CH302 Exam 3 Question Types

1. assigning rate expressions easy

I will provide a balanced reaction

$$2A \rightarrow B$$

you will convert it into $\pm \frac{\Delta A}{2\Delta t} = \pm \frac{\Delta B}{\Delta t}$ ....

Just like quiz 5 question.

OR I will give you a numerical value for the rate of one cmpd and you relate to another

2. calculating reaction rates easy Example $A = -5/s$ $\therefore$ $B = +2.5/s$

Application of the differential rate eqn

$$\frac{\Delta[\ ]}{\Delta t} = \text{rate} = k[A]^x[B]^y$$

you will either solve for the slope on left $\frac{\Delta[\ ]}{\Delta t}$ or plug and chug into the rate law (I give k, [A], x, [B], y) and you find rate

3. units of rate constants easy

you have seen this 1,000,000 times.

I want to know units of k and this falls out of the diff. rate law by canceling units.

order	units k
0	M/s
1	s^{-1}
2	$M^{-1}s^{-1}$

Hint. That won't be on the test. You will be asked for units that are not 0, 1, 2 or you will be asked to generalize.

4. method of initial rates easy

classic array with [ ] at diff amounts and the resulting rate

Exp	A	B	C	rate
1				
2				
3				

you need to find the orders of each and sum for the reaction.

Hint: if something turns out to be 0th order then we may not hold it's concentration constant just to mess with you.

5. integrated rate law calculation

This is a classic plug & chug.

1. Find the order of reaction (from k's units)
2. write down the equation for either 0, 1, or 2 order
3. Solve for either $[C]$, $[C_0]$, k, t

Hint: $[C]$ is what is left. $C_0 - C$ is what was used up.

Hint: you like algebra so you'll want solve for $[C]$ may be different

Hint: ratio of concentration may be used. set $C_0 = 1$

6. integrated rate law calculation (half life)

One of two problems:

1. I give you a starting amount + a half life (1st order) and you do a bunch of ÷ by 2s

5 ½ lives =

$1024 \xrightarrow{1} 512 \xrightarrow{2} 256 \xrightarrow{3} 128 \xrightarrow{4} 64 \xrightarrow{5} 32$

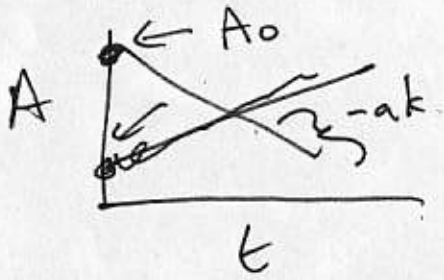
2. Relate k to $t_{1/2}$ and then solve a normal integrated rate law.

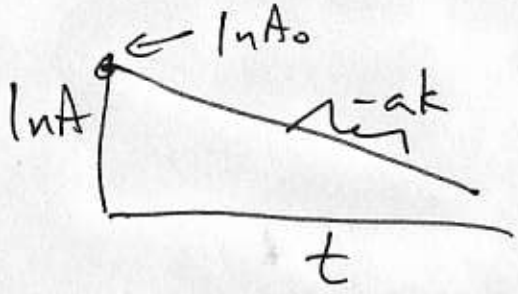
Example, if $t_{1/2} = 30s$, and I start with 100, after 106 sec, what is left. soln: convert $t_{1/2} \rightarrow k$ and do problem 5 above.

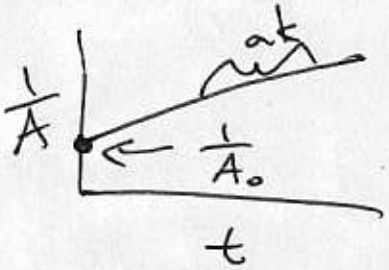
7. extracting information from straight line plots easy as pie

note that 0, 1, 2 order reactions have straight line functions

$A = A_0 - akt$ $\ln A = \ln A_0 - akt$ $\frac{1}{A} = \frac{1}{A_0} + akt$







Hint. I may ask what the functional relationship is and what is extracted (just the variable names) or I may make you pull the data out as a calculation.

8. kinetic theory—collision

easy, easy, easy. don't make it hard.

- collisions must occur
- they must have high enough energy
- the orientation must be correct

} otherwise collision is ineffective

} if true then effective collision

9 kinetic theory—transition state

easy. ← unless Travis sneaks me in, otherwise I will toss it later.

Transition state Theory, no matter how much Travis wants to make it sound hard, is this,

- Transition Theory says that there is an energy barrier called E_a
- on top of E_a hill there is a transient reversible process in which a transition state is formed and falls down a hill.
- catalysts can lower E_a by changing mechanism.

10. Arrhenius equation

- a simple plug & chug

$$k = Ae^{-E_a/RT}$$

I give you 3 of

k, A, E_a, T

and you find the 4th not known.

or.

- you need to tell me ~~also~~ the functional relationship involving

k and E_a, T, A

exp direct.

H.t. A common trick question in kinetics: we ask where [ ] affects k. No. It affects rate not k.

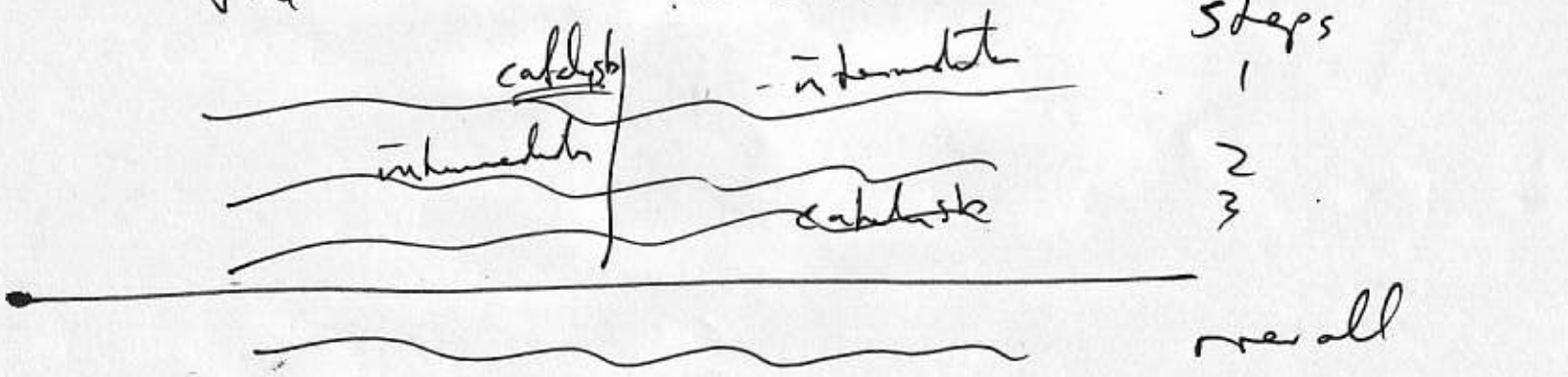
11. combined Arrhenius calculation easy

This will be a classic plug + chug. Be ready for ratios and be ready to solve for <u>any</u> of the variables

k_1, k_2, T_1, T_2, E_a

12. reaction mechanisms easy

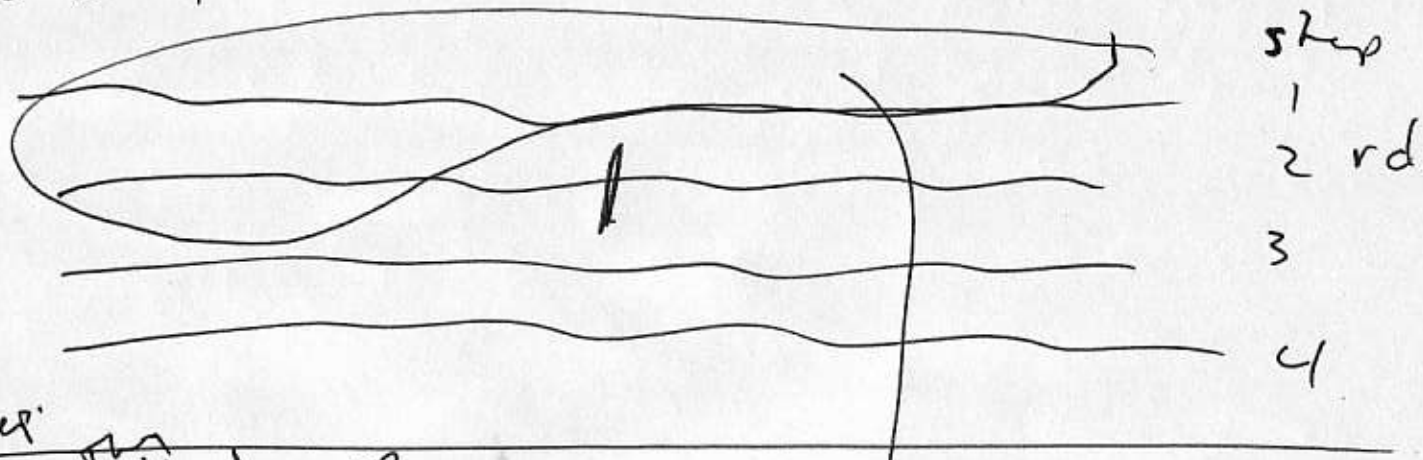
I will provide a multistep reaction and the overall reaction.



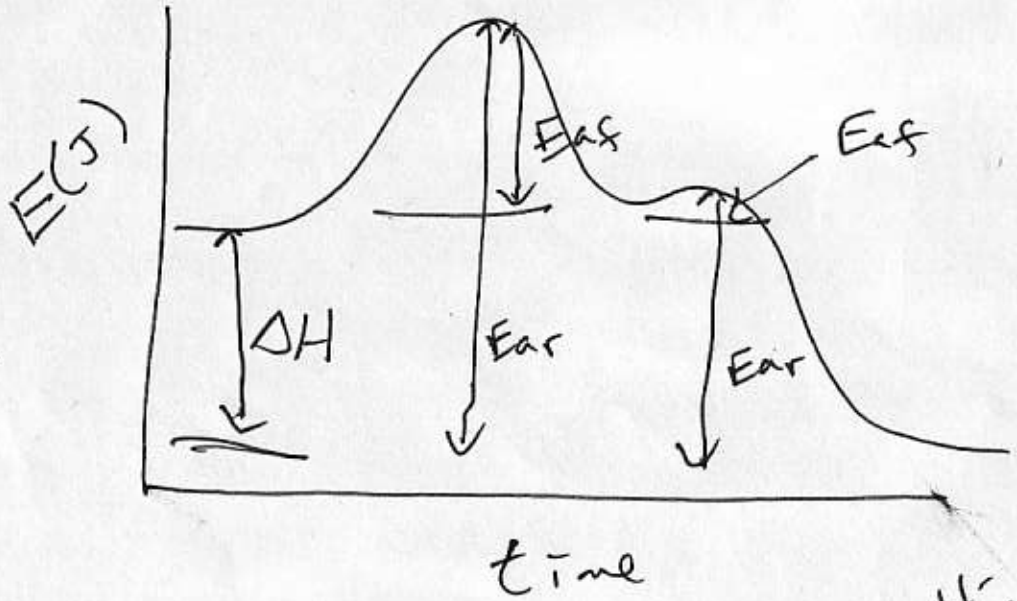
And will ask which species are reactants, products, intermediates, or catalysts.

13. reaction mechanisms easy

I will want a rate law for a multistep process and will give a limiting step. Cancel everything before rds and what goes in is left into rate = k [what is left] overall



14. Ea and energy profiles easy



I will want a calculation of ΔH & whether it is exo or endo, and I will want Ea values for either forward or reverse reaction.

Hint. set your signs right. ΔH + endo − exo Ea always +

15. famous catalysts In this class there were two.

- ozone
- catalytic converter.

For both you should know. famous reactants, famous products, the catalyst

$O_3 \rightarrow O_2$

a free radical from a CF_xCl_y hit by $h\nu$ to make $F\cdot$ or $Cl\cdot$ is the catalyst

$NO_x \rightarrow N_2$ red.

$CO \rightarrow CO_2$ } oxid.

$CH \rightarrow CO_2$ }

↑ magical proprietary metal oxide

16. properties and reactivity of alkali metals

For questions 16 → 22, it is in the lecture notes or it isn't on the test.

These questions come in 3 forms.

Type 1, general trends + properties of the group.
Example: Group I – 1 val. e⁻ – water explode – form salts – low I.E. – metals.

Type 2. The famous reactions that group

$Na + H_2O \rightarrow H_2 + OH^-$

$Ca + H_2O \rightarrow Ca(OH)_2\ H_2$

$CH_4 + O_2 \rightarrow CO_2 + H_2O$

Type 3. Fun facts. Learn the two or 3 for each group in the lecture notes

17. properties and reactivity of alkali earths

Be is only covalent one (emerald)
Mg is in chlorophyll
Ca is structural backbone (a pun) cement, teeth, bones

properties
- explosive (actually they fizz) in hot water
- +2 ions (higher charge density and ∴ stronger building blocks)
- basic hydrides + oxides ($CaO \rightarrow Ca(OH)_2$ slaked lime)

18. properties and reactivity of the B family

B makes cool compounds like borax (soap) and boric acid (kills things)

Al is a metal (lightest and less resistant to oxidation)
↳ know the Hall process for making Al electrochemically.

19. properties and reactivity of the C family

C makes bio stuff but also

- C allotropes
  - graphite sp^2
  - diamond sp^3
  - fullerenes C_{60} balls + tubes
- carbonates which love to create the world's cement

Si most common element that doesn't fly around
present in sand → glass and lots of cheap knock off gems
oh, and semiconductors.

20. properties and reactivity of the N family on Tuesday

N + P are the sources of plant food

N: $N^{-3}H_3 \rightarrow N^{+5}O_3^-$

8 e^- change in species

most important is NH_3 so I will teach

- Haber process
- N_2 fixation
- HNO_3 as an oxidizing agent

P → phosphates which are good for plants
Also are found in detergents, fertilizers, matches, pesticides.

21. properties and reactivity of the O family

Hint: to know everything you can about O atomic properties reactivity

Know why O_2 is so important. Understand where S comes from and how S is made and then goes on to form H_2SO_4.

Know the important reactions of H_2SO_4 as an oxidizer, acid and dehydrator. This means knowing the important industrial reactions that make it the #1 chemical produced.

22. properties and reactivity of the halogen family

Hint: know everything you can about atomic F_2 its properties and chemistry

Know the general reactivity of the halogens and the periodic trends that drive this reactivity.

Understand why F makes fundamentally different compounds than the other halogens and why its reactivity is so special.

Be able to explain why Cl_2 is used as a precursor in so many chemical reactions to produce products we use in our daily lives.

23. famous named manufacturing processes I will want starting + ending materials for the following processes.

Hall · alumina → Al

Bayer bauxite → alumina

Claus H_2S → S

Ostwald NH_3 → HNO_3

contact S → H_2SO_4

Haber $H_2, N_2 \rightarrow NH_3$

24. identifying famous gemstones

Only the ones in the lecture notes are fair game.

Know the basic elements that make the gems in the lecture note pictures.

25. hydrocarbon isomers

I will give you a hydrocarbon

CH_4, C_2H_5, C_3H_8 ..... C_8H_{18}

and you tell me

- either # structural isomers
- whether a compound is a unique structural isomer for a hydrocarbon.

26. naming organic molecules

you will be asked to do

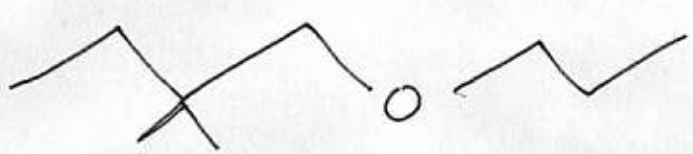
1 → 10 C parent an easier name in which

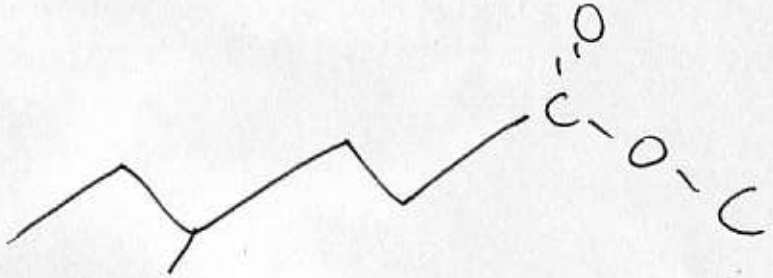
There is only 1 subst. or functional group

or

27. naming organic molecules

multiple substs + one functl grp.

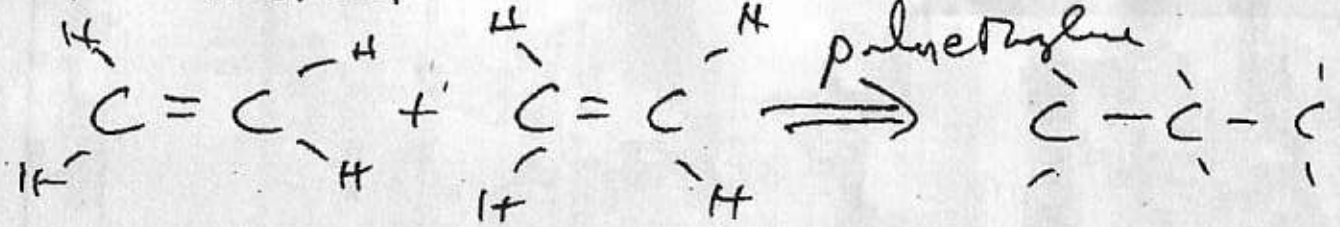




28. organic polymer chemistry

2 kinds of reactn

addtn



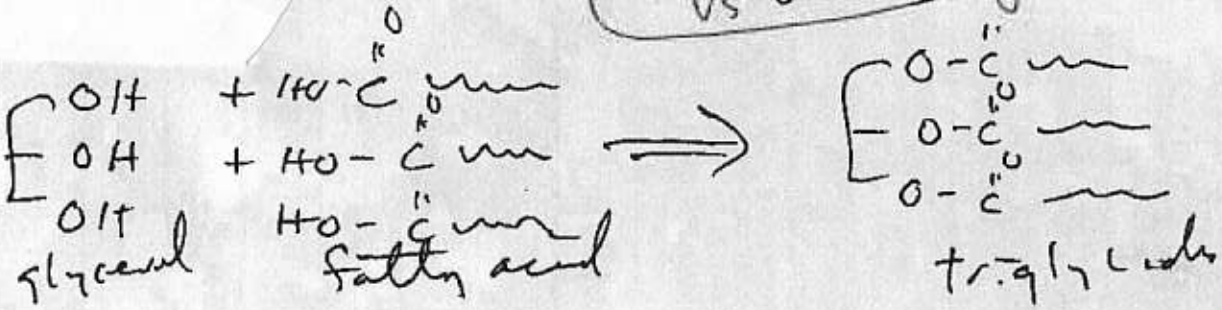
polymer will be from these types

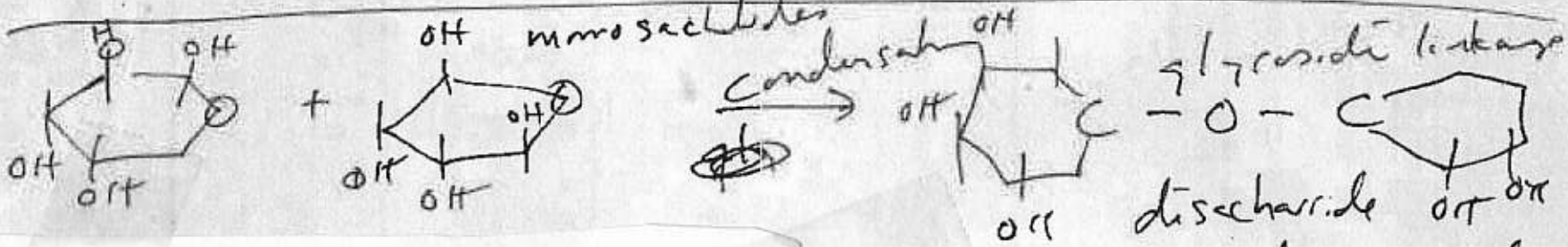
condensatn reactn

H_2O is produced. See it in Nylon reactn but also formatn of polysaccharides, peptides/proteins and polynucleotides

29 biomolecule structure

fatty acids
know the
numbers





30. biomolecule structure

amino acids (20)