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VCE Chemistry ½
Solubility & Precipitation [1.9]
Homework

Homework Outline:

Compulsory Questions	Pg 2 – Pg 13
Supplementary Questions	Pg 14 – Pg 24

Section A: Compulsory Questions (53 Marks)

Sub-Section: Explain the Process by Which Ionic Compounds Dissolve in Water with Reference to Ion-Dipole Bonding

Question 1 (2 marks)

Consider a Na^+ ion that is placed right next to a molecule of H_2O. Explain how ion-dipole bonds between these two are formed.

Question 2 (3 marks)

Between ion-dipole bonds, ionic bonds and dipole-dipole attractions, rank these in terms of increasing strength, giving your justification for your answer.

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Question 3 (4 marks)

Consider the substance NaCl. Show, with the use of diagrams, how NaCl would dissolve in water and explain the process.

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Sub-Section: Write Balanced Equations for Ionic Compounds Dissociating/Ionising in Water

Question 4 (2 marks)

Write the ionisation reactions for the following compounds.

a. LiF. (1 mark)

_____

b. NaCl. (1 mark)

_____

Question 5 (4 marks)

Write the ionisation reactions for the following.

a. K_2SO_4. (2 marks)

_____

b. H_2CO_3. (2 marks)

_____

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Question 6 (4 marks)

Consider a certain sample of Na_2SO_4. Explain how it is dissolved in water, including the reaction that represents this process.

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Sub-Section: Identify Which Compounds Will or Will Not Dissolve in Water, with Reference to SNAPE and/or Solubility Tables

Question 7 (4 marks)

For each of the following compounds, determine whether they are soluble in water.

a. HNO_3. (1 mark)

_____

b. C_2H_6. (1 mark)

_____

c. NH_4Cl. (1 mark)

_____

d. NaF. (1 mark)

_____

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Question 8 (4 marks)

Referring to the following solubility table, determine whether the following compounds are soluble in H_2O.

Solubility table

Salts	Soluble	Insoluble
Sodium	All	None
Potassium		
Ammonium		
Nitrate		
Ethanoate		
Bromide, Chloride, Iodide	Most are soluble.	Lead(ll), Silver,$CuBr_2$, CuI_2
Sulphate	Most soluble.	Barium, Calcium, Lead(ll), Silver
Carbonate	Group 1 ions, ammonium	Most are insoluble.
Phosphate	Group 1 ions. ammonium	Most are insoluble.
Hydroxide	Group 1 ions. ammonium	Most are insoluble.

a. $PbBr_2$. (1 mark)

_____

b. $CuSO_4$. (1 mark)

_____

c. $Pb_3(PO_4)_2$. (1 mark)

_____

d. $Al(OH)_3$. (1 mark)

_____

Question 9 (4 marks)

Consider the molecule of AgCl.

a. Determine whether it is soluble in water. (1 mark)

_____

b. Explain your answer with reference to intermolecular bonding. (3 marks)

_____

_____

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Sub-Section: Write Full & Ionic Equations for Precipitation Reactions

Question 10 (4 marks)

Identifying spectator ions from equations already written and identifying whether the ionic or full equation is given and explaining their difference maybe.

For each of the following, identify their spectator ions and whether it is an ionic equation or a full equation.

a. $2NaCl(aq) + Fe(NO_3)_2(aq) \rightarrow 2NaNO_3(aq) + FeCl_2(s)$

i. Type of reaction. (1 mark)

_____

ii. Spectator ions. (1 mark)

_____

b. $2Ag^+(aq) + CO_3^{2-}(aq) \rightarrow Ag_2CO_3(s)$

i. Type of reaction. (1 mark)

_____

ii. Spectator ions. (1 mark)

_____

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Question 11 (4 marks)

For each of the following, state whether a precipitate will form and if so, write its identity and state any spectator ions, if applicable.

a. NaBr and $Pb(NO_3)_2$.

i. Precipitate. (1 mark)

_____

ii. Spectator ions. (1 mark)

_____

b. KCl and $NaNO_3$.

i. Precipitate. (1 mark)

_____

ii. Spectator ions. (1 mark)

_____

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Question 12 (6 marks)

For the following, write their fully balanced precipitation reactions from the following reactants. Make sure to identify any spectator ions, and write the net ionic equations as well.

a. Sodium bromide and Lead (II) nitrate. (2 marks)

b. Potassium dichromate, $K_2Cr_2O_7$ and silver sulphate. (2 marks)

c. Aluminium (III) nitrate and potassium sulphide. (2 marks)

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Sub-Section: The 'Final Boss'

Question 13 (8 marks)

You are a scientist working in a chemical research lab investigating the properties of a newly synthesised compound. You are given an unknown white crystalline solid, labelled Compound *X*, and are tasked with determining its solubility in water and the potential reactions it might undergo.

Observations:

- Compound *X* is either Zinc Oxalate (ZnC_2O_4) or Silver Nitrate ($AgNO_3$).
- Compound *X* can be dissolved in water.
- You are also provided with solutions of potassium sulphate K_2SO_4 and ammonium carbonate $(NH_4)_2CO_3$ to conduct precipitation reactions.

a. Predict whether zinc oxalate or silver nitrate would dissolve in water and therefore identify Compound *X*'s identity. (2 marks)

_____

_____

_____

b. Write the dissolution reaction for Compound *X* in water and explain the process of how it will go through this process. (3 marks)

_____

_____

_____

_____

_____

c. Now, Compound *X* is mixed with a solution of potassium sulphate.

i. Fully balanced reaction. (2 marks)

_____

ii. Does a precipitate form? If so, what is it? (1 mark)

_____

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Section B: Supplementary Questions (62 Marks)

Sub-Section: Explain the Process by Which Ionic Compounds Dissolve in Water with Reference to Ion-Dipole Bonding

Question 14 (2 marks)

Explain why NaCl dissolves in water but not in another molecule like hexane, C_6H_{14}.

Question 15 (3 marks)

Explain why hydrogen bonding is stronger than dipole-dipole interactions but weaker than ion-dipole bonds.

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Question 16 (4 marks)

Aside from understanding intermolecular bonds themselves, we also need to understand how they compare with each other.

a. Explain why ion-dipole bonds are stronger than dipole-dipole interactions. (2 marks)

_____

_____

_____

b. Would this behaviour be the same as when we compare ion-dipole bonds with ionic bonding? Justify your answer. (2 marks)

_____

_____

_____

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Question 17 (7 marks)

Consider the compound of calcium nitrate.

a. Write its dissolution reaction in water. (2 marks)

_____

b. Explain the bonding that the components of this substance undergo with water when it is dissolved. (2 marks)

_____

_____

_____

c. Do you expect the bonds between this compound and water to be stronger or weaker than the bonds between water and itself? Explain your answer. (3 marks)

_____

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Sub-Section: Write Balanced Equations for Ionic Compounds Dissociating/Ionising in Water

Question 18 (1 mark)

What is the difference between solvent and solute?

Question 19 (3 marks)

Write the dissolution reactions for the following.

a. NH_4NO_3. (1 mark)

b. $Al_2(SO_4)_3$. (2 marks)

Question 20 (3 marks)

Describe how the compound $CaCO_3$ would dissolve in water, including writing the reaction that represents this process.

Question 21 (7 marks)

Consider the molecule HCl.

a. Describe how a molecule of HCl would dissolve in water, including writing the reaction that represents this process. (3 marks)

b. What is the difference between HCl before and after the process detailed in **part a.**? Justify your answer. (2 marks)

c. Would you expect either one of these to be electrically conductive? Explain. (2 marks)

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Sub-Section: Identify Which Compounds Will or Will Not Dissolve in Water, with Reference to SNAPE and/or Solubility Tables

Question 22 (2 marks)

For each of the following, determine whether they are soluble or not, giving justification.

a. $Fe(NO_3)_2$. (1 mark)

_____

b. Na_2CO_3. (1 mark)

_____

Question 23 (2 marks)

Suggest something the SNAPE rule does not tell you about the solubility of compounds.

_____

_____

_____

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Question 24 (3 marks)

Determine whether the following are soluble, referring to solubility tables.

a. Lead (II) Sulphate. (1 mark)

b. Potassium Carbonate. (1 mark)

c. Silver Chloride. (1 mark)

Question 25 (7 marks)

Consider the compound of $Ni(OH)_2$.

a. Is the molecule soluble in water? (1 mark)

b. According to your answer to **part a.**, explain how this occurs with reference to intermolecular bonding. (3 marks)

c. Now, given the molecule of $NiSO_4$, would your answer change? If so, explain why. (3 marks)

_____

_____

_____

_____

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Sub-Section: Write Full & Ionic Equations for Precipitation Reactions

Question 26 (2 marks)

For the reaction below, explain whether a precipitate is formed.

$$HCl\ (aq)\ +\ NaOH\ (aq) NaCl\ (aq)\ +\ H_2O\ (l)$$

Question 27 (4 marks)

For the following full reactions, write the ionic equations and identify the spectator ions, if any.

a. $MgBr_2 + K_2SO_4 \rightarrow MgSO_4 + 2KBr$.

i. Ionic Equation. (1 mark)

ii. Spectator ions. (1 mark)

b. $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$

i. Ionic Equation. (1 mark)

ii. Spectator ions. (1 mark)

Question 28 (6 marks)

For each of the following compounds, write the reaction that will occur between them and specify any precipitate and spectator ions.

a. Aluminium phosphate and silver (I) nitrate.

i. Full reaction. (1 mark)

_____

ii. Spectator ions. (1 mark)

_____

iii. Precipitate. (1 mark)

_____

b. Calcium chloride and sodium carbonate.

i. Full reaction. (1 mark)

_____

ii. Spectator ions. (1 mark)

_____

iii. Precipitate. (1 mark)

_____

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Question 29 (6 marks)

Consider a beaker of H_2O that has magnesium nitrate dissolved in it.

a. Write the dissolution reaction for magnesium nitrate. (2 marks)

_____

b. As we add more magnesium nitrate into the beaker, do we expect it to become easier or harder to dissolve? (2 marks)

_____

_____

_____

c. If we put a few droplets of sodium iodide into the solution, write the reaction that will occur, including states. (2 marks)

_____

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