Topic 2: Managing chemical processes

Subtopic 2.1: Rates of reactions

This subtopic builds on concepts from Stage 1 subtopic 4.4.

|  |
| --- |
| The rates of a reaction at different times can be compared by considering the slope of a graph of quantity or concentration of reactant or product against time.* Draw and interpret graphs representing changes in quantities or concentration of reactants or products against time.

Rates of reaction can be influenced by a number of factors, including the presence of inorganic and biological catalysts (enzymes).* Predict and explain, using collision theory, the effect on rates of reaction due to changes in:
* concentration
* temperature
* pressure (for reactions involving gases)
* surface area
* the presence of a catalyst.

Energy profile diagrams can be used to represent the relative enthalpies of reactants and products, the activation energy, and the enthalpy change for a chemical reaction. * Draw and interpret energy profile diagrams.
 |
|
|

Subtopic 2.2: Equilibrium and yield

This subtopic uses energy concepts from Stage 1 subtopics 2.3, 4.3, and 4.4, and links to Stage 2 subtopics 1.1 (ocean acidification), 4.2 (water treatment), and 4.3 (availability of soil nutrients).

|  |
| --- |
| Chemical systems may be open or closed.Over time, reversible chemical reactions carried out in a closed system at fixed temperature eventually reach a state of chemical equilibrium.The changes in concentrations of reactants and products, as a system reaches equilibrium, can be represented graphically.* Draw and interpret graphs representing changes in concentrations of reactants and products.

The position of equilibrium in a chemical system at a given temperature can be indicated by a constant, *Kc*, related to the concentrations of reactants and products.* Write *Kc* expressions that correspond to given reaction equations for homogeneous equilibrium systems.
* Undertake calculations involving *Kc* and initial and/or equilibrium quantities of reactants and products for homogeneous equilibrium systems.

The final equilibrium concentrations, and hence position of equilibrium, for a given reaction depend on various factors.* Predict and explain, using Le Châtelier’s principle, the effect on the equilibrium position of a system of a change in the:
* concentration of a reactant or product
* overall pressure of a gaseous mixture
* temperature of an equilibrium mixture for which the *△H* value for the forward or back reaction is specified.
* Predict the change that occurred in a system, or whether a reaction is exothermic or endothermic, given the effect of the change on the equilibrium position of the system.
 |
|

Subtopic 2.3: Optimising production

This subtopic integrates concepts from subtopics 2.1 and 2.2.

|  |
| --- |
| Designing chemical-synthesis processes involves constructing reaction pathways that may include more than one chemical reaction.The steps in industrial chemical processes can be conveniently displayed in flow charts.* Interpret flow charts and use them for such purposes as identifying raw materials, chemicals present at different steps in the process, waste products, and by-products.

Industrial processes are designed to maximise profit and to minimise impact on the environment.* Explain how certain reaction conditions represent a compromise that will give maximum yield in a short time.
* Explain the impact of increases in temperature and pressure on manufacturing conditions and costs, and on the environment.
* Explain how use of a catalyst may benefit both the manufacturer and the environment.
 |
|