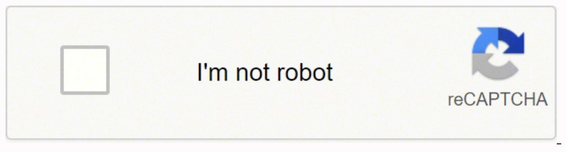

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Catalysis lecture notes pdf

Magnetic Catalysis: A Review

Igor A. Shovkovy

Abstract We give an overview of the magnetic catalysis phenomenon. In the framework of quantum field theory, magnetic catalysis is broadly defined as an enhancement of dynamical symmetry breaking by an external magnetic field. We start from a brief discussion of spontaneous symmetry breaking and the role of a magnetic field in its a dynamics. This is followed by a detailed presentation of the essential features of the phenomenon. In particular, we emphasize that the dimensional reduction plays a profound role in the pairing dynamics in a magnetic field. Using the general nature of underlying physics and its robustness with respect to interaction types and model content, we argue that magnetic catalysis is a universal and model-independent phenomenon. In support of this claim, we show how magnetic catalysis is realized in various models with short-range and long-range interactions. We argue that the general nature of the phenomenon implies a wide range of potential applications: from certain types of solid state systems to models in cosmology, particle and nuclear physics. We finish the review with general remarks about magnetic catalysis and an outlook for future research.

1 Introduction

The magnetic catalysis is broadly defined as an enhancement of dynamical symmetry breaking by an external magnetic field. In this review, we discuss the underlying physics behind magnetic catalysis and some of its most prominent applications. Considering that the ideas of symmetry breaking take the center stage position in many branches of modern physics, we hope that this review will be of interest to a rather wide audience.

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Efficiency of polymerization measured in terms of kinetic chain length

$$\equiv \frac{\#\text{ of monomers consumed}}{\#\text{ of active centers produced}}$$

$$= \frac{\text{rate of propagation}}{\text{rate of initiation}}$$

$$= \frac{\text{rate of propagation}}{\text{rate of termination}} \quad \text{since rate of initiation} \cong \text{rate of termination}$$

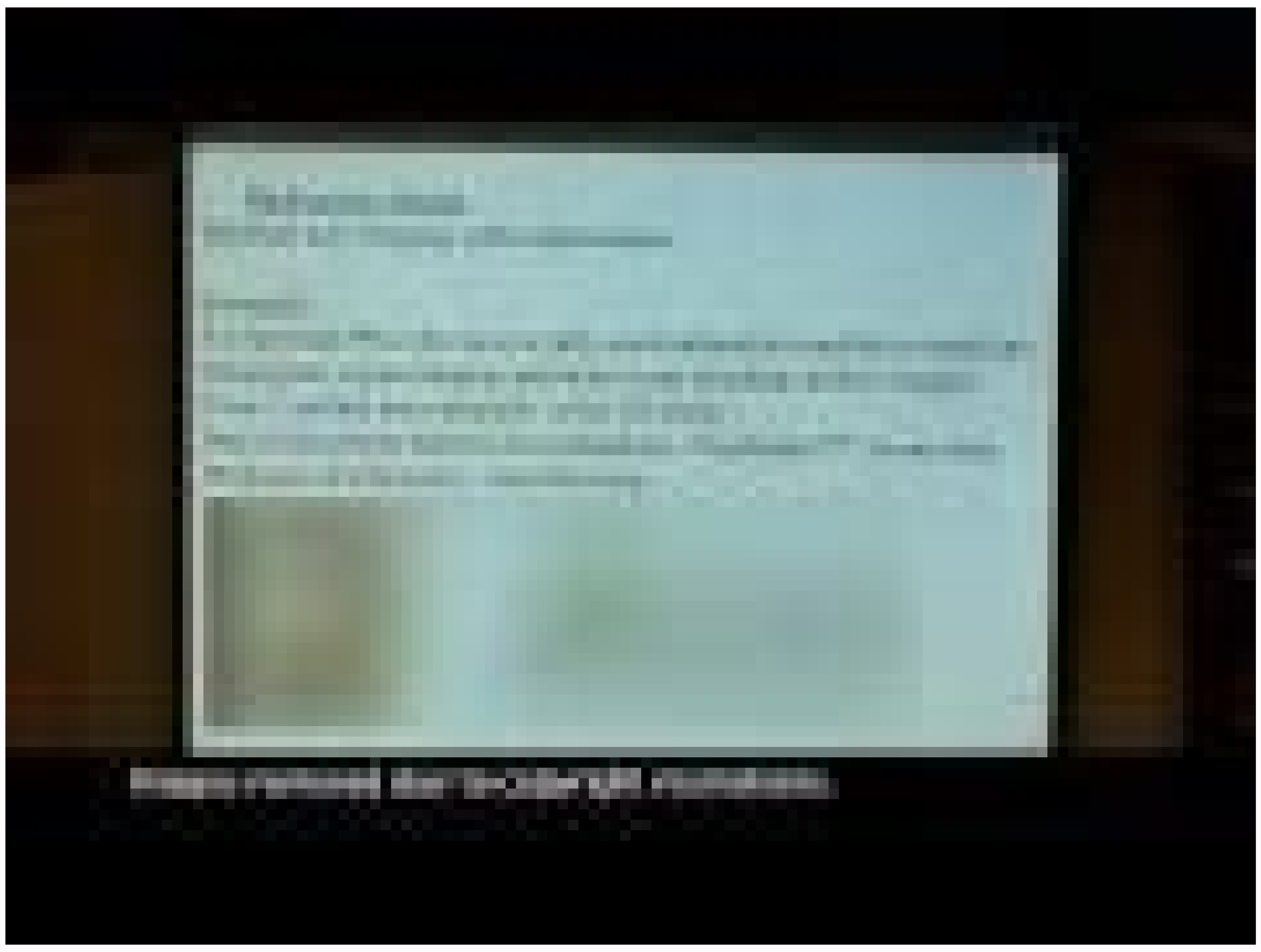
$$= \frac{k_p [M][M^\bullet]}{2 k_t [M^\bullet]^2}$$

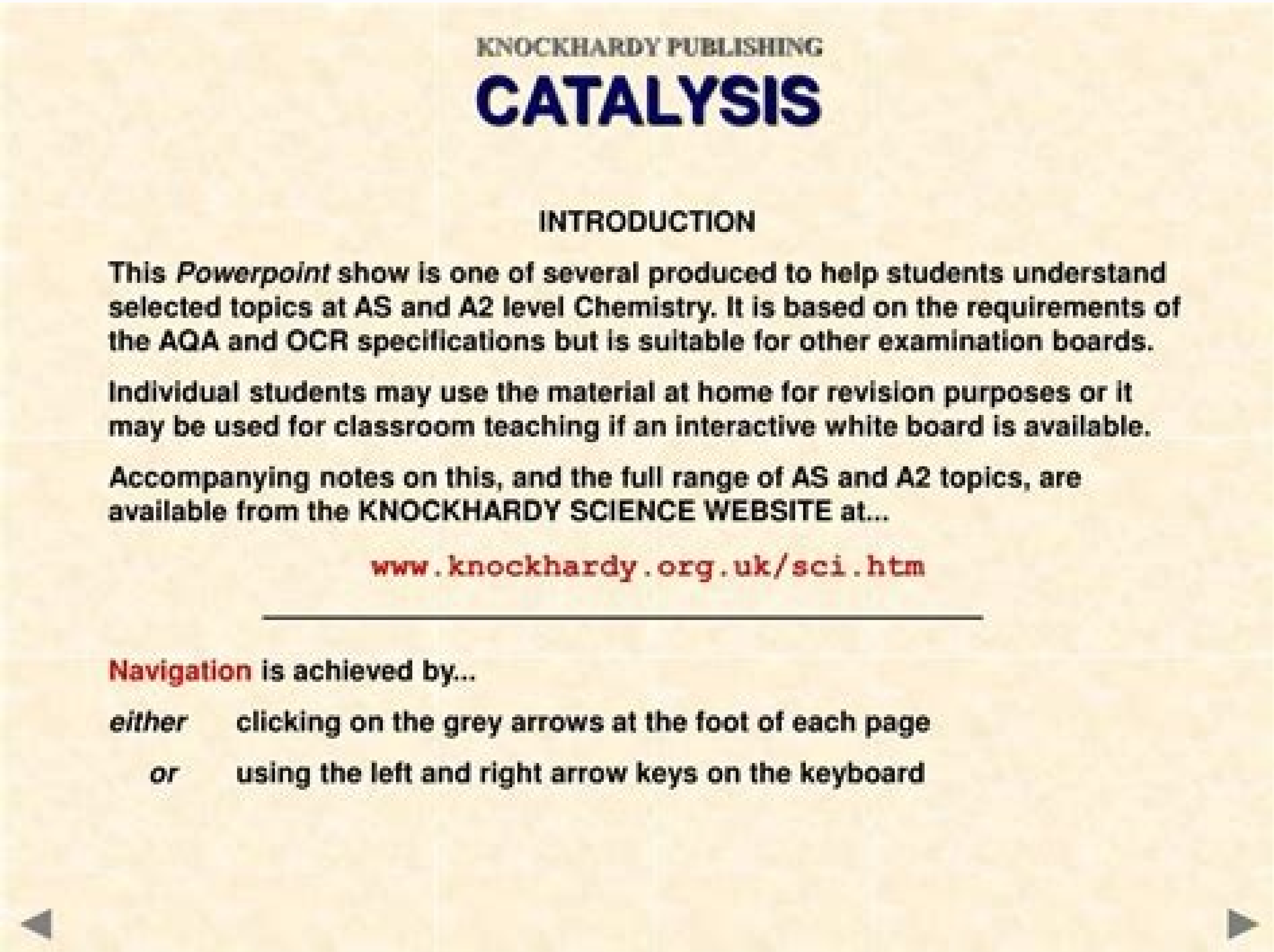
$$= \frac{k_p [M]}{2 k_t [M^\bullet]} \quad \text{where } [M^\bullet] = \left(\frac{\phi k_i}{k_t}\right)^{1/2} [I]^{1/2}$$

$$= k [M][I]^{-1/2} \quad \text{where } k = \tfrac{1}{2} k_p (\phi k_i / k_t)^{-\frac{1}{2}}$$

So, the slower the initiation (i.e. the smaller $[I]$, k_i)
the greater the chain length or
the efficiency of polymerization or
the higher the molar mass of polymer

See example 26.4, P. 805 (6th)
P. 912 (5th)





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An example of such reaction is the partial oxidation of ethylene in ethylene oxide, as shown in figure \ (\ pataintex {3} \). Rev., 10, 1] assuming that \ (k _ {- 1} \ gg k_1 \), we can apply a stationary state approximation to spy \ (\ text {as} \): \ [\ Dfrac {d \ left [\ text {like} \ right]} {dt} = 0 = k_1 \ left \ text {a} \ right] \ left [\ text} \ right] - k _ {- 1} \ text {as} \ right] _ _ _ {SS} - K_2 \ LEFT [\ Text {as} \ right] _ _ _ _ _ _ _ _ _ _ \ left [\ text {b} \ right] \ label {eq16 \] As in the case of unimolecular catalyzed reactions, we can express the concentrations of \ (\ text {as} \) and \ (\ text} \) in terms of a fraction of the total number of active sites, \ (\ text} _0 \) and rewrite the above equity as \ [= k_1 \ left [\ text {the} \ right] \ left (1 - \ theta \ right) \ left [\ text {s } \ right] _0 - K _ {- 1} \ left [\ text} \ right] _0 - K_2 \ Theta \ Left [\ text {S} \ right] _0 \ Left [\ text {b} \ right] \ Rotule {eq17} \] \ (\ theta \) yield \ [\ theta = \ dfac {k_1 \ left [\ text {A} \ right]} {K_1 \ Left [\ text {A} \ right] + k _ {- 1} + k_2 \ left [\ text {b} \ right]} \ label {eq18}}} \] In addition, \ (K_2 \ LL K_1 \) and \ (k _ \ 1} \), we can simplify \ (\ theta \) to \ [\ a ta = \ dfac {k_1 \ left [\ text {a} \ right]} {k_1 \ left [\ text {A} \ right] + k _ {- 1}} \ label {eq19 \] The production rate of \ (\ text {p} \) can be expressed as \ [\ dfrac \ \ text {p} \ right]} { dt} = k_2 \ left [\ text {like} _ \} \ Left [\ text {b} \ right] = K_2 \ theta \ left [\ text } \ logo] _0 \ Logo [\ text {b} \ right] = {k_2 \ left [\ text {A} \ right]} {K_1 \ Left [\ text {A} \ right] + k _ {- 1}} \ left [\ text {s} \ right] _0 \ Logo [\ text {b} \ right] \ label {eq20}} Also write the above expression in terms of the equilibrium constant, \ (k \ (k \), which is equal to \ (k_1 / k _ {- 1} \) \ [\ dfac \ left [\ text {p } \ right]} {dt} = K K_2 \ Left [\ text {b} \ right] \ dfac {K \ Left [\ text {A} \ right]} {k \ text [\ text {A} \ right • in biological systems, the enzymes act as catalysts and play a christective role in acceleration acceleration Anywhere in \ (10 Â €

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