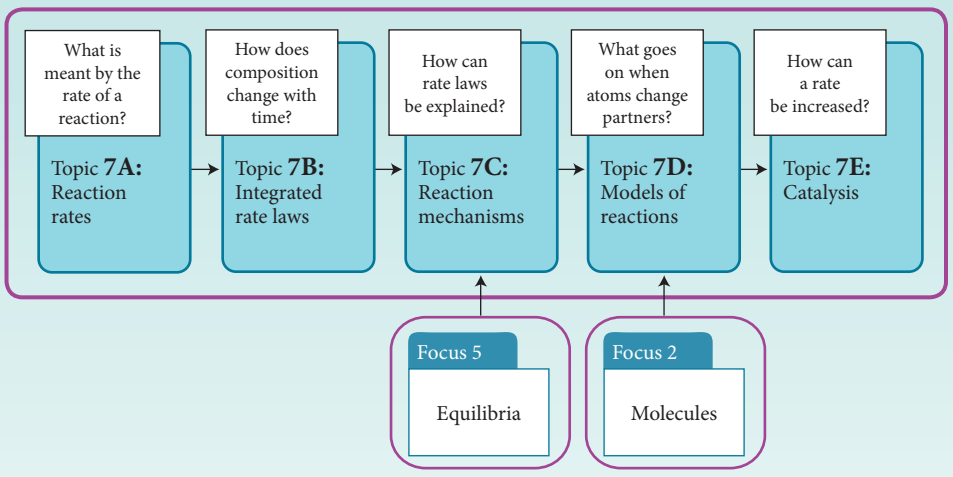
FOCUS 7

KINETICS



Thermodynamics (Focus 4) is used to predict the spontaneous direction of chemical change and the extent of reaction at equilibrium but says nothing about how quickly the reaction approaches equilibrium. Some spontaneous reactions—such as the decomposition of benzene into carbon and hydrogen—do not seem to proceed at all, whereas other reactions—such as proton transfer reactions—reach equilibrium very rapidly. This Focus examines the rates of reactions, including the details of how reactions proceed, what determines their rates, and how to control those rates. These aspects of chemical reactions constitute the field of "chemical kinetics."

TOPIC 7A introduces the concept of reaction rate and how it can be expressed in terms of the concentrations of the reactants (and sometimes products) involved in a reaction. The existence of these expressions, which are known as "rate laws," allows reactions to be classified according to their kinetic behavior. A rate law is expressed in terms of a "rate constant," a parameter that characterizes the rate of a given reaction. **TOPIC 7B** describes methods by which rate constants are determined experimentally and shows how this information is used to make predictions about how the concentrations of reactants and products change over time.

Rate laws are important because they provide a clue to how reactions take place at a molecular level. In particular, as shown in **TOPIC 7C**, they provide criteria for judging whether a "reaction mechanism," a suggested sequence of steps by which the overall reaction takes place, is acceptable. In a similar way, **TOPIC 7D** shows how the determination of the value of the rate constant and how it changes with temperature can be used to build models of the intimate details of how individual reaction events take place when bonds break and atoms exchange partners. These details point toward, in **TOPIC 7E**, an understanding of how "catalysts" function, and how their biological analogs, enzymes, act in organisms.