaCl precipitates Hg^+ as Hg_2Cl_2 and Pb^{2+} as $PbCl_2$.

So these two cations can be separated from their solution with this reagent.

23 **Answer (A)**

Dilute HCl detects nitrite NO_2^- by giving off reddish-brown fumes of NO_2.

It detects Hg^+ by forming a white precipitate of Hg_2Cl_2.

24 **Answer (C)**

Dilute H_2SO_4 detects Pb^{2+} by a white precipitate of $PbSO_4$.

Conc. H_2SO_4 detects the nitrate by giving off reddish-brown fumes, so the acid detects both ions.

25 **Answer (D)**

The black precipitate with H_2S in an acidic medium shows the Cu^{2+} cation (CuS).

The white precipitate with $AgNO_3$ shows chloride, so the salt is $CuCl_2$ and the gas is H_2S.

26 **Answer (C)**

H_2S with Cu^{2+} in an acidic medium gives black CuS.

$AgNO_3$ with Na_2S gives black Ag_2S.

27 **Answer (C)**

CuS precipitates from H_2S in an acidic medium, so the gas is passed in with dilute HCl.

28 **Answer (B)**

A black precipitate with H_2S in an acidic medium shows Cu^{2+}.

A white precipitate with $BaCl_2$ shows SO_4^{2-}.

So the salt is $CuSO_4$.

29 **Answer (D)**

30 **Answer (D)**

NH_4OH is the right reagent for Fe^{2+} (not wrong), it is a weak base, and it needs no heating.

The colour of the precipitate differs from the expected one if the salt is mixed with other salts.

31 **Answer (D)**

An old $FeSO_4$ solution is oxidised in air from Fe^{2+} to Fe^{3+}.

So with KOH it gives a reddish-brown precipitate of $Fe(OH)_3$.

32 **Answer (A)**

The precipitate that dissolves in excess NaOH is $Al(OH)_3$ (amphoteric).

So the salt solution is $Al(NO_3)_3$.

33 **Answer (A)**

$Al(OH)_3$ dissolves in excess NaOH, forming the soluble aluminate salt $NaAlO_2$.

34 **Answer (C)**

$(NH_4)_2CO_3$ precipitates both Ca^{2+} and Mg^{2+} as white precipitates, so it does not distinguish between them.

In the other pairs only one precipitates: Ca^{2+}, Mg^{2+} or Fe^{2+}, while Na^+ and K^+ do not.

35 **Answer (D)**

$AlCl_3$ gives a white precipitate that dissolves in excess NaOH and does not dissolve in excess NH_4OH.

HCl gives white clouds of NH_4Cl with the ammonia evaporating from NH_4OH, and does not give them with NaOH.

$FeCl_3$ and $FeCl_2$ give the same precipitate with both reagents.

36 **Answer (D)**

X decomposes on heating into the red oxide Fe_2O_3, and $FeSO_4$ decomposes by heat into Fe_2O_3.

The oxide with conc. HCl gives $FeCl_3$ (Y), and on adding ammonia $Fe(OH)_3$ precipitates (Z).

37 **Answer (B)**

NH_4OH (C) detects Al^{3+} in (A), giving a white gelatinous precipitate.

It detects Fe^{2+} in (B), giving a greenish-white precipitate.

HCl does not detect sulphate, $Al(NO_3)_3$ does not detect a cation or the chloride anion, and $FeSO_4$ does not detect NH_4^+ or Cl^-.

38 **Answer (C)**

(1) $AgNO_3$ gives white AgCl with $CaCl_2$.

(2) $(NH_4)_2CO_3$ gives white $CaCO_3$.

(3) Na_2SO_4 gives white $CaSO_4$.

39 **Answer (A)**

$NaNO_2$ reduces acidified $KMnO_4$ so its colour disappears, and gives no precipitate with NaOH, so it is (A).

$FeSO_4$ reduces $KMnO_4$ so its colour disappears, and gives $Fe(OH)_2$ with NaOH, so it is (B).

40 **Answer (D)**

$Pb(NO_2)_2$ with HCl gives a white precipitate of $PbCl_2$, and reddish-brown NO_2 is given off from the nitrite.

$NaNO_2$ gives a gas only, and $AgNO_3$ gives a precipitate only.

41 **Model answer**

(1) 1– Salt (X): FeS

2– Salt (Y): $FeCl_2$

(2) • Precipitate (A): copper(II) sulphide.

• Precipitate (B): iron(II) hydroxide.

42 **Model answer**

(1) 1– Salt (ZCl_2): $CuCl_2$

2– Black precipitate (W): CuS

(2) $AgNO_3$, $Pb(NO_3)_2$

43 **Model answer**

(1) Sulphuric acid.

(2) $FeSO_4$

(3) $Ca(HCO_3)_2$

(4) KCl