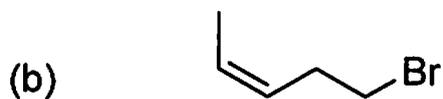
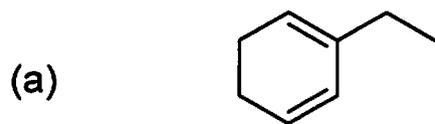


Name \_\_\_\_\_

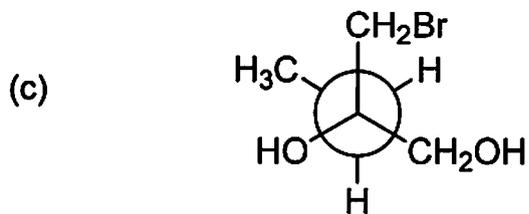
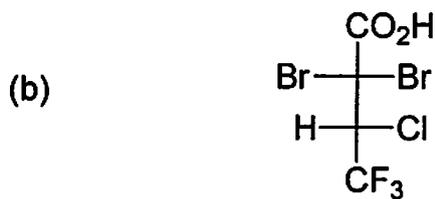
1-10 Are True/False (10pts)

- 1)  $S_N1$  and E1 reactions are both types of substitution reaction.
- 2) The terms R and S are assigned to a chiral center by application of the Convention rules established by Anne, T. Mark and Kovnikov.
- 3) E1 reactions are stereospecific because the leaving group must attack from directly behind the cation.
- 4) An addition reaction adds two atoms (or groups) across a  $\pi$  bond.
- 5) A *stereospecific* reaction is where a certain stereoisomer reacts to generate one specific stereoisomer as product.
- 6) Cyclobutene has more ring strain than cyclobutane.
- 7) The  $S_N2$  reaction proceeds with 100% inversion of configuration as a consequence of "back side attack" by the Nucleophile on the Carbon-Leaving Group bond.
- 8) An epoxide is a three membered ring.
- 9)  $S_N1$  and E1 reactions both proceed through carbanion intermediates.
- 10)  $\pi$  Covalent bonds are weaker than  $\sigma$  covalent bonds.

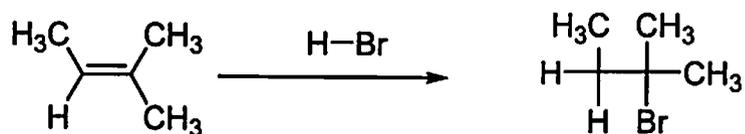
11) Provide the correct full IUPAC names for the following molecules.  
(3+3=6pts)



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

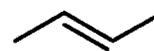
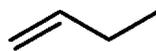
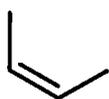


13) Write the mechanism for the below electrophilic addition. (3pts)



What is the *regiochemistry* of the above reaction ? (1pt)

14) (1+1+1=3pts) For the following four alkenes:

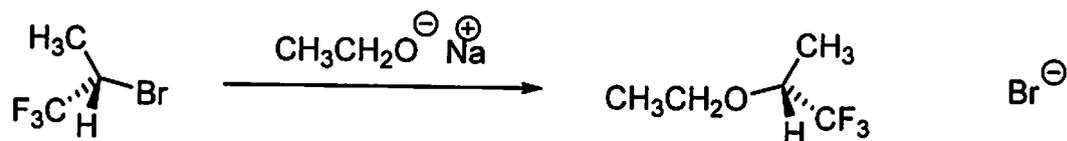


a) Which one is most stable ?

b) Which one is the least stable ?

c) How many of them would require the stereodescriptor Z or E in their full IUPAC name ?

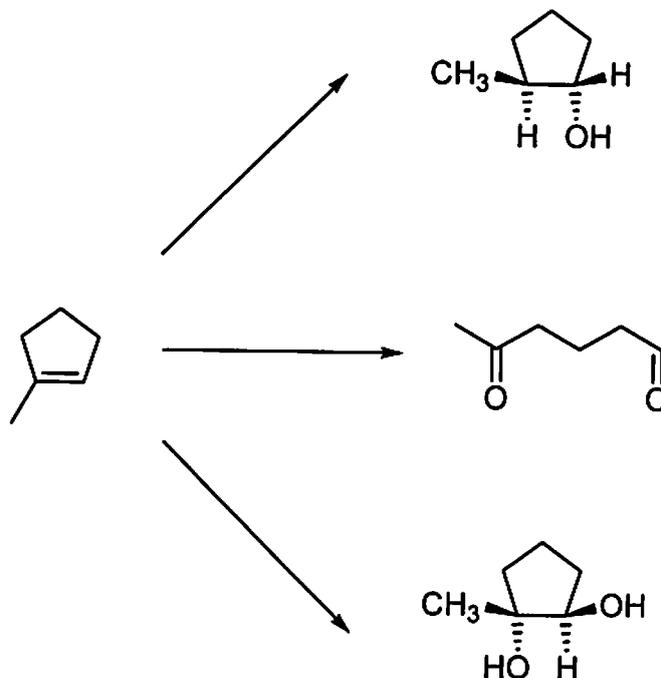
15) (1+1+1+1+1=5pts) For the following reaction:



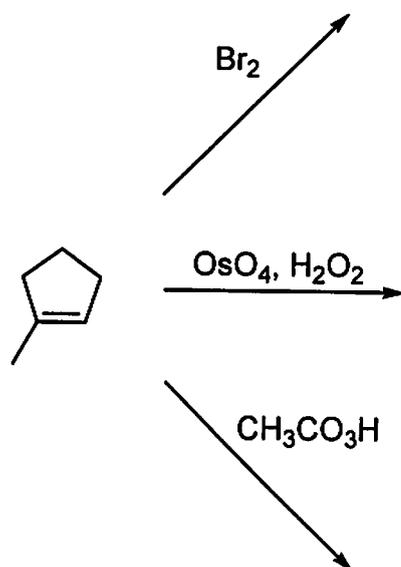
- Is this a *substitution*, *elimination* or *addition* ?
- How many lone pairs are in the alkyl halide starting material ?
- What is the designation of the chiral center in the starting material ?
- If the product is generated as a single enantiomer as shown, what does that tell you about the reaction mechanism ?
- In a single sentence explain your answer to (d).

16) Provide the definition of a “meso” compound, and then name an everyday object that is correctly described as being “meso” (2pts)

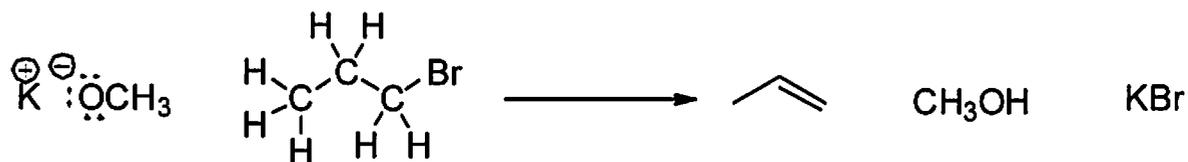
17) Provide the reagents that accomplish each of the three transformations shown. (6pts)



18) Provide the products that are generated in each of the three transformations shown. (6pts)



19) Draw the mechanism (i.e. curly arrows) for the following E2 elimination. (2pts)



**\*\*BONUS POINTS (up to 3 points)\*\***

Draw the “family tree of isomers”, showing as many different types of isomers as you can (e.g. *geometric*, *structural*, etc.).

hydrogen 1 1.0079 H	beryllium 4 9.0122 Be	scandium 21 44.956 Sc	titanium 22 47.867 Ti	vanadium 23 50.942 V	chromium 24 51.996 Cr	manganese 25 54.938 Mn	iron 26 55.845 Fe	cobalt 27 58.933 Co	nickel 28 58.693 Ni	copper 29 63.546 Cu	zinc 30 65.39 Zn	boron 5 10.811 B	carbon 6 12.011 C	nitrogen 7 14.007 N	oxygen 8 15.999 O	fluorine 9 18.998 F	helium 2 4.0026 He	
lithium 3 6.941 Li	beryllium 4 9.0122 Be	yttrium 39 88.906 Y	zirconium 40 91.224 Zr	niobium 41 92.906 Nb	molybdenum 42 95.94 Mo	technetium 43 [98] Tc	ruthenium 44 101.07 Ru	rhodium 45 102.91 Rh	nickel 46 106.42 Pd	silver 47 107.87 Ag	cadmium 48 112.41 Cd	aluminum 13 10.811 Al	silicon 14 12.011 Si	phosphorus 15 14.007 P	sulfur 16 15.999 S	chlorine 17 18.998 Cl	neon 10 20.180 Ne	
sodium 11 22.990 Na	magnesium 12 24.305 Mg	zinc 30 65.39 Zn	niobium 41 92.906 Nb	vanadium 23 50.942 V	chromium 24 51.996 Cr	manganese 25 54.938 Mn	iron 26 55.845 Fe	cobalt 27 58.933 Co	nickel 28 58.693 Ni	copper 29 63.546 Cu	zinc 30 65.39 Zn	boron 5 10.811 B	carbon 6 12.011 C	nitrogen 7 14.007 N	oxygen 8 15.999 O	fluorine 9 18.998 F	argon 18 39.948 Ar	
potassium 19 39.098 K	calcium 20 40.078 Ca	scandium 21 44.956 Sc	titanium 22 47.867 Ti	vanadium 23 50.942 V	chromium 24 51.996 Cr	manganese 25 54.938 Mn	iron 26 55.845 Fe	cobalt 27 58.933 Co	nickel 28 58.693 Ni	copper 29 63.546 Cu	zinc 30 65.39 Zn	boron 5 10.811 B	carbon 6 12.011 C	nitrogen 7 14.007 N	oxygen 8 15.999 O	fluorine 9 18.998 F	potassium 19 39.098 K	
rubidium 37 85.468 Rb	strontium 38 87.62 Sr	yttrium 39 88.906 Y	zirconium 40 91.224 Zr	niobium 41 92.906 Nb	molybdenum 42 95.94 Mo	technetium 43 [98] Tc	ruthenium 44 101.07 Ru	rhodium 45 102.91 Rh	nickel 46 106.42 Pd	silver 47 107.87 Ag	cadmium 48 112.41 Cd	aluminum 13 10.811 Al	silicon 14 12.011 Si	phosphorus 15 14.007 P	sulfur 16 15.999 S	chlorine 17 18.998 Cl	rubidium 37 85.468 Rb	
cesium 55 132.91 Cs	barium 56 137.33 Ba	lutetium 71 174.97 Lu	hafnium 72 178.49 Hf	tantalum 73 180.95 Ta	tungsten 74 183.84 W	rhenium 75 186.21 Re	osmium 76 190.23 Os	iridium 77 192.22 Ir	platinum 78 195.08 Pt	gold 79 196.97 Au	mercury 80 200.59 Hg	beryllium 4 9.0122 Be	boron 5 10.811 B	carbon 6 12.011 C	nitrogen 7 14.007 N	oxygen 8 15.999 O	fluorine 9 18.998 F	cesium 55 132.91 Cs
francium 87 [223] Fr	radium 88 [226] Ra	berkeleyum 103 [263] Lr	rutherfordium 104 [261] Rf	dubnium 105 [262] Db	seaborgium 106 [266] Sg	bohrium 107 [264] Bh	hassium 108 [269] Hs	meitnerium 109 [268] Mt	unnilium 110 [271] Uun	ununium 111 [272] Uuu	unbibium 112 [277] Uub	beryllium 4 9.0122 Be	boron 5 10.811 B	carbon 6 12.011 C	nitrogen 7 14.007 N	oxygen 8 15.999 O	fluorine 9 18.998 F	francium 87 [223] Fr

\* Lanthanide series

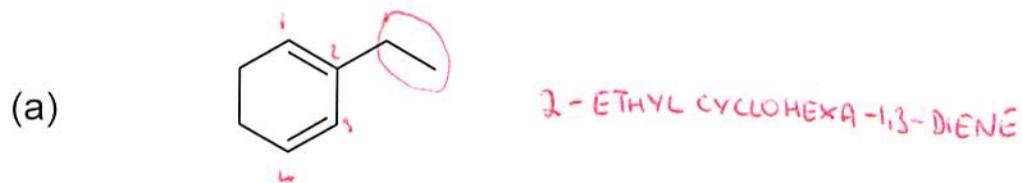
lanthanum 57 138.91 La	cerium 58 140.12 Ce	praseodymium 59 140.91 Pr	neodymium 60 144.24 Nd	promethium 61 [145] Pm	samarium 62 150.36 Sm	europium 63 151.96 Eu	gadolinium 64 157.25 Gd	terbium 65 158.93 Tb	dyprosium 66 162.50 Dy	holmium 67 164.93 Ho	erbium 68 167.26 Er	thulium 69 168.93 Tm	ytterbium 70 173.04 Yb
actinium 89 [227] Ac	thorium 90 232.04 Th	protactinium 91 231.04 Pa	uranium 92 238.03 U	neptunium 93 [237] Np	plutonium 94 [244] Pu	americium 95 [243] Am	curium 96 [247] Cm	berkelium 97 [247] Bk	californium 98 [251] Cf	einsteinium 99 [252] Es	fermium 100 [257] Fm	mendelevium 101 [259] Md	nobelium 102 [259] No

\*\* Actinide series

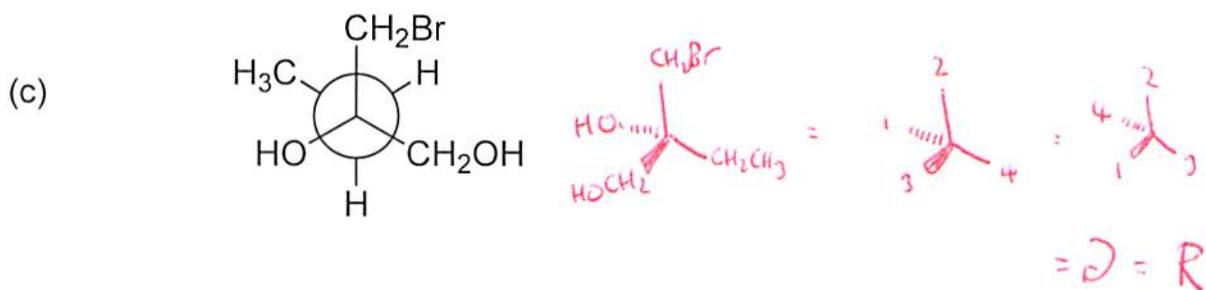
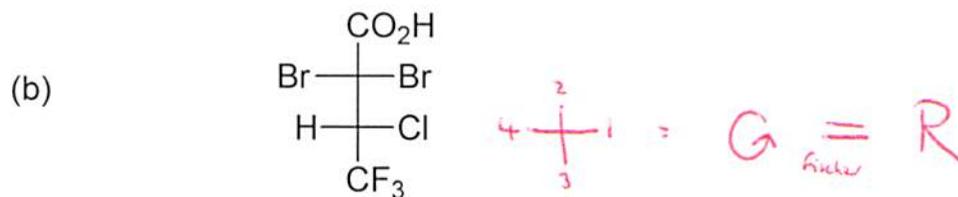
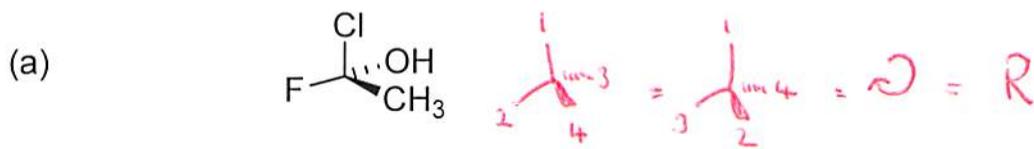
Name WAYLON DOWDMAIL1-10 Are True/False (10pts)

- 1)  $S_N1$  and  $E1$  reactions are both types of substitution reaction. False
- 2) The terms R and S are assigned to a chiral center by application of the Convention rules established by Anne, T. Mark and Kovnikov. False
- 3)  $E1$  reactions are stereospecific because the leaving group must attack from directly behind the cation. false
- 4) An addition reaction adds two atoms (or groups) across a  $\pi$  bond. T
- 5) A *stereospecific* reaction is where a certain stereoisomer reacts to generate one specific stereoisomer as product. T
- 6) Cyclobutene has more ring strain than cyclobutane. T
- 7) The  $S_N2$  reaction proceeds with 100% inversion of configuration as a consequence of "back side attack" by the Nucleophile on the Carbon-Leaving Group bond. T
- 8) An epoxide is a three membered ring. T
- 9)  $S_N1$  and  $E1$  reactions both proceed through carbanion intermediates. false
- 10)  $\pi$  Covalent bonds are weaker than  $\sigma$  covalent bonds. T

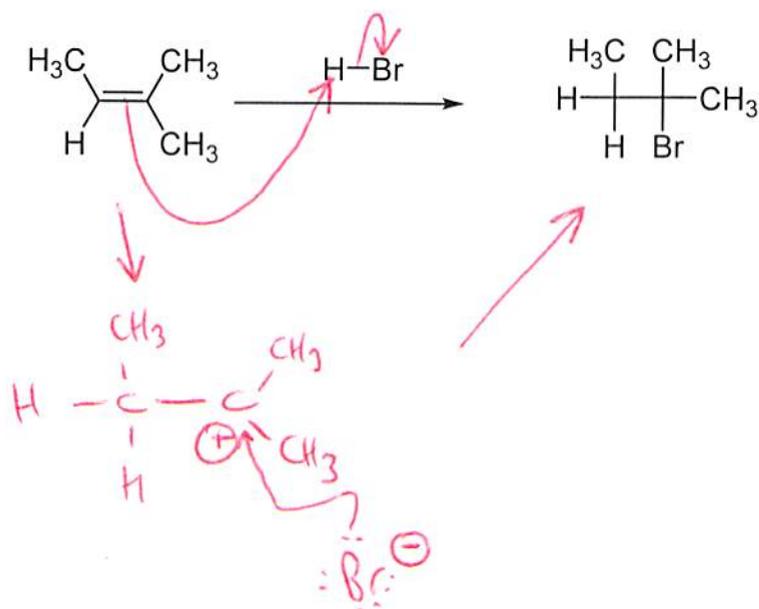
11) Provide the correct full IUPAC names for the following molecules.  
(3+3=6pts)



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



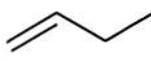
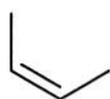
13) Write the mechanism for the below electrophilic addition. (3pts)



What is the *regiochemistry* of the above reaction? (1pt)

MARIKOV NIKOV ✓

14) (1+1+1=3pts) For the following four alkenes:



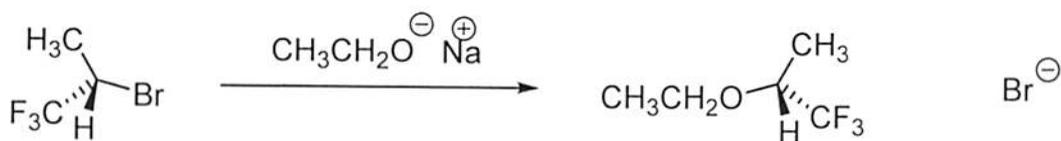
a) Which one is most stable?

b) Which one is the least stable?

c) How many of them would require the stereodescriptor Z or E in their full IUPAC name?

TWO OF THEM

15) (1+1+1+1+1=5pts) For the following reaction:

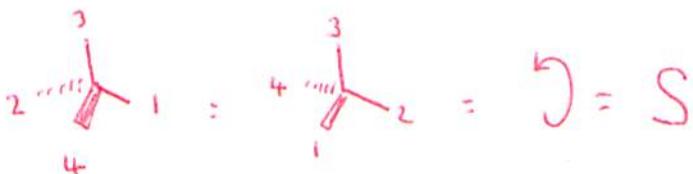


a) Is this a substitution, elimination or addition?

b) How many lone pairs are in the alkyl halide starting material?

12

c) What is the designation of the chiral center in the starting material?



d) If the product is generated as a single enantiomer as shown, what does that tell you about the reaction mechanism?

Inversion implies this is  $\text{S}_{\text{N}}2$ .

e) In a single sentence explain your answer to (d).

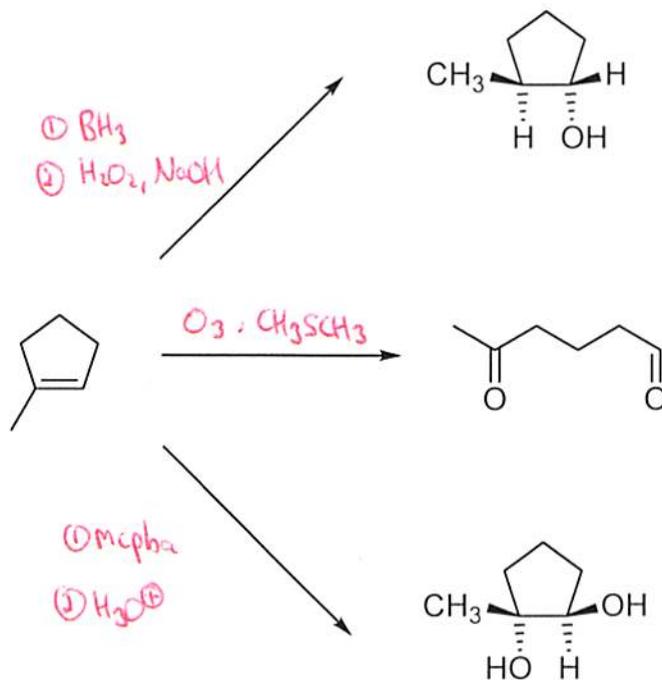
This reaction is a nucleophilic substitution which has proceeded with an inversion of stereochemistry at the stereocentre, and such a result is only consistent with the  $\text{S}_{\text{N}}2$  mechanistic process.

16) Provide the definition of a "meso" compound, and then name an everyday object that is correctly described as being "meso" (2pts)

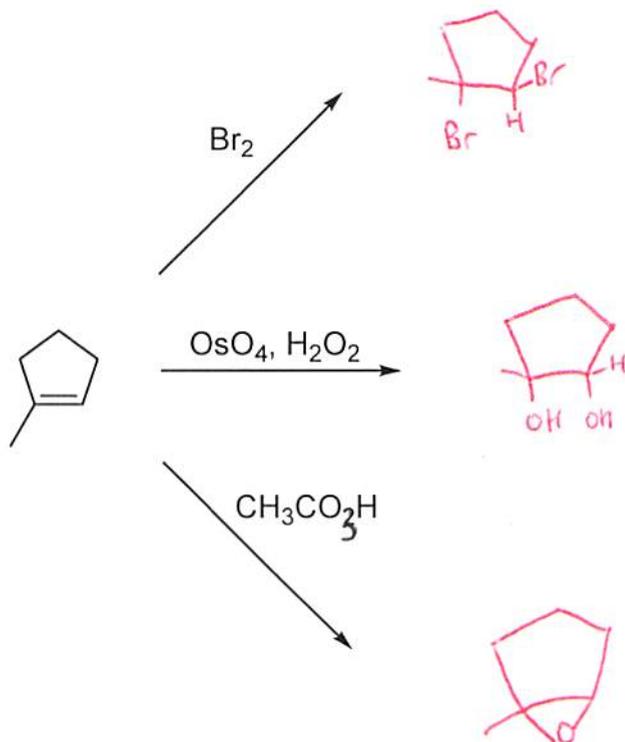
A meso object is something that has chiral sections, but is overall an achiral object.

E.g. a pair of shoes; a pair of gloves; a human; a bicycle, etc.

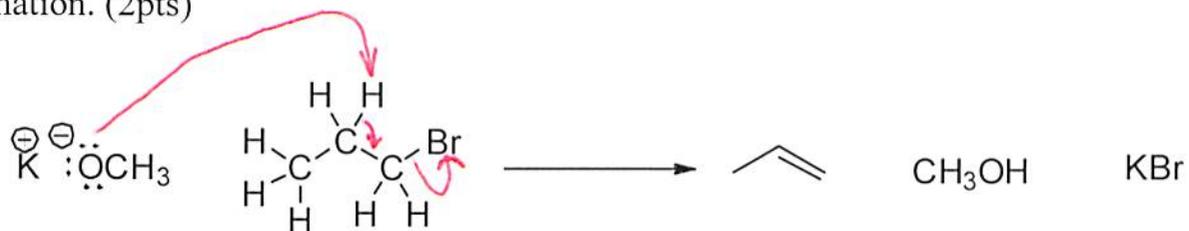
17) Provide the reagents that accomplish each of the three transformations shown. (6pts)



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19) Draw the mechanism (i.e. curly arrows) for the following E2 elimination. (2pts)



**\*\*BONUS POINTS (up to 3 points)\*\***

Draw the “family tree of isomers”, showing as many different types of isomers as you can (e.g. *geometric*, *structural*, etc.).

