Topic 4: Mixtures and Solutions

Knowledge	Application

Subtopic 4.1: Miscibility and Solutions

Solvents can be considered as polar (e.g. water, methanol) or non-polar (e.g. hexane, turpentine, petrol). Polar and non-polar solvents do not readily mix.	Identify water as a polar solvent and hydrocarbons as non-polar solvents. Identify a solvent as polar or non-polar, based on its miscibility with water and hydrocarbons.
Highly polar molecular substances are more soluble in water than non-polar molecules of a similar size. Molecular substances with small molecules are more soluble in water than larger molecules of similar polarity. Compounds with non-polar and polar or ionic components facilitate the mixing of polar and non-polar substances.	Predict, given the structural formulae, which of two compounds would be more soluble in polar and non-polar solvents.

Subtopic 4.2: Solutions of Ionic Substances

Many ionic substances are soluble in water. This is particularly so for ammonium and alkali metal salts. Equations can be written to represent the dissociation and hydration of ions that occurs when ionic substances dissolve in water.	Describe the formation of ion-dipole interactions when ionic substances dissolve in water. Write equations for the dissolving of ionic substances in water.
Some ionic substances are not very soluble in water; such substances form as precipitates when solutions containing the relevant ions are mixed.	Write ionic equations for precipitation reactions. Explain why soap forms a scum in water containing calcium ions.

Subtopic 4.3: Quantities in Reactions

Chemical equations can be written to describe a chemical change.	Write chemical equations when given the reactants and products of a reaction.
The concentration of a solution can be described in terms of mass concentration (mass of solute per unit volume, ρ) or as molar concentration (moles of solute per unit volume, c).	Undertake calculations using the relationship $\rho = \frac{m}{V}$ and its rearrangements. Undertake calculations using the relationship $c = \frac{n}{V}$ and its rearrangements. Undertake conversions between mass concentrations and molar concentrations.
Chemicals react in definite proportions.	Undertake stoichiometric calculations for precipitation reactions.

Subtopic 4.4 on next page.

Subtopic 4.4: Energy in Reactions

Knowledge	Application
All chemical reactions involve the formation of a new substance and are accompanied by the gain of energy (endothermic reactions) or the loss of energy (exothermic reactions). The energy changes in endothermic and exothermic reactions can be explained in terms of the Law of Conservation of Energy and the breaking and forming of bonds.	Identify a reaction as exothermic or endothermic, given relevant information.
When ionic substances dissolve in water, the dissociation of the ions requires energy and the hydration of the ions releases energy.	Explain the endothermic or exothermic nature of dissolving ionic substances in terms of the Law of Conservation of Energy, the energy required for dissociation of ions, and the energy released by hydration of the ions. Write thermochemical equations for the dissolving of ionic substances in water.
Enthalpy changes for solution reactions can be determined experimentally.	Explain the following relationships and undertake calculations involving their rearrangements: $Q = mc\Delta T$ $\Delta H = \frac{Q}{n}$ Experimentally determine enthalpies of solution. Identify a reaction as exothermic or endothermic, given a thermochemical equation or the value of its enthalpy change.