

Name \_\_\_\_\_

If you do not want your graded exam placed in the box outside my office, then please put a cross here \_\_\_\_\_

(1 a-j) are TRUE/FALSE (10pts)

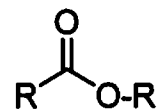
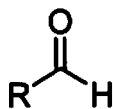
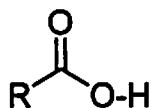
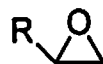
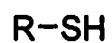
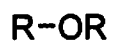
- a) A nucleophile is a two electron donor.
- b) An  $sp^2$  hybridized atom has one unhybridized p orbital.
- c) Butane and cyclobutane have the same molecular formula.
- d) A Lewis acid is a two electron donor.
- e) A chiral molecule has a non-superimposable mirror image.
- f) Hammond's postulate states that (for related processes) things that are similar in energy will be similar in structure.
- g) An anion has a negative charge.
- h)  $S_N2$  reactions are stereospecific (giving 100% inversion) because of the required *backside attack* of the nucleophile.
- i)  $\pi$  bonds are formed by the sideways overlap of aligned p orbitals on adjacent atoms.
- j) A *racemic* mixture is one that contains both possible enantiomers of the product.

2) Define the following terms: (2+2=4pts)

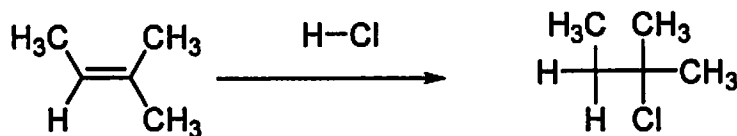
*Isomer*

*Substitution reaction.*

3) Name the classes of compound that the following molecules belong to (e.g. alkane, amide, etc.). (6pts)



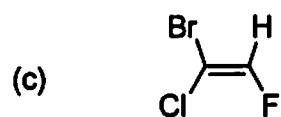
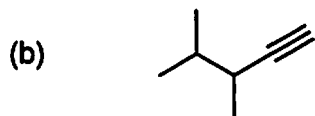
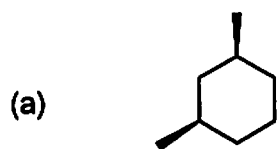
4) Write a mechanism (i.e. curly arrows) for this alkene reaction. (4+1+1=6pts)



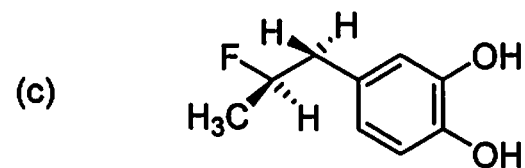
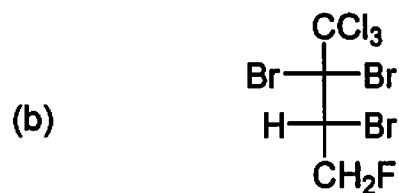
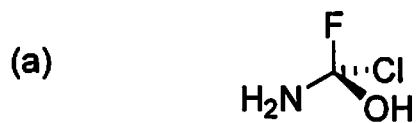
Is this an *Electrophilic* or *Nucleophilic* type of addition reaction?

What is the *regiochemistry* of this reaction?

5) Name the following molecules in IUPAC form. (3x4=12pts)



6) Assign R or S to each chiral center in these molecules. (6pts)



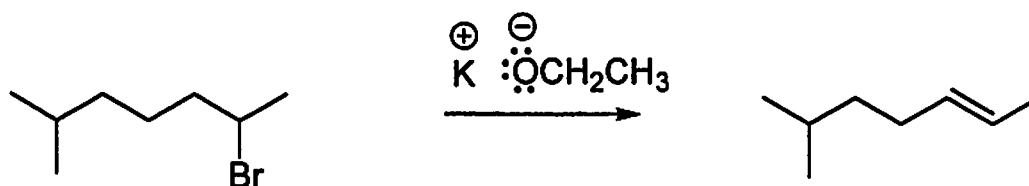
7) (3pts) For *cyclopropanol*:

How many Carbons are there?

How many Hydrogens?

What is the hybridization of the Carbons?

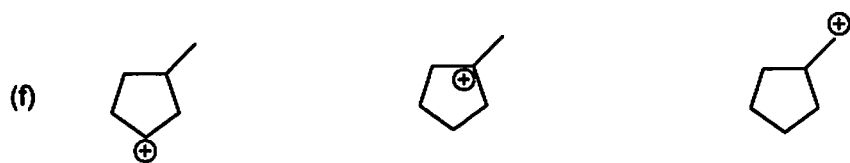
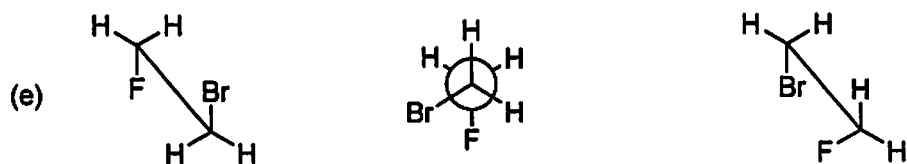
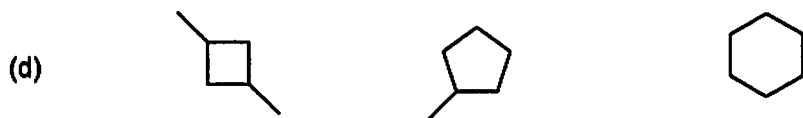
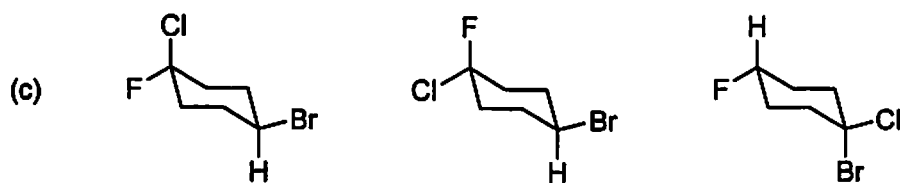
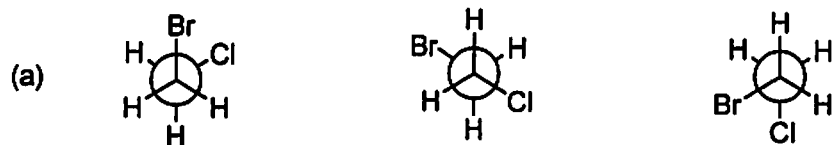
8) Write a mechanism (i.e. curly arrows) for this E2 elimination. (4+1+1=6pts)



Is the regiochemistry of this reaction *Saytzeff* or *Hoffman*?

Is the product alkene *E*, *Z* or *neither*?

9) Circle the most stable member of each threesome. (6pts)

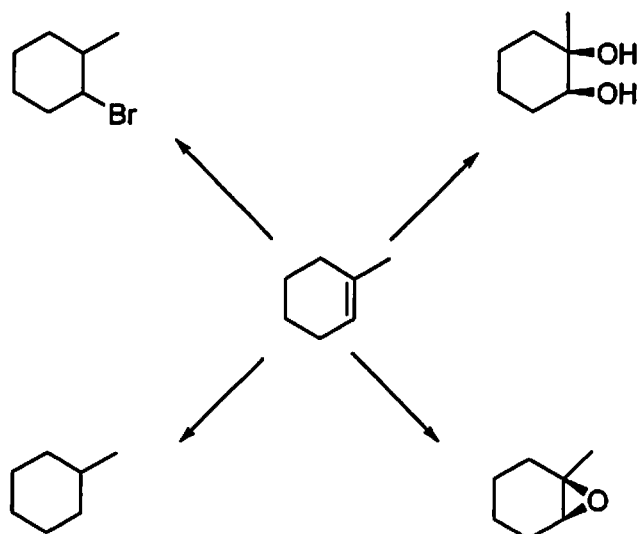


10) The following alcohol will undergo  $S_N1$  reaction with H-I, as shown below.

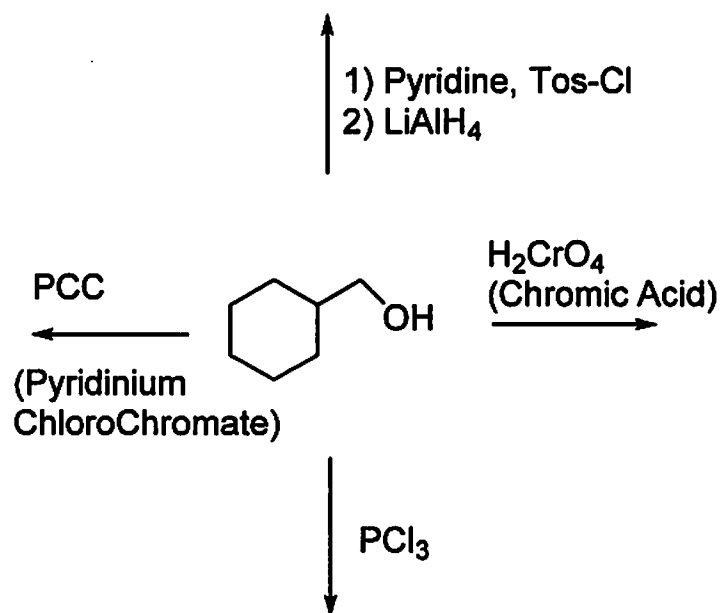


Write the mechanism (*i.e.* curly arrows) for this  $S_N1$  process (and remember there is a reason why acidic conditions are *essential* for this reaction to occur). (5pts)

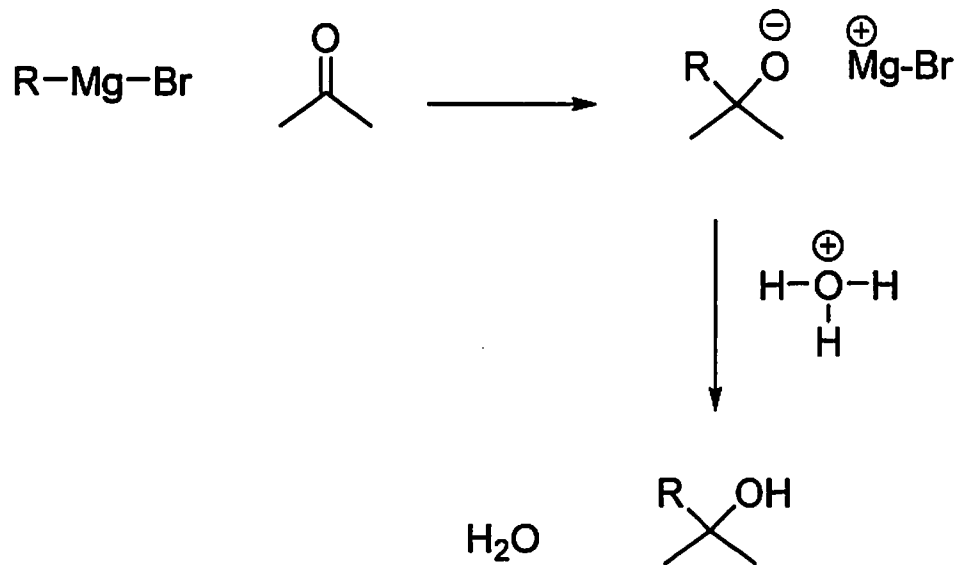
11) Give the reagents for the following alkene reactions. (8pts)



12) Draw the products for the following transformations. (8pts)



13) Draw in the arrows for the following mechanism. (6pts)



14) Give the reagents (for a, b & d), and the products (for c & e). (10pts)



15) (2+2=4pts) Using line angle diagrams, draw...

Two different **structural** isomers of *Butyne*.

Two different **stereoisomers** of *But-2-ene*.



**\*\*\*BONUS POINTS (up to THREE)\*\*\***

Name three common everyday type items or objects that are *chiral* (your answers CANNOT be parts of a body or items of clothing).

1	H	hydrogen	1.00794
2	He	helium	4.00260
3	Li	lithium	6.941
4	Be	beryllium	9.0122
5	B	boron	10.811
6	C	carbon	12.011
7	N	nitrogen	14.007
8	O	oxygen	15.999
9	F	fluorine	18.998
10	Ne	neon	20.180
11	Na	sodium	22.990
12	Mg	magnesium	24.305
13	Al	aluminum	26.982
14	Si	silicon	28.086
15	P	phosphorus	30.974
16	S	sulfur	32.065
17	Cl	chlorine	35.453
18	Ar	argon	39.948
19	K	potassium	39.098
20	Ca	calcium	40.078
21	Sc	scandium	44.956
22	Ti	titanium	47.867
23	V	vanadium	50.942
24	Cr	chromium	51.996
25	Mn	manganese	54.938
26	Fe	iron	55.845
27	Co	cobalt	58.933
28	Ni	nickel	58.693
29	Cu	copper	63.546
30	Zn	zinc	65.39
31	Ga	gallium	69.723
32	Ge	germanium	72.61
33	As	arsenic	74.922
34	Se	selenium	78.96
35	Br	bromine	79.904
36	Kr	krypton	83.80
37	Rb	rubidium	85.468
38	Sr	strontium	87.62
39	Y	yttrium	88.906
40	Zr	zirconium	91.224
41	Nb	niobium	92.906
42	Mo	molybdenum	95.94
43	Tc	technetium	98
44	Ru	ruthenium	101.07
45	Rh	rhodium	102.91
46	Pd	palladium	106.42
47	Ag	silver	107.87
48	Cd	cadmium	112.41
49	In	indium	114.82
50	Sn	tin	118.71
51	Sb	antimony	121.76
52	Te	tellurium	127.60
53	I	iodine	126.90
54	Xe	xenon	131.29
55	Cs	cesium	132.91
56	Ba	barium	137.33
57-70			
71	Lu	lutetium	174.97
72	Hf	hafnium	178.49
73	Ta	tantalum	180.95
74	W	wolfram	183.84
75	Re	rhenium	186.21
76	Os	osmium	190.23
77	Ir	iridium	192.22
78	Pt	platinum	195.08
79	Au	gold	196.97
80	Hg	mercury	200.59
81	Tl	thallium	204.38
82	Pb	lead	207.2
83	Bi	bismuth	208.98
84	Po	polonium	209
85	At	astatine	210
86	Rn	radon	222
87	Fr	francium	223
88	Ra	radium	226
89	Ac	actinium	227
90	Th	thorium	232.04
91	Pa	protactinium	231.04
92	U	uranium	238.03
93	Np	neptunium	237
94	Pu	plutonium	244
95	Am	americium	243
96	Cm	curium	247
97	Bk	berkelium	247
98	Cf	californium	251
99	Es	einsteinium	252
100	Fm	fermium	257
101	Md	mendelevium	258
102	No	nobelium	259
103	Lr	lawrencium	261
104	Rf	rutherfordium	261
105	Db	dubnium	262
106	Sg	seaborgium	266
107	Bh	bohrium	264
108	Hs	hassium	265
109	Mt	meitnerium	268
110	Uun	ununnium	271
111	Uuu	ununium	271
112	Uub	ununium	271
113	Uuq	ununium	289

\* Lanthanide series

\*\* Actinide series

57	La	lanthanum	138.91
58	Ce	cerium	140.12
59	Pr	praseodymium	140.91
60	Nd	neodymium	144.24
61	Pm	promethium	145
62	Sm	samarium	150.36
63	Eu	europium	151.96
64	Gd	gadolinium	157.25
65	Tb	terbium	158.93
66	Dy	dysprosium	162.50
67	Ho	holmium	164.93
68	Er	erbium	167.26
69	Tm	thulium	168.93
70	Yb	ytterbium	173.04

Name \_\_\_\_\_

Miss L. Toe

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(1 a-j) are TRUE/FALSE (10pts)

- a) A nucleophile is a two electron donor. *True*
- b) An  $sp^2$  hybridized atom has one unhybridized p orbital. *True*
- c) Butane and cyclobutane have the same molecular formula. *False*
- d) A Lewis acid is a two electron donor. *False*
- e) A chiral molecule has a non-superimposable mirror image. *True*
- f) Hammond's postulate states that (for related processes) things that are similar in energy will be similar in structure. *True*
- g) An anion has a negative charge. *True*
- h)  $S_N2$  reactions are stereospecific (giving 100% inversion) because of the required *backside attack* of the nucleophile. *True*
- i)  $\pi$  bonds are formed by the sideways overlap of aligned p orbitals on adjacent atoms. *True*
- j) A *racemic* mixture is one that contains both possible enantiomers of the product. *True*

2) Define the following terms: (2+2=4pts)

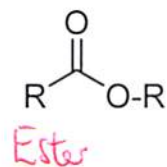
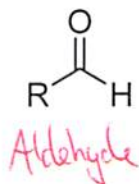
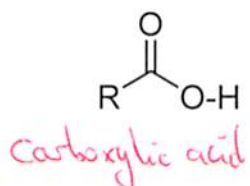
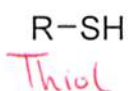
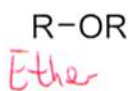
*Isomer*

*Things that are different but have the same molecular formula.*

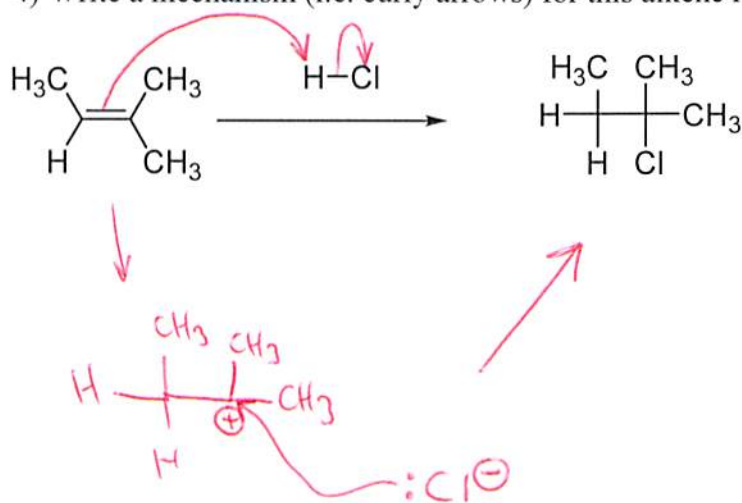
*Substitution reaction.*

*Where one atom (or group) is substituted (replaced) by another atom (or group).*

3) Name the classes of compound that the following molecules belong to (e.g. alkane, amide, etc.). (6pts)



4) Write a mechanism (i.e. curly arrows) for this alkene reaction. (4+1+1=6pts)

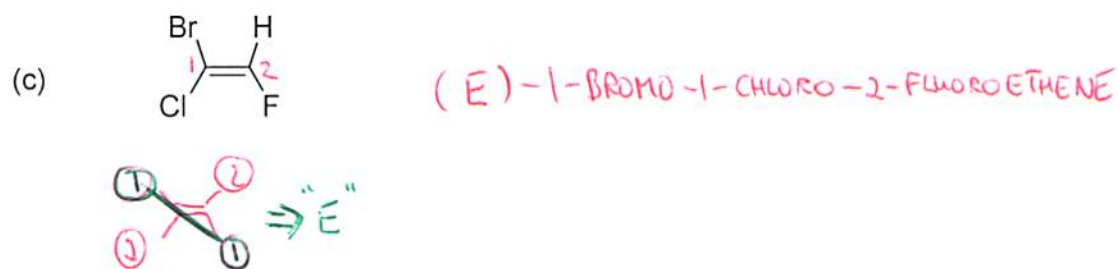
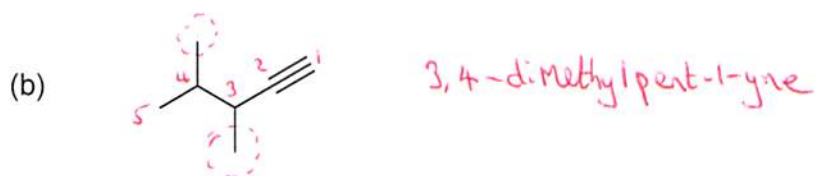
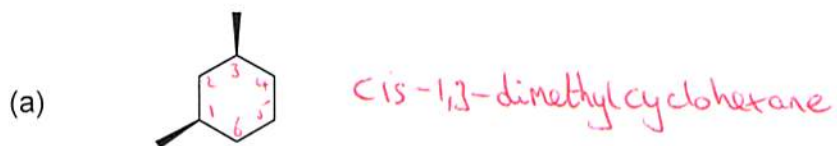


Is this an Electrophilic or Nucleophilic type of addition reaction?

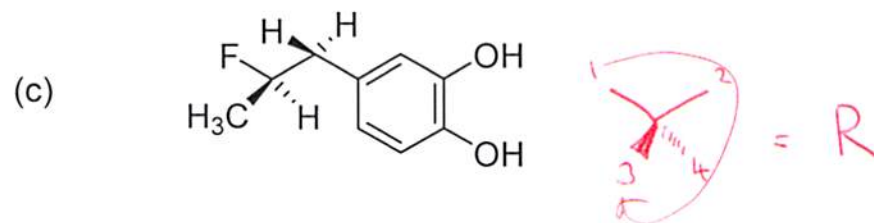
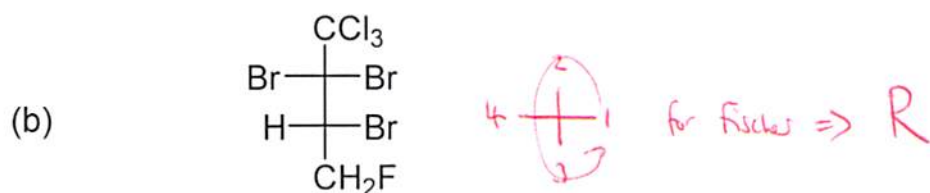
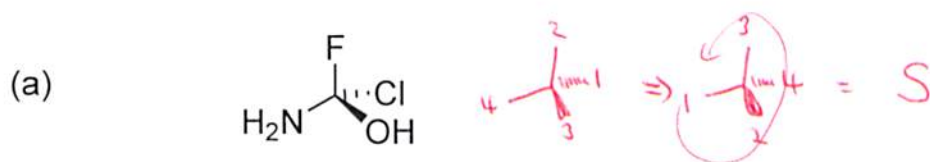
What is the regiochemistry of this reaction?

Markovnikov

5) Name the following molecules in IUPAC form. (3x4=12pts)



6) Assign **R** or **S** to each chiral center in these molecules. (6pts)

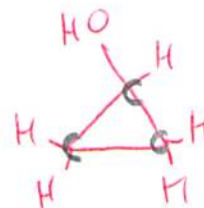


7) (3pts) For cyclopropanol:

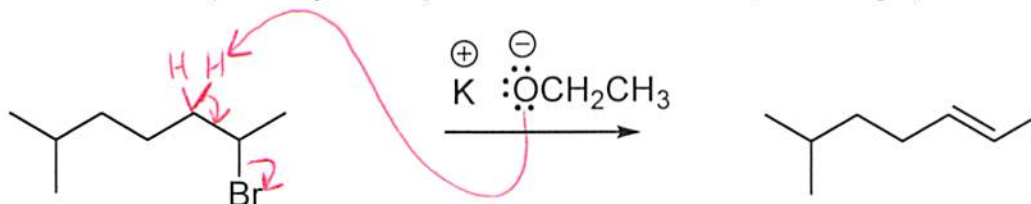
How many Carbons are there? 3

How many Hydrogens? 6

What is the hybridization of the Carbons?  $sp^3$

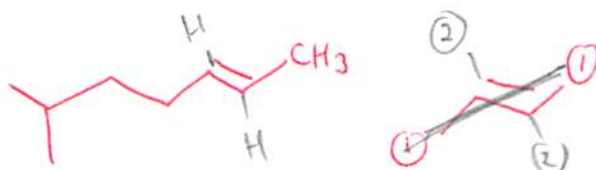


8) Write a mechanism (i.e. curly arrows) for this E2 elimination. (4+1+1=6pts)

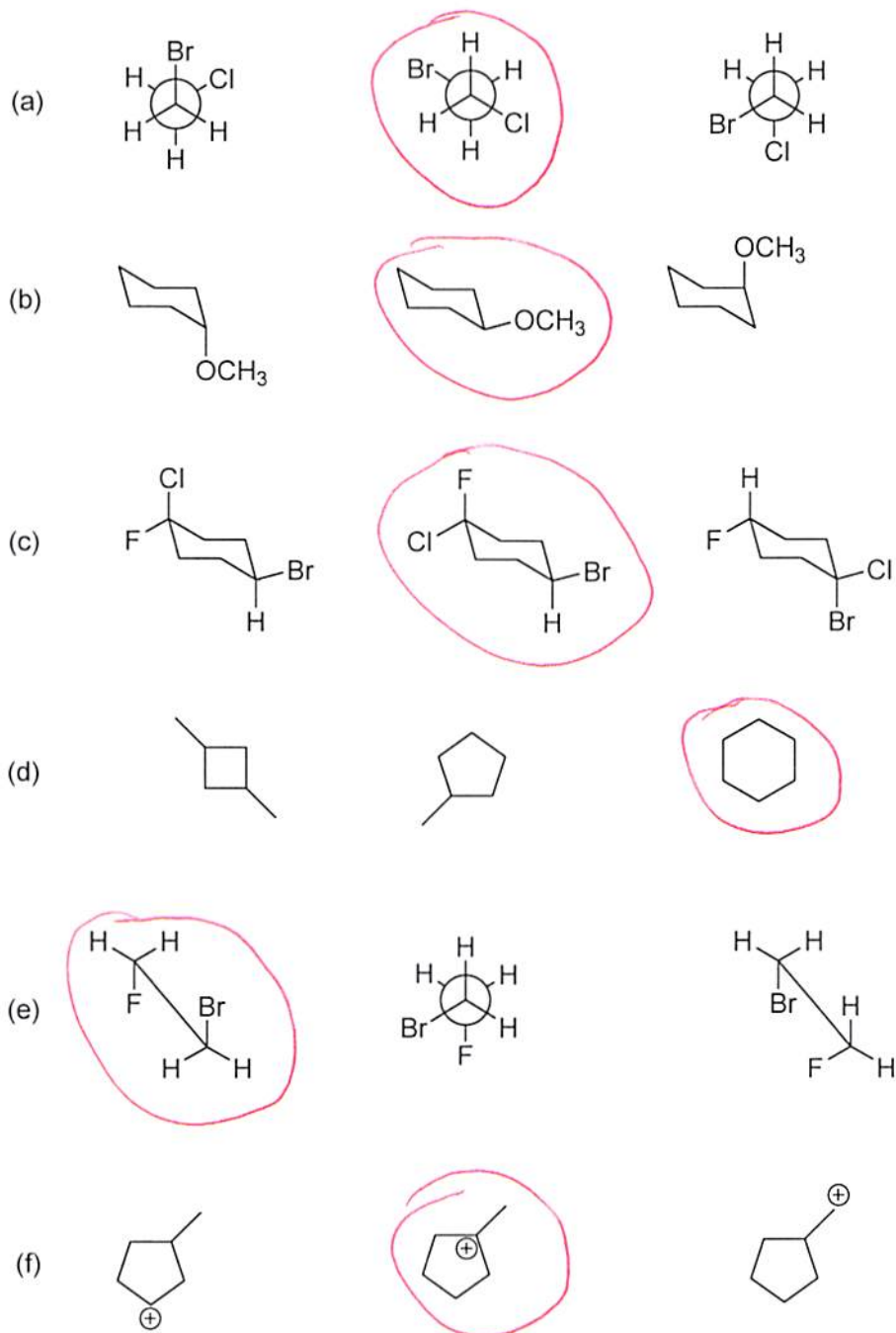


Is the regiochemistry of this reaction Saytzeff or *Hoffman*?

Is the product alkene E, *Z* or *neither*?



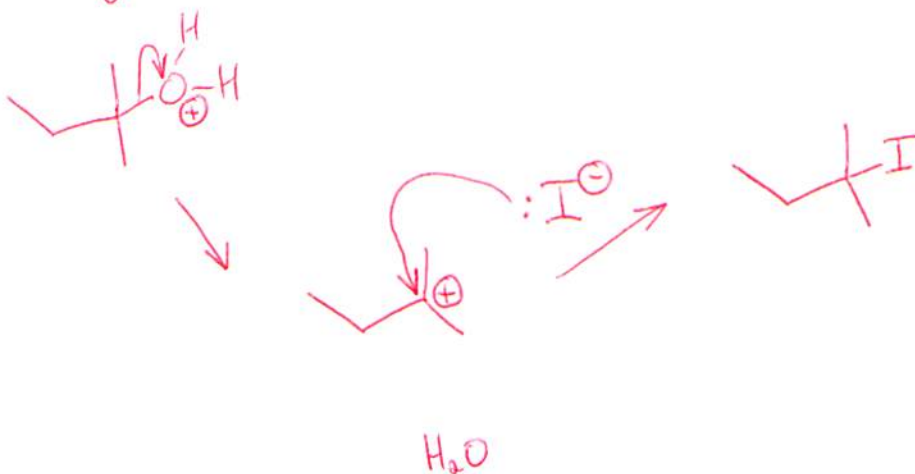
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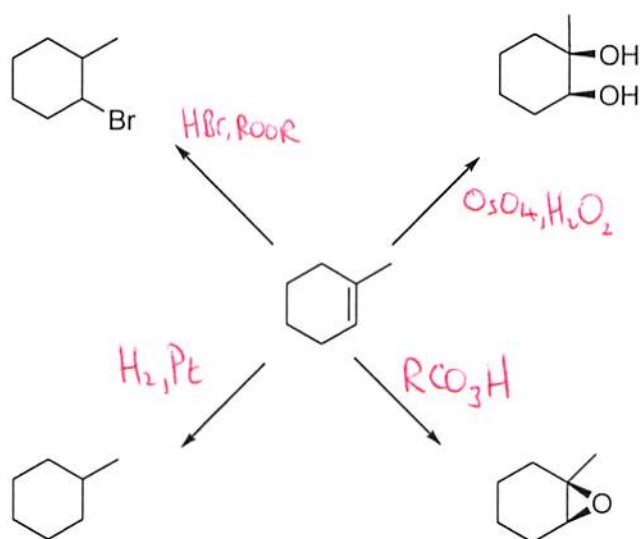
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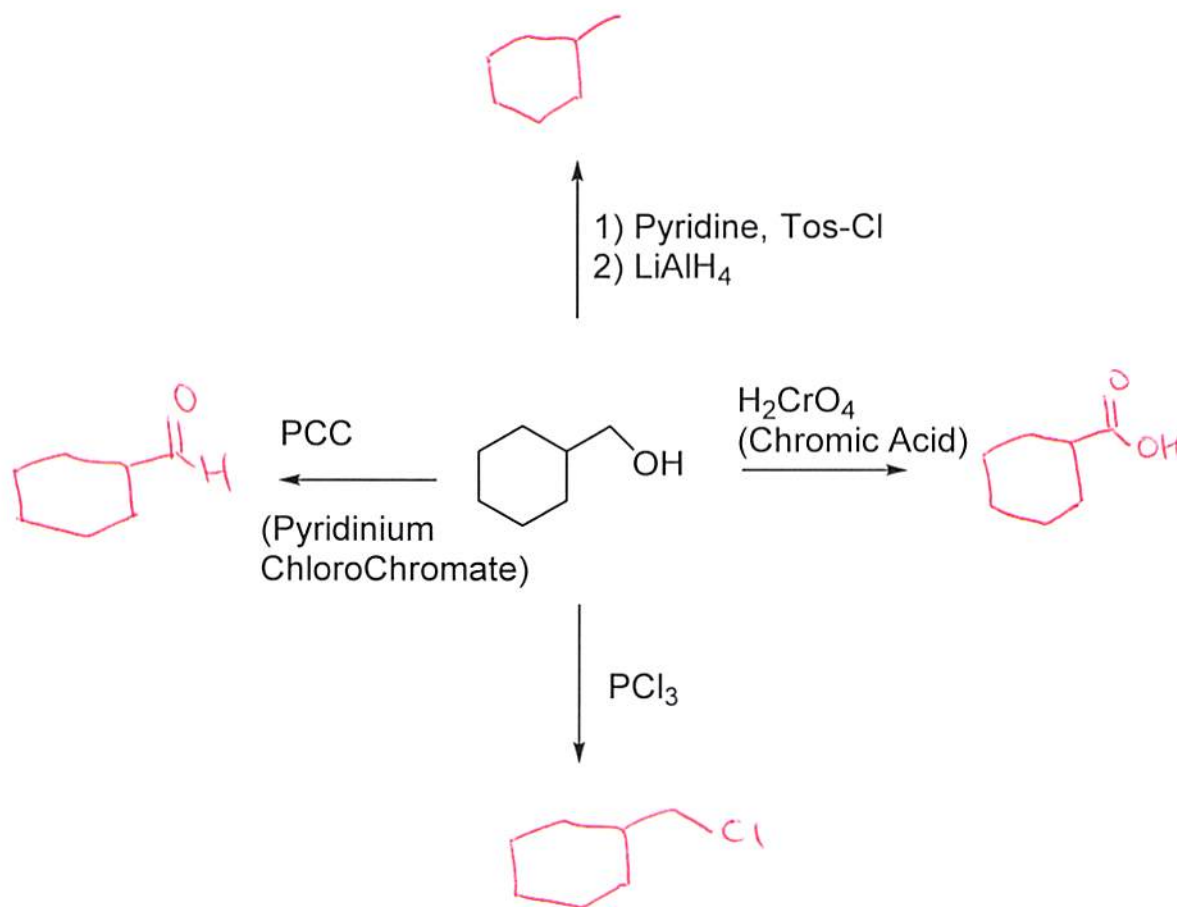


11) Give the reagents for the following alkene reactions. (8pts)

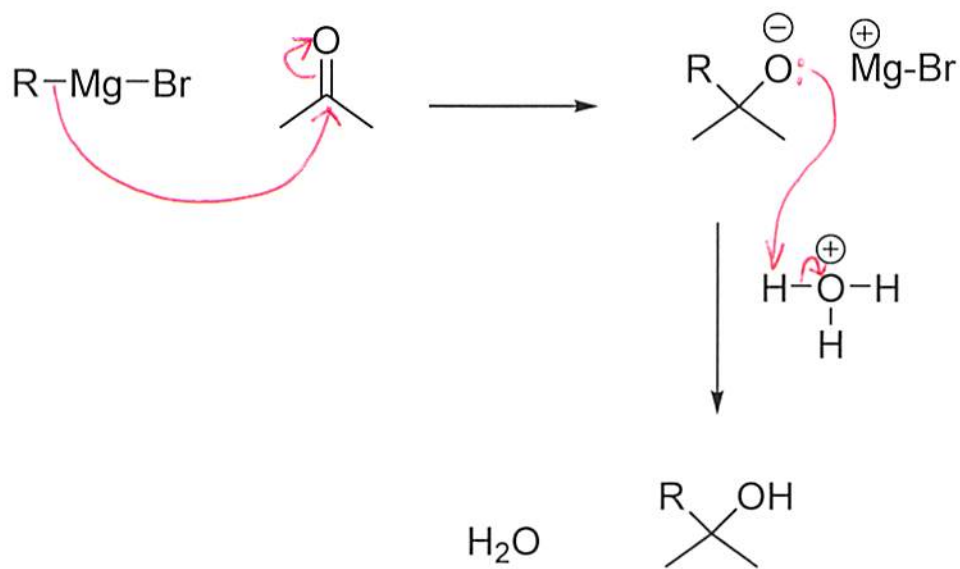




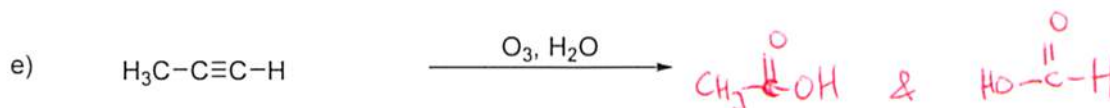
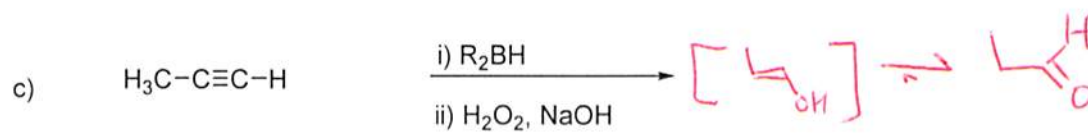
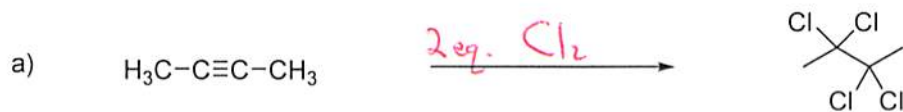
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15) (2+2=4pts) Using line angle diagrams, draw...

Two different **structural** isomers of *Butyne*.



Two different **stereoisomers** of *But-2-ene*.



**\*\*\*BONUS POINTS (up to THREE)\*\*\***

Name three common everyday type items or objects that are *chiral* (your answers CANNOT be parts of a body or items of clothing).

Golf club, scissors, Corkscrew, staircase, car, screw, dice, ...etc.