

1) (20pts)

In what major form is naturally occurring fluorine found in the earth's crust?

CALCIUM FLUORIDE (CaF_2) as Fluorspar.

What is a fluorocarbon?

A compound with a C-F bond

What is the name of the only known enzyme to create a C-F bond?

FLUORINASE

Name a fluorinated commercial product you encountered this week.

Eg. GORETEX, Prozac, toothpaste, etc.

Give two similarities between Hydrogen and Fluorine.

Both small, univalent, form strong bonds to C, $I = 1/2$, ... etc

What are the three characteristics that make fluorine such a special and unique substituent?

① F is the most electronegative element

② Next smallest substituent after Hydrogen

③ It forms a stronger bond to Carbon than Hydrogen does.

2) (24pts)

Draw a Lewis structure with lone pairs for a:

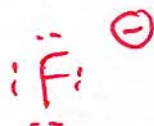
fluorine atom



fluorine molecule



fluoride ion



hydrogen fluoride



Circle which bond is longer

C-H or C-F

Circle which bond is more polar

C-H or C-F

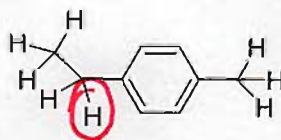
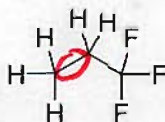
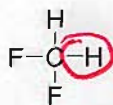
Circle the molecule with the stronger σ bond:

CF₄ or CF₂H₂

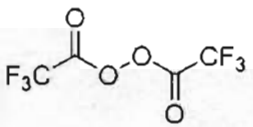
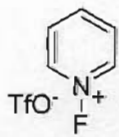
BBr₃ or BCl₃

F-F or Cl-Cl

Circle the weakest sigma bond in each molecule:



3) (20pts) Match the reagents with the correct process (using the letters – as shown in the example: *KF, Sulpholane* performs **A** - *Nucleophilic Fluorination*): Not all letters will be used – and some may be used more than once.

Reagents	Letter code of reaction type
KF, Sulpholane	A
$(\text{CH}_3\text{OCH}_2\text{CH}_2)_2\text{NSF}_3$	D
Selectfluor TM	K
CoF_3	E
F_2	B
 , heat	C
	K
$\text{Pb}(\text{OAc})_4, \text{HF}$	E
CsF , Diglyme	A
SF_4, HF	D
$\text{F}_2, \text{HCO}_2\text{H}$	K

A - *Nucleophilic Fluorination*

B - *Radical Fluorination*

C - *Radical Trifluoromethylation*

D - *DeoxoFluorination*

E - *Oxidative Fluorination*

F - *Cartman Chiral Fluoridation*

G - *Electrophilic Epoxidation*

H - *Poptart Elimination*

I - *Reductive Defluorination*

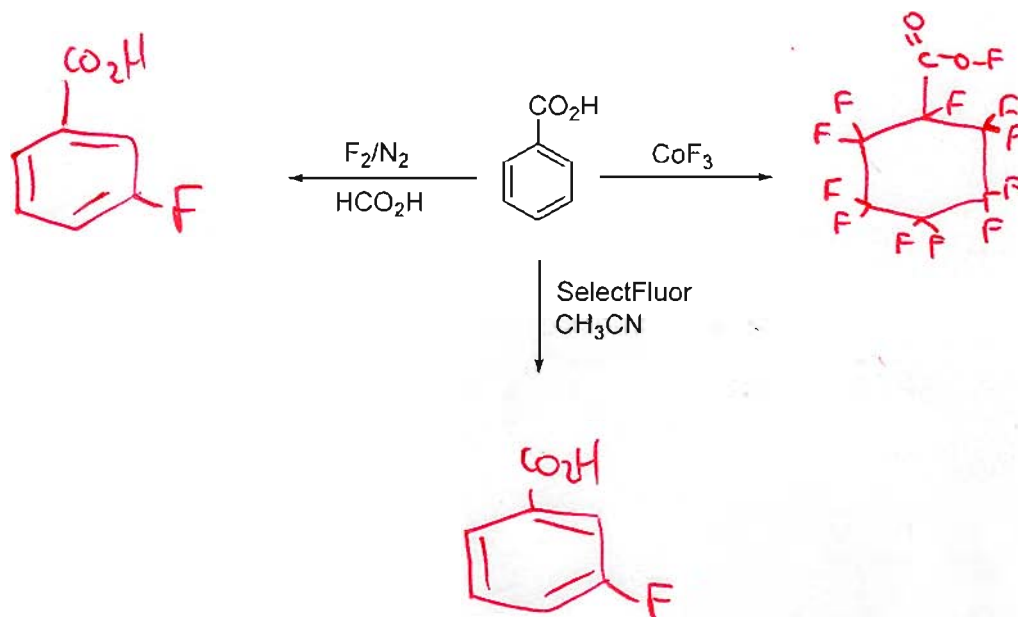
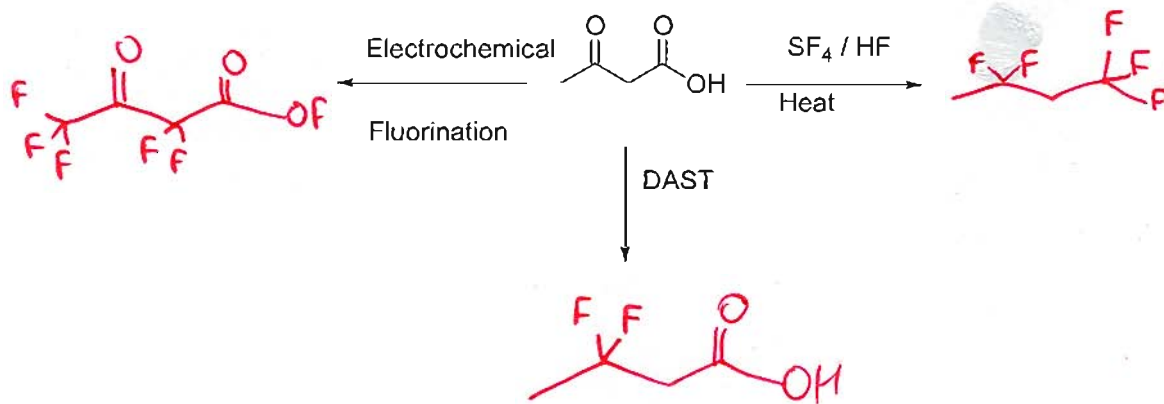
J - *Garrison Cycloaddition*

K - *Electrophilic Fluorination*

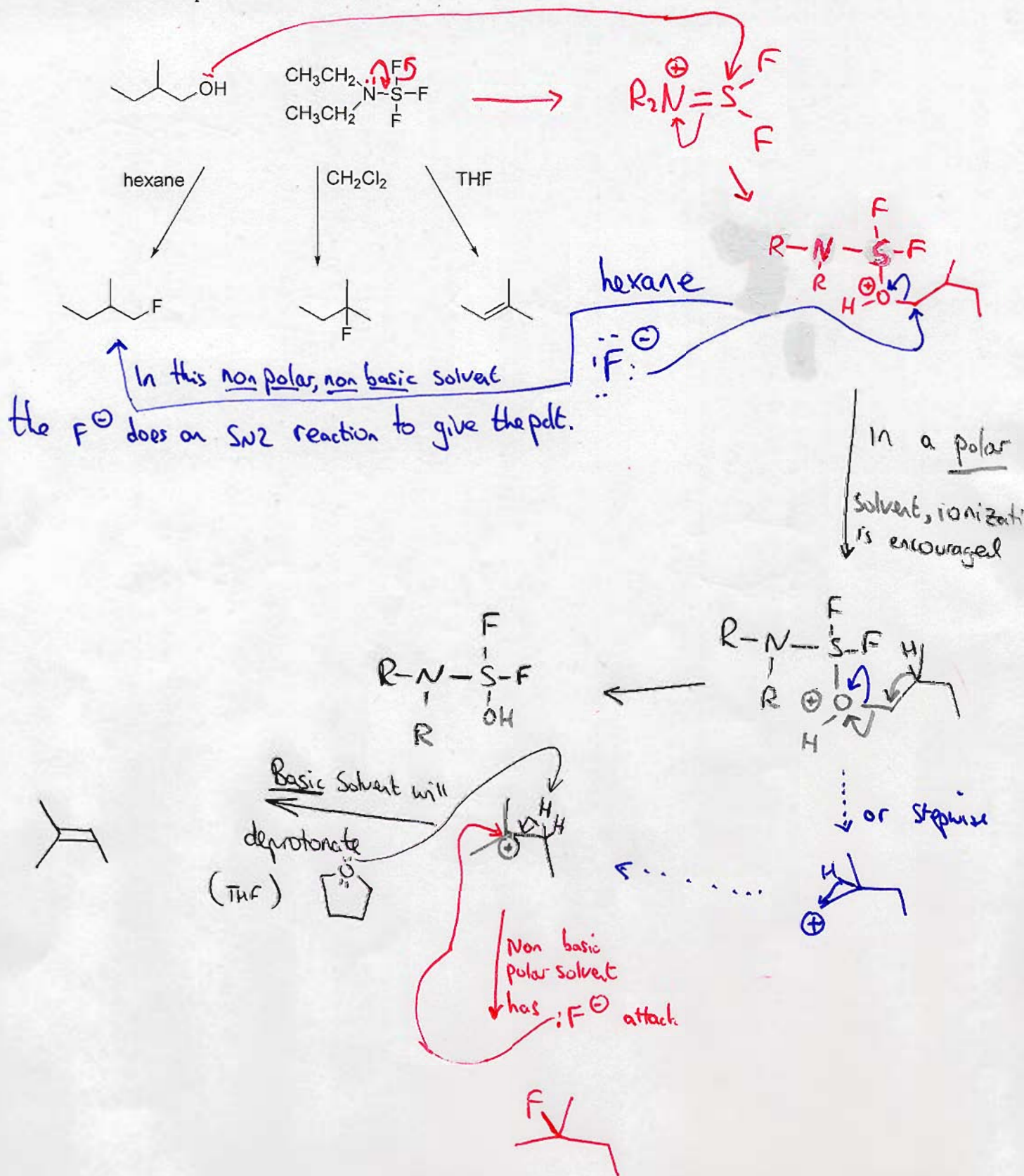
L - *Oxidative Elimination*

M - *Deozonification*

4) (18pts) Fill in the products:



5) (20pts) In this DAST reaction, explain why the three different solvents encourage the three different products.



6) (13 pts)

What is an "aprotic" solvent?

A solvent without acidic hydrogens.

Why is a crown ether used in HALEX metal fluoride reactions ?

To help solvate the metal cation, thus producing available F^-

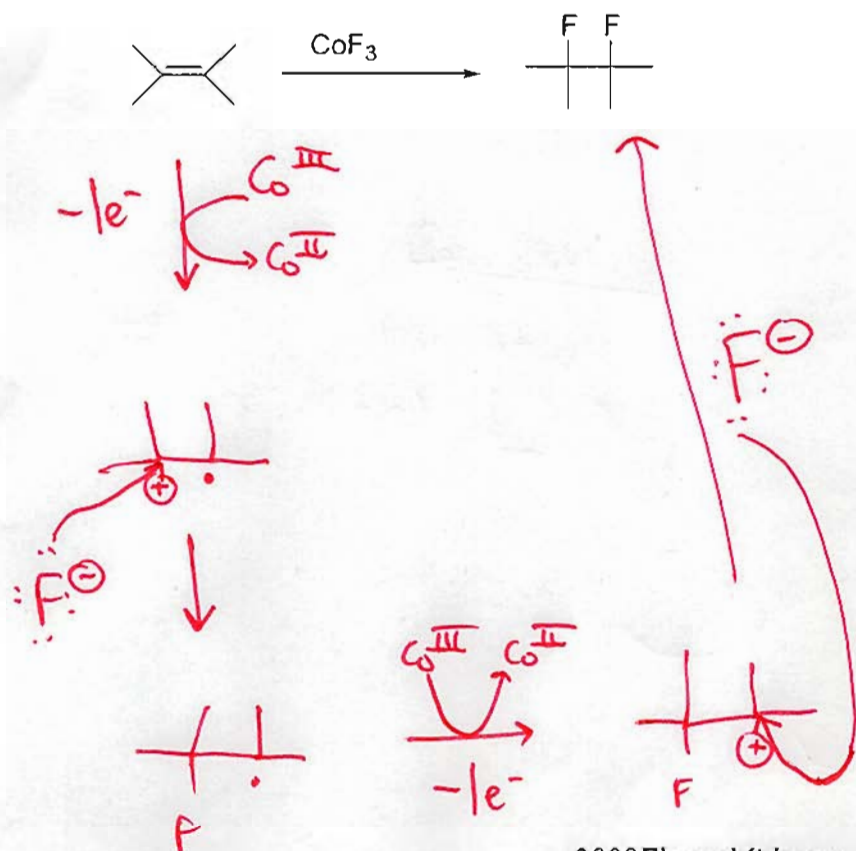
How is elemental fluorine gas produced industrially?

Electrolysis of Hydrogen Fluoride (really HF.KF)

State a disadvantage of using sulfur tetrafluoride as a reagent.

A gas, very reactive, very toxic

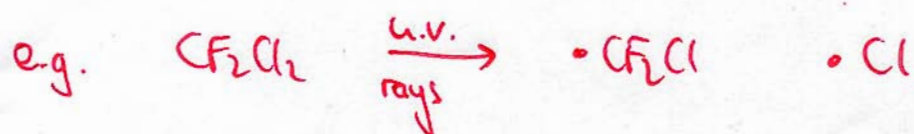
Write the mechanism for this oxidative fluorination by Cobalt trifluoride.



7) (10pts) Explain how CFC's are detrimental to the Ozone layer.

CFC's are chlorofluorocarbons, which are compounds that only contain C, F & Cl atoms.

CFC's that are released into the environment will float up into the stratosphere, and then react with the U.V. rays. This process generates chlorine radicals which react and destroy the ozone. (Ozone = O_3).



these radicals continue the free radical chain process.

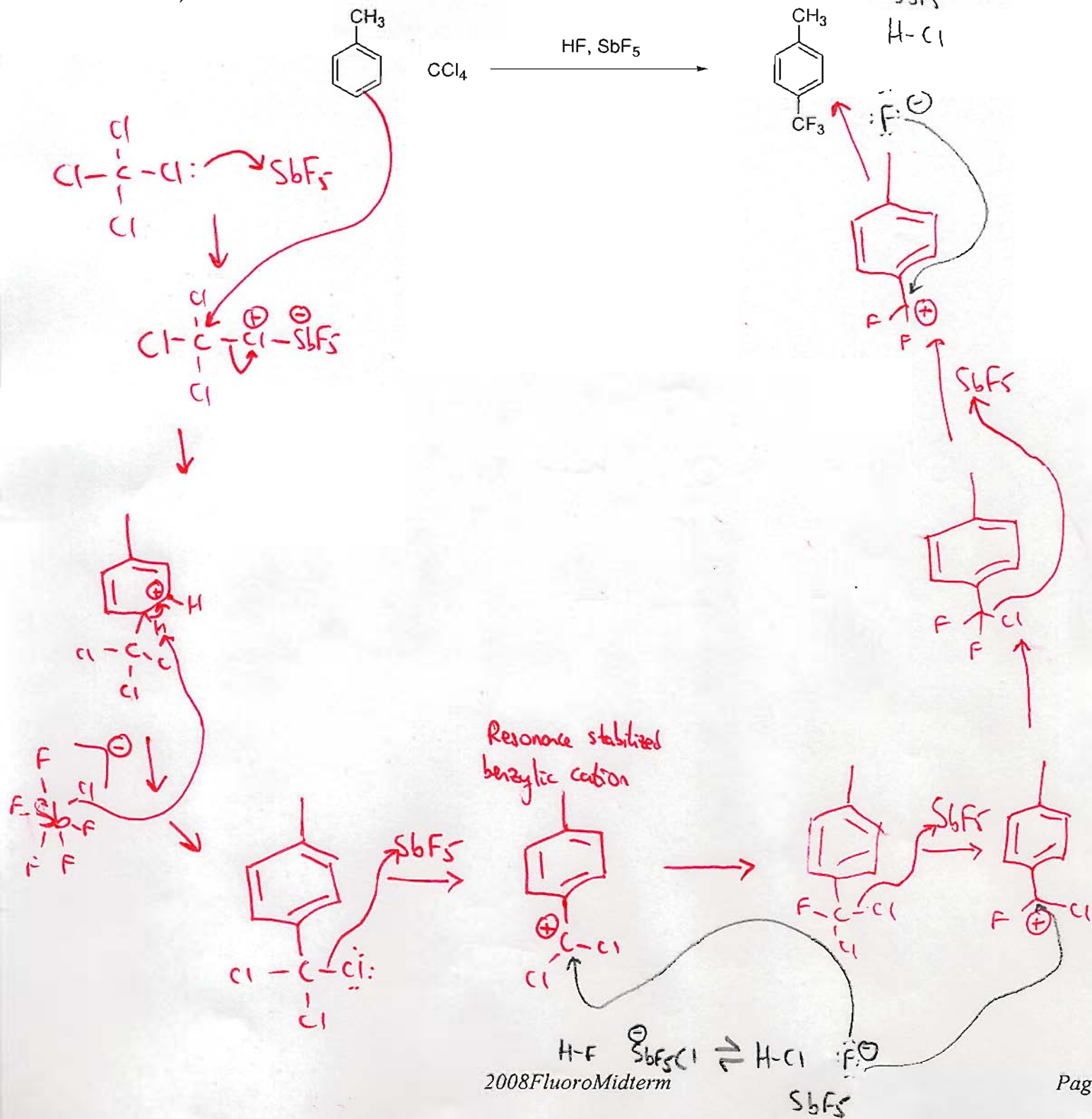
So overall:



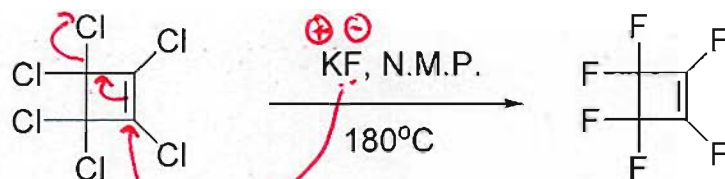
8) Mechanisms (3x25 = 75pts)

Using curly arrows, write mechanisms for three of the four following reactions.

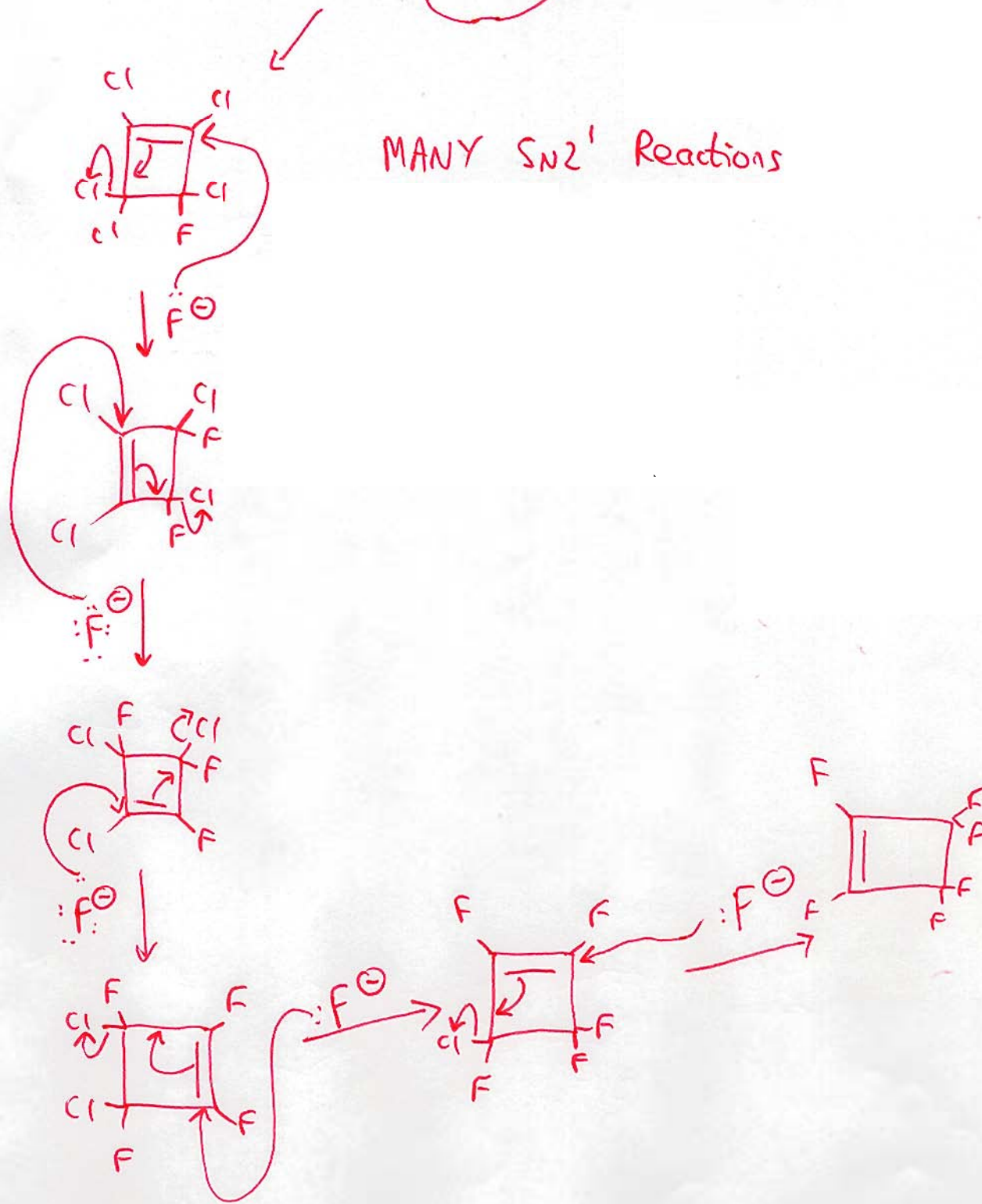
a)



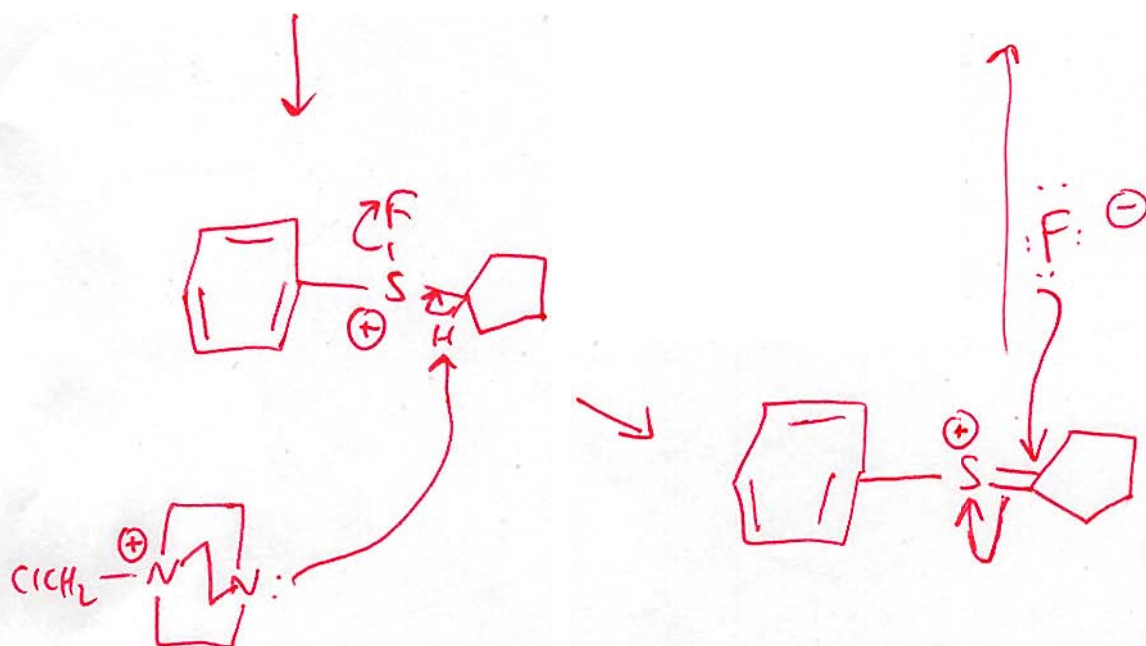
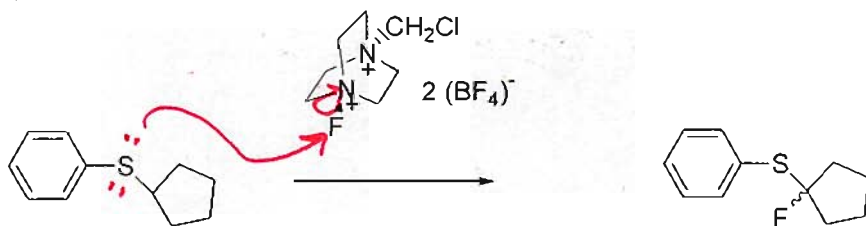
b)



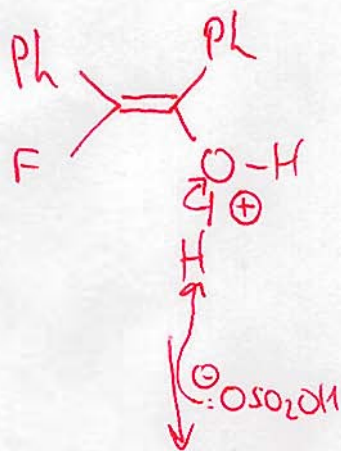
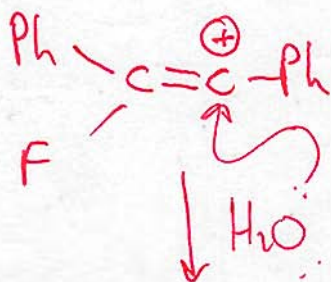
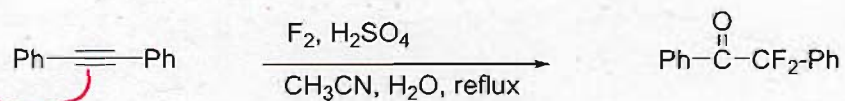
MANY $\text{S}_{\text{N}}2'$ Reactions



c)



d)



(ENOL)

