AP

(d) Which of the following reaction mechanisms is consistent with the rate law established in (a)? Explain your choice.

I. $NO + NO \rightleftharpoons N_2O_2$ (fast)

$N_2O_2 + Br_2 \rightarrow 2\ NOBr$ (slow)

II. $Br_2 \rightarrow Br + Br$ (slow)

$2(NO + Br \rightarrow NOBr)$ (fast)

3.

$$N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$$

Dinitrogen pentoxide gas decomposes according to the equation above. The first-order reaction was allowed to proceed at 40°C and the data below were collected.

$[N_2O_5]$ (*M*)	Time (min)
0.400	0.0
0.289	20.0
0.209	40.0
0.151	60.0
0.109	80.0

a) $= \ln[A]_t + \ln[A]_0 = -Kt$

$= \ln[.289] \ln[0.40] = -k20$

$K = 0.0163\ min^{-1}$

b.) $\ln[.350] \ln[.40] = 0.016\ t$

$t = 8.19\ min.$

✓(a) Calculate the rate constant for the reaction using the values for concentration and time given in the table. Include units with your answer.

✓(b) After how many minutes will $[N_2O_5]$ be equal to 0.350 *M*?

c.) $\ln[A]_t \ln[.4] = .0163$

$N_2O_5 = e^{-2.55}$

$M = 0.078M$

(c) What will be the concentration of N_2O_3 after 100 minutes have elapsed?

(d) Calculate the initial rate of the reaction. Include units with your answer.

(e) What is the half-life of the reaction?

*Graph or use formula $= \frac{.693}{k} = \frac{.693}{.0163} = 42.5$

1st order: Rate $= K[A]$

$= 0.0163(.4)$

$= .0052\ M/min$

4.

$$2\,A + B \rightarrow C + D$$

The following results were obtained in experiments designed to study the rate of the reaction above:

Experiment	Initial Concentration (moles/L) [A]	[B]	Initial Rate of Formation of D (*M*/min)
1	0.10	0.10	1.5×10^{-3}
2	0.20	0.20	3.0×10^{-3}
3	0.20	0.40	6.0×10^{-3}

1-2 double A double B Rxn double ∴ no help

2-3 A ons B double Rate double.

∴ A = 0 B = 2° due to no change

(a) Write the rate law for the reaction. Rate $= k[B]$

(b) Calculate the value of the rate constant, *k*, for the reaction. Include the units. 3rd order overall ∴ no eq

(c) If experiment 2 goes to completion, what will be the final concentration of D? Assume that the volume is unchanged over the course of the reaction and that no D was present at the start of the experiment.

∴ solve $K = \frac{Rate}{B}$

$K = \frac{1.5 \times 10^{-3}}{.1}$

$1.5 \times 10^{-2}\ min^{-1}$

skip

(d) Which of the following possible reaction mechanisms is consistent with the rate law found in (a)?

Rate = k[A][B]

I.	$A + B \rightarrow C + E$	(slow)
	$A + E \rightarrow D$	(fast)
II.	$B \rightarrow C + E$	(slow)
	$A + E \rightarrow F$	(fast)
	$A + F \rightarrow D$	(fast)

follows Rate law

Rate = k[B]

(e) Calculate the half-life of reactant B.

B = 1st order ∴ $\frac{0.693}{1.5 \times 10^{-2}} =$ 46 min

ESSAYS

5. $A(g) + B(g) \rightarrow C(g)$

2° 0° ∴ Rate = k[A]²

The reaction above is second order with respect to A and zero order with respect to B. Reactants A and B are present in a closed container. Predict how each of the following changes to the reaction system will affect the rate and rate constant and explain why.

(a) More gas A is added to the container. ↑ because rate is dep on A K=same

(b) More gas B is added to the container. n/c B = zero order K=same [ ]=no eff

(c) The temperature is increased. ↑ due to K due to ↑ collisions theory

(d) An inert gas D is added to the container. not involved in Rxn

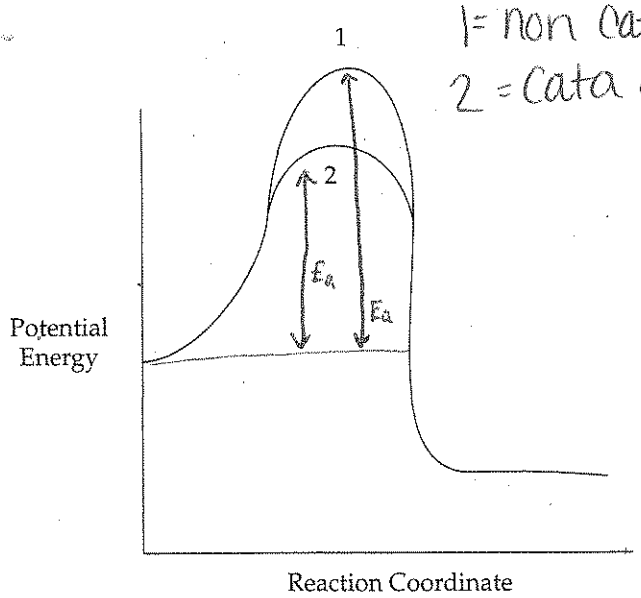
(e) The volume of the container is decreased. ↑ in rate of Rxn ↑ [A]

6. Use your knowledge of kinetics to answer the following questions. Justify your answers.

(a)

1 = non cata

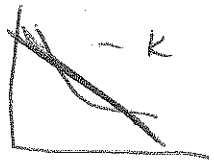
2 = cata due to ↓ in Ea



The two lines in the diagram above show different reaction pathways for the same reaction. Which of the two lines shows the reaction when a catalyst has been added?

#2

1st order

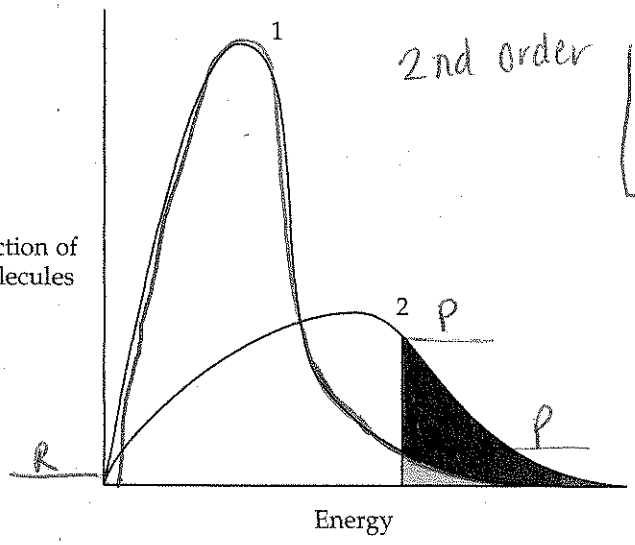


$y\text{ int} = \ln[A]_0$

decrease exchange →

(b)

@ high temp
∴ ↓ in Ea
Rxn
due to
collision
theory



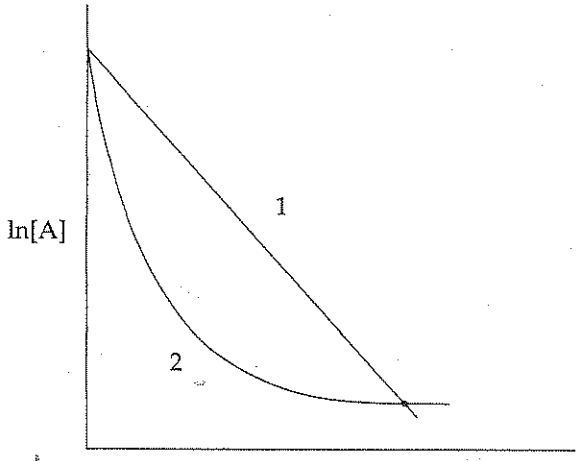
2nd order

$y = \frac{1}{[A]_0}$

no y int

Which of the two lines in the energy distribution diagram shows the conditions at a higher temperature?

(c)



$\ln[A]_t - \ln[A]_0 = -kt$

Which of the two lines in the diagram above shows the relationship of ln[A] to time for a first order reaction with the following rate law:

Rate = k[A]

$\ln[A]_t = -k + \ln[A]_0$ ∴ 1st orde best fit $-k = 1$

$y = mx + b$ $y\text{ int} = \ln[A]$

ESSAYS

5. $A(g) + B(g) \rightarrow C(g)$ rate = k[A]

The reaction above is second order with respect to A and zero order with respect to B. Reactants A and B are present in a closed container. Predict how each of the following changes to the reaction system will affect the rate and rate constant and explain why.

(a) More gas A is added to the container.

(b) More gas B is added to the container.

(c) The temperature is increased.

(d) An inert gas D is added to the container.

(e) The volume of the container is decreased.

a.) ↑ [A] ↑ rate because rate depends on [A] due to rate law $k[A]^2$ = rate

b.) ↑ [B] no rate change since B has no effect on the rate law. (B is 0 order)

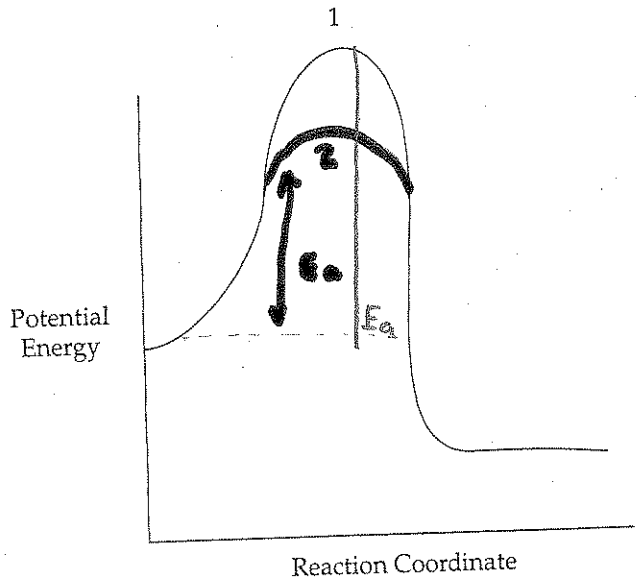
c.) ↑ temp ↑ rate + K
↑ t ↑ KE ∴ more gas molecules collide w/ enough energy to overcome Ea.

D.) D is not involved in the Rxn or the rate law so rate + K are not effected

E.) ↓ volume ↑ concentration ↑ [A] ↑ rate
rate constant K is independent of [A] so it won't change.

6. Use your knowledge of kinetics to answer the following questions. Justify your answers.

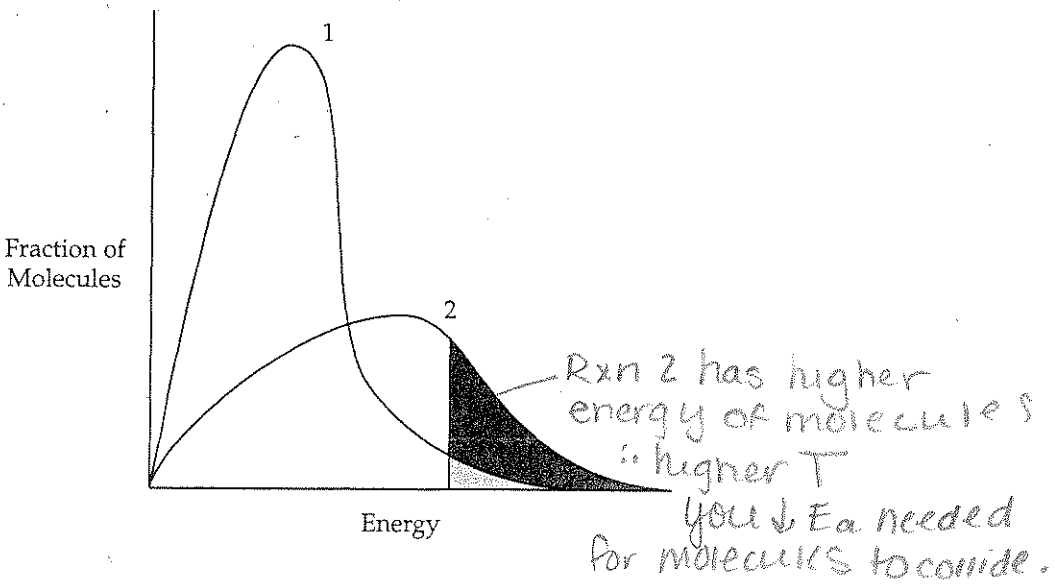
(a)



The two lines in the diagram above show different reaction pathways for the same reaction. Which of the two lines shows the reaction when a catalyst has been added?

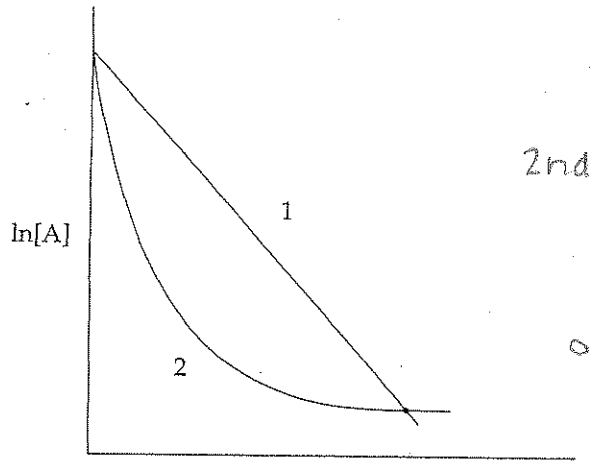
-Rxn 2 since it has a lower activation energy.

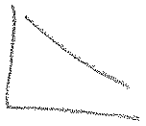
(b)



Which of the two lines in the energy distribution diagram shows the conditions at a higher temperature?

(c)



1st  Slope = -k

2nd  Slope = K

0  -k
no y intercept.

Which of the two lines in the diagram above shows the relationship of ln[A] to time for a first order reaction with the following rate law:

Rate = k[A] (1)

$\ln[A] - \ln[A]_0 = -kt$

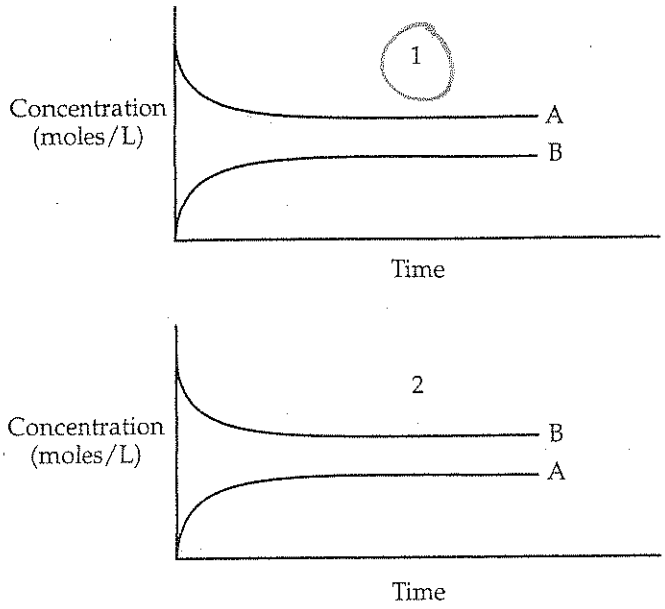
$Y = mx + B$

∴ 1st order best fits $-k = 1$

Y intercept = $\ln[A]$

(d)

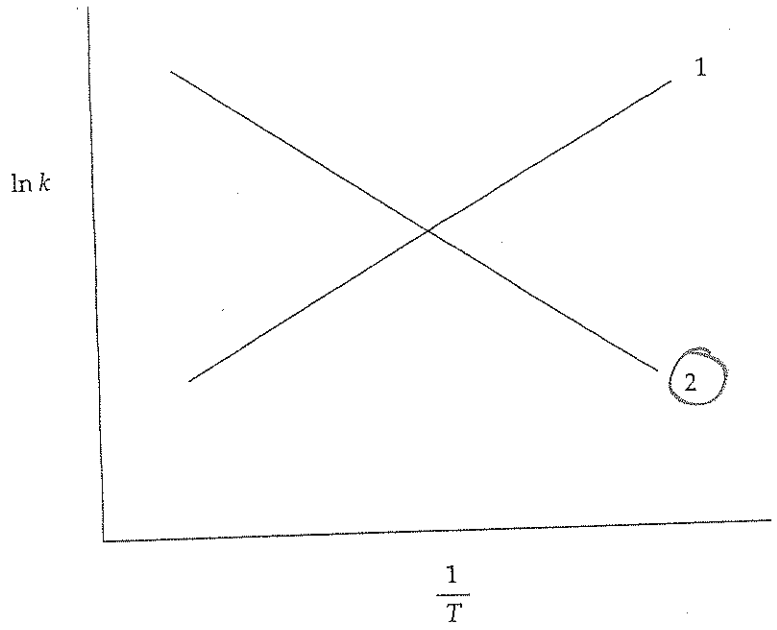
A is a reactant
+ its [A] ↓ over time
[B] ↑ over time
because it is a
product.



Which of the two graphs above shows the changes in concentration over time for the following reaction? A → B

$A \rightarrow B$

(e)



a. Which of the two lines in the diagram above shows the relationship of ln*k* to $\frac{1}{T}$ for a reaction?

b. How is the slope of the line related to the activation energy for the reaction?

a. K ↑ as T ↑ ∴ \ -K or slope since $x = \frac{1}{T}$

b.) slope = $-\frac{E_a}{R}$

$\ln K = -\frac{E_a}{R} + \ln A$

7.

Use your knowledge of kinetics to explain each of the following statements:

(a) An increase in the temperature at which a reaction takes place causes an increase in reaction rate.

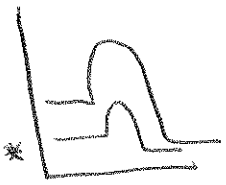
(b) The addition of a catalyst increases the rate at which a reaction will take place.

(c) A catalyst that has been ground into powder will be more effective than a solid block of the same catalyst.

(d) Increasing the concentration of reactants increases the rate of a reaction.

A.) ↑ T = ↑ Energy = ↑ collisions = ↑ reaction rate

B.) alternative path at a lower Ea. ∴ collisions that make contact at a ↓ energy will be able to go to completion. Where prior to catalyst that energy would not have been sufficient.



C.) Surface area has an effect on Rxn rate
↑ surface area ↑ rxn rate. ∴ pwd = ↑ surface area.

D.) ↑ [reactants] = ↑ probability of collisions