Topic 1: Monitoring the environment

Subtopic 1.1: Global warming and climate change

This subtopic builds upon acid base concepts introduced in Stage 1 subtopics 5.1, 5.2, and 5.3.

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| Some gases in the atmosphere, called ‘greenhouse gases’, keep the Earth’s atmosphere warmer than it would be without these gases. This is known as the ‘greenhouse effect’.   * Describe the action of the common greenhouse gases, carbon dioxide and methane, to maintain a steady temperature in the Earth’s atmosphere.   Anthropogenic increases in greenhouse gases disrupt the thermal balance of the atmosphere.   * Explain the warming associated with global climate change and its consequences for the environment. |
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| Ocean acidification is caused by the ocean absorbing higher levels of carbon dioxide from the atmosphere.   * Describe and write equations to show how carbon dioxide lowers the pH of the oceans. * Calculate the pH of solutions given the concentration of H+ or OH–, and vice versa.   The skeletons and shells of many marine organisms are made of calcium carbonate and are vulnerable to dissolution at low pH.   * Explain, using equilibrium principles, the impact of altering ocean pH on the formation of carbonates. * Write equations for carbonates reacting in acidic conditions. |
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Subtopic 1.2: Photochemical smog

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| Nitrogen oxides are formed in high-temperature engines and furnaces.   * Write equations for the formation of nitrogen oxides NO and NO2. |
| Nitrogen oxides and ozone are pollutants in the troposphere that are associated with photochemical smog.   * Describe and write equations showing the role of nitrogen oxides in the formation of ozone in the troposphere. * Describe the harmful effects of nitrogen oxides and ozone in the troposphere. * Describe and write equations showing how catalytic converters reduce the quantities of nitrogen oxides generated by motor vehicles. |
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Subtopic 1.3: Volumetric analysis

This subtopic builds upon concepts introduced in Stage 1 subtopics 1.3, 2.3, and 4.3.

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| Concentrations can be described by using a number of standard conventions.   * Calculate concentration and interconvert units, including: mol L1, g L1, %w/v, ppm, and ppb. * Apply SI prefix conventions to quantities.   Knowledge of the mole ratios of reactants can be used in quantitative calculations.   * Perform stoichiometric calculations when given the reaction equation and the necessary data.   A titration can be used to determine the concentration of a solution of a reactant in a chemical reaction.   * Describe and explain the procedure involved in carrying out a titration, particularly rinsing glassware and determining the end-point. * Determine the concentration of a solution of a reactant in a chemical reaction by using the results of a titration. |
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Subtopic 1.4: Chromatography

This subtopic builds upon concepts of polarity introduced in Stage 1 subtopics 3.1 and 3.2. Ion exchange is developed in subtopics 4.2 and 4.3.

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| Chromatography techniques, including thin layer chromatography (TLC), gas chromatography (GC), high-performance liquid chromatography (HPLC), and ion chromatography (IC), involve the use of a stationary phase and a mobile phase to separate the components of a mixture.  The rate of movement of the components is caused by the differences between the strengths of the interactions between atoms, molecules, or ions in the mobile and stationary phases.   * Predict the relative rates of movement of components along a stationary phase on the basis of their polarities and charge, given the structural formulae or relative polarities of the two phases.   Data from chromatography techniques can be used to determine the composition and purity of substances.   * Calculate and apply *R*F values and retention times in the identification of components in a mixture. |
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| Ion chromatography (also known as ion exchange chromatography) is used to remove either cations or anions from a mixture by replacing them with ions of another type.   * Explain, using equilibrium principles, how ions attached to the surface of a resin can be exchanged with ions in aqueous solution. |
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Subtopic 1.5: Atomic spectroscopy

This subtopic connects to atomic theory established in Stage 1 subtopics 1.2 and 2.2.

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| Flame tests and atomic absorption spectroscopy (AAS) are analytical techniques that can be used to identify elements; these methods rely on electron transfer between atomic energy levels.   * Write the electron configuration using subshell notation of an atom or monatomic ion of any of the first 38 elements in the periodic table. * Explain the effect of the absorption or emission of radiation on the electron configuration of electrons in atoms or ions.   The wavelengths of radiation emitted and absorbed by an element are unique to that element and can be used to identify its presence in a sample.   * Explain why some wavelengths of radiation emitted and absorbed by an element are unique to that element.   Atomic absorption spectroscopy is used for quantitative analysis.   * Explain the principles of atomic absorption spectroscopy in identifying elements in a sample. * Describe the construction and use of calibration graphs in determining the concentration of an element in a sample. |
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