

14.9 1) energy of reactants 2) activation energy
3) net energy change for the reaction 4) energy of products

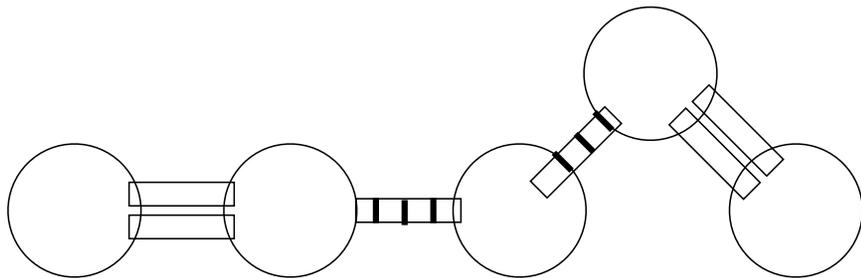
14.11 a) False, the red pathway will be slower because its activation energy is higher, meaning fewer collisions are effective, slowing the reaction.

b) True, the reverse pathways both have higher activation energies than the corresponding forward pathways.

c) True, both pathways begin and end at the same energy

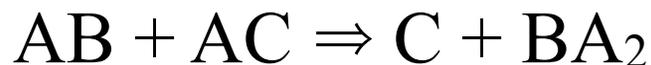
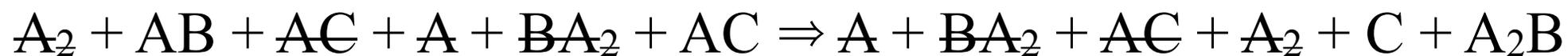
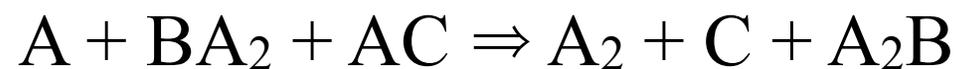
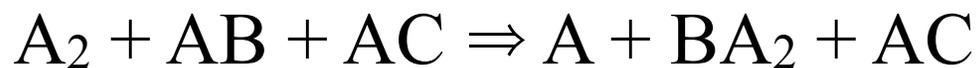
14.13 The reaction presented in this diagram has a two step mechanism. It forms 1 intermediate, identified as B. The process has 2 transition states. The second step (B \rightarrow C) will be fastest and the overall process is exothermic, meaning ΔE is negative.

14.14



Examining the products, an oxygen from ozone must collide with nitrogen from NO in order to transfer the oxygen.

14.15a)



b) The intermediate for this reaction is A

c) The catalyst for this reaction is A_2

14.51a) Energy and orientation are the factors that determine whether a collision will result in a reaction.

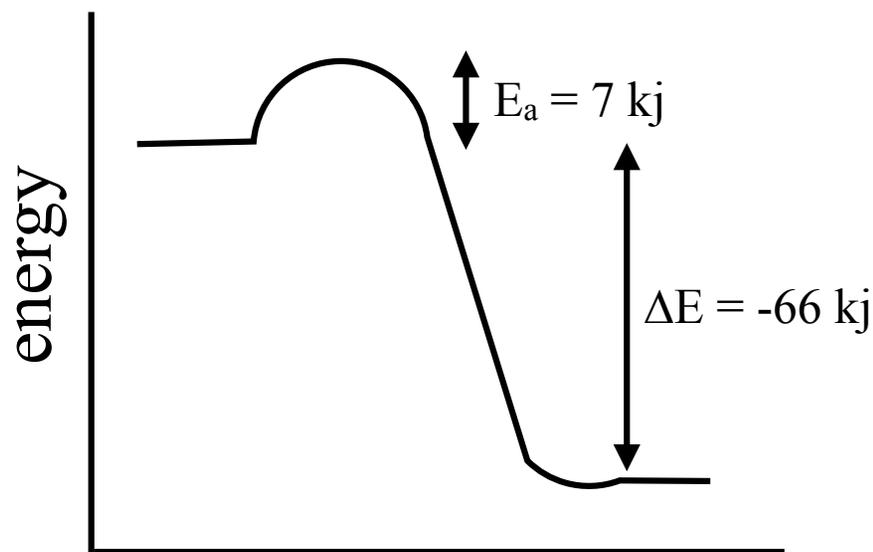
b) The value for the rate constant (k) typically will increase with increasing temperature.

c) The fraction of molecules with energy greater than E_a is most sensitive to changes in temperature.

14.52a) I would expect orientation to be less of a factor in the formation of HCl from H and Cl atoms, since any collision between these individual atoms will be properly oriented.

b) The orientation factor does not depend on temperature.

14.55a)



14.57b) The activation energy for the reverse process is 73kJ.

14.57a) False, the reaction with the higher activation energy will be slower.

b) False, a reaction with a small k does not necessarily have a low frequency factor because other factors influence the value of k .

c) True

14.59 The speed of the reaction is not dependent on the overall energy change of the reaction. Instead it is inversely related to the activation energy. As such, reaction b would be the fastest and reaction c would be the slowest.

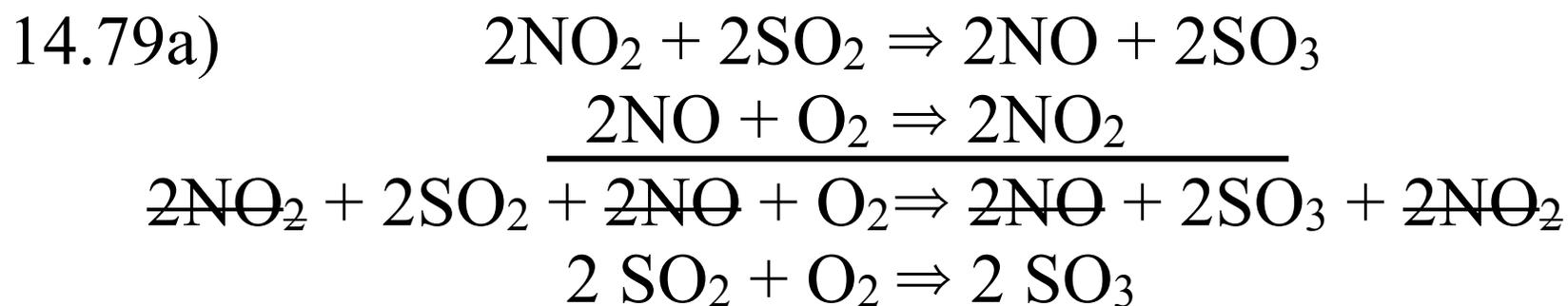
14.75a) A catalyst is a substance which speeds (usually) a reaction without being consumed by it.

b) A homogeneous catalyst exists in the same phase as the reactant particles. A heterogeneous catalyst exists in a phase different from the reactant particles.

c) Catalysts speed a reaction by changing the activation energy of the process. They do not, however, change the overall energy change for the reaction.

14.76a) Particles size is important to the function of a catalyst because smaller particles have more surface area, increasing the number of active sites. This increases their ability to catalyze a reaction.

b) Adsorption describes the process of a reactant binding to the surface of a catalyst.



b) NO_2 is a catalyst in this reaction because it is consumed by the first step of the mechanism, then produced by the second step with no net change to this molecule.

c) By contrast, an intermediate would be first produced, then consumed, as in the case of NO .

d) Since NO_2 is the same phase as the other reactants, it is a homogeneous catalyst.

14.82a) Automotive catalytic converters capture CO and hydrocarbons and catalyze their combustion to H₂O and CO₂. They also capture NO_x and speed their conversion to N₂ and O₂. As such, to test the effectiveness of a catalytic converter we would test for the presence of CO, hydrocarbons and NO_x compounds.

b) The high temperatures could speed the rate of the reactions the catalytic converter seeks to catalyze. Unfortunately, the high heat could also increase the rate of unwanted reactions, creating other pollutants or causing the catalytic converter to corrode.

c) The rate of gas flow through the catalytic converter will impact the rate of adsorption. If the flow rate is too fast, some particles may pass through the device without being adsorbed, releasing pollutants. If the flow rate is too low, it could potentially foul the surface of the catalyst or impact the efficiency of the vehicle.