

## Problem Set #3 (100 points)

Due Nov. 11 by 9:30 a.m. Chicago time (CDT)

Name:

# PERIODIC TABLE OF ELEMENTS

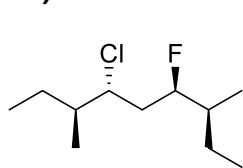
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18																
1 <b>H</b> Hydrogen 1.008	<div> <div> <div>C Solid</div> <div>Hg Liquid</div> <div>H Gas</div> <div>Rf Unknown</div> </div> <div> <div>Metals</div> <div>Alkali metals</div> <div>Alkaline earth metals</div> <div>Lanthanoids (Lanthanides)</div> <div>Actinoids (Actinides)</div> <div>Transition metals</div> <div>Post-transition metals</div> <div>Metalloids</div> <div>Reactive nonmetals</div> <div>Noble gases</div> </div> <div> <div>Nonmetals</div> <div>Phytogens</div> <div>Chalcogens</div> <div>Halogens</div> </div> </div>																2 <b>He</b> Helium 4.0026																
3 <b>Li</b> Lithium 6.94	4 <b>Be</b> Beryllium 9.0122															7 <b>N</b> Nitrogen 14.007	8 <b>O</b> Oxygen 15.999	9 <b>F</b> Fluorine 18.998	10 <b>Ne</b> Neon 20.180														
11 <b>Na</b> Sodium 22.990	12 <b>Mg</b> Magnesium 24.305															15 <b>P</b> Phosphorus 30.974	16 <b>S</b> Sulfur 32.06	17 <b>Cl</b> Chlorine 35.45	18 <b>Ar</b> Argon 39.948														
19 <b>K</b> Potassium 39.098	20 <b>Ca</b> Calcium 40.078	21 <b>Sc</b> Scandium 44.956	22 <b>Ti</b> Titanium 47.867	23 <b>V</b> Vanadium 50.942	24 <b>Cr</b> Chromium 51.996	25 <b>Mn</b> Manganese 54.938	26 <b>Fe</b> Iron 55.845	27 <b>Co</b> Cobalt 58.933	28 <b>Ni</b> Nickel 58.693	29 <b>Cu</b> Copper 63.546	30 <b>Zn</b> Zinc 65.38	31 <b>Ga</b> Gallium 69.723	32 <b>Ge</b> Germanium 72.630	33 <b>As</b> Arsenic 74.922	34 <b>Se</b> Selenium 78.971	35 <b>Br</b> Bromine 79.904	36 <b>Kr</b> Krypton 83.798																
37 <b>Rb</b> Rubidium 85.468	38 <b>Sr</b> Strontium 87.62	39 <b>Y</b> Yttrium 88.906	40 <b>Zr</b> Zirconium 91.224	41 <b>Nb</b> Niobium 92.906	42 <b>Mo</b> Molybdenum 95.95	43 <b>Tc</b> Technetium (98)	44 <b>Ru</b> Ruthenium 101.07	45 <b>Rh</b> Rhodium 106.42	46 <b>Pd</b> Palladium 107.87	47 <b>Ag</b> Silver 107.87	48 <b>Cd</b> Cadmium 112.41	49 <b>In</b> Indium 114.82	50 <b>Sn</b> Tin 118.71	51 <b>Sb</b> Antimony 121.76	52 <b>Te</b> Tellurium 127.60	53 <b>I</b> Iodine 126.90	54 <b>Xe</b> Xenon 131.29																
55 <b>Cs</b> Caesium 132.91	56 <b>Ba</b> Barium 137.33															83 <b>Bi</b> Bismuth 208.98	84 <b>Po</b> Polonium (209)	85 <b>At</b> Astatine (210)	86 <b>Rn</b> Radon (222)														
87 <b>Fr</b> Francium (223)	88 <b>Ra</b> Radium (226)	<div>For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.</div>														115 <b>Mc</b> Moscovium (290)	116 <b>Lv</b> Livermorium (293)	117 <b>Ts</b> Tennessine (294)	118 <b>Og</b> Oganesson (294)														
		6 <b>La</b> Lanthanum 138.91	58 <b>Ce</b> Cerium 140.12	59 <b>Pr</b> Praseodymium 140.91	60 <b>Nd</b> Neodymium 144.24	61 <b>Pm</b> Promethium (145)	62 <b>Sm</b> Samarium 150.36	63 <b>Eu</b> Europium 151.96	64 <b>Gd</b> Gadolinium 157.25	65 <b>Tb</b> Terbium 158.93	66 <b>Dy</b> Dysprosium 162.50	67 <b>Ho</b> Holmium 164.93	68 <b>Er</b> Erbium 167.26	69 <b>Tm</b> Thulium 168.93	70 <b>Yb</b> Ytterbium 173.05	71 <b>Lu</b> Lutetium 174.97																	
		7 <b>Ac</b> Actinium (227)	90 <b>Th</b> Thorium 232.04	91 <b>Pa</b> Protactinium 231.04	92 <b>U</b> Uranium 238.03	93 <b>Np</b> Neptunium (237)	94 <b>Pu</b> Plutonium (244)	95 <b>Am</b> Americium (243)	96 <b>Cm</b> Curium (247)	97 <b>Bk</b> Berkelium (247)	98 <b>Cf</b> Californium (251)	99 <b>Es</b> Einsteinium (252)	100 <b>Fm</b> Fermium (257)	101 <b>Md</b> Mendelevium (258)	102 <b>No</b> Nobelium (259)	103 <b>Lr</b> Lawrencium (260)																	

Design Copyright © 2019 Michael Dayah (support@table.com). For a fully interactive version in 50 languages with property trend visualization, 3D orbitals, isotopes, compound mixing, lesson plans, free printouts, and posters in all sizes, visit [table.com](https://table.com).

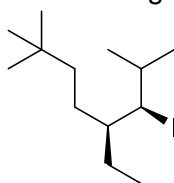
Image © 2019 by Michael Dayah. All rights reserved. 2019-2020. Version 1.0.0.0. All rights reserved. 2019-2020. Version 1.0.0.0.

### Problems:

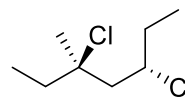
1. (12 points) Provide the name for the following compounds.



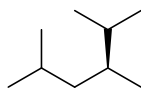
(a)



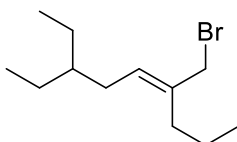
(b)



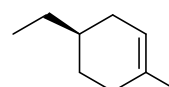
(c)



(d)

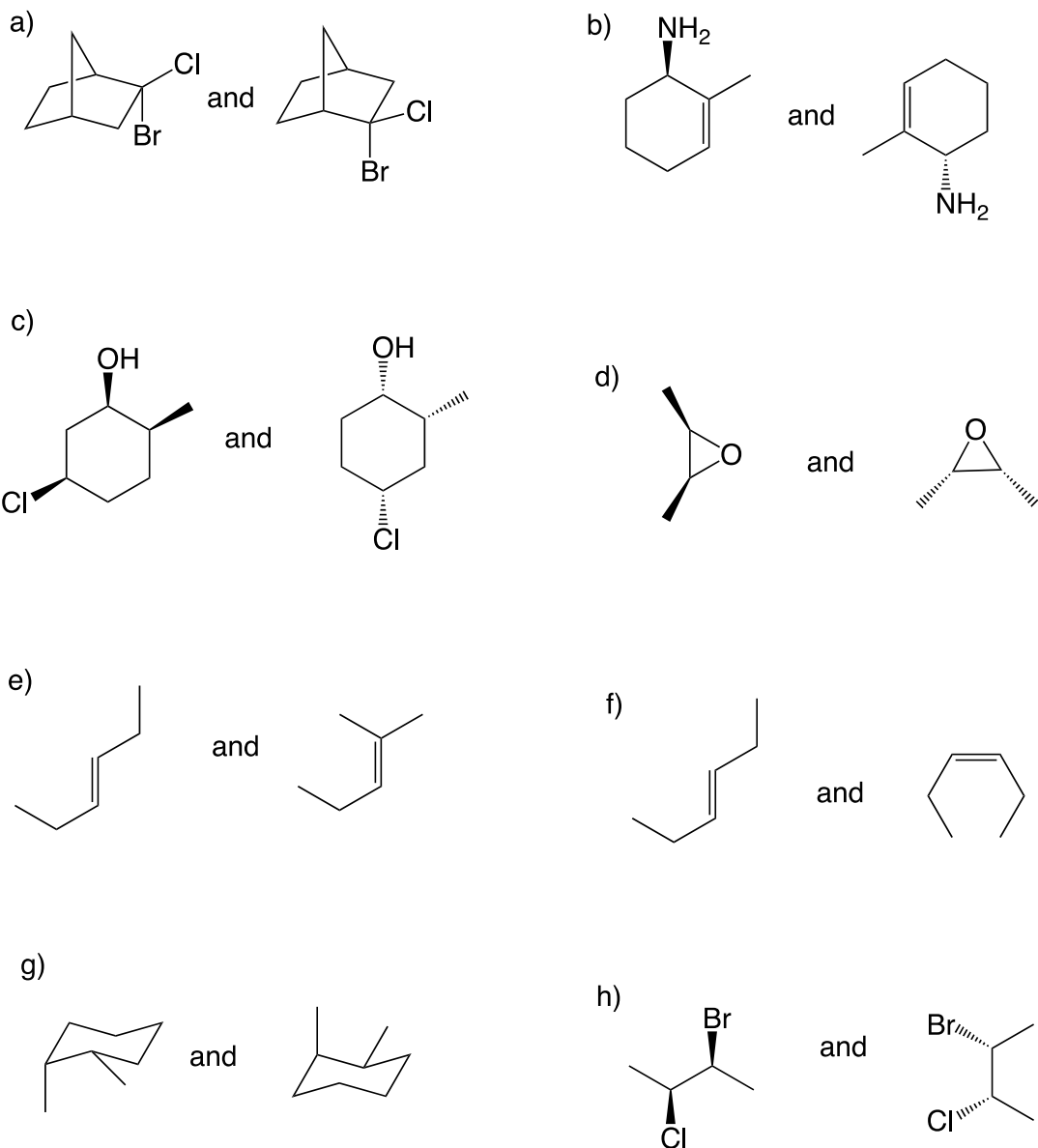


(e)

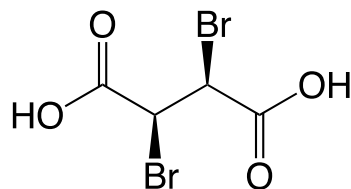


(f)

2. **(8 points)** Are the pairs of structures shown below constitutional isomers, enantiomers, diastereomers, or the same?



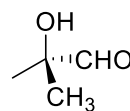
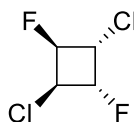
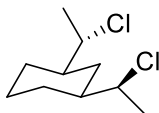
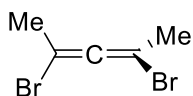
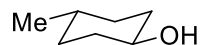
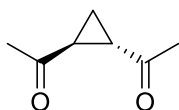
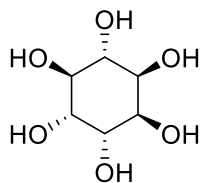
3. **(10 points)** For this molecule:



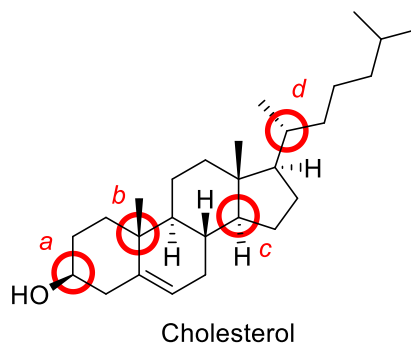
- Label each chiral center as R/S.
- Draw all other stereoisomers.
- Indicate which of these is the enantiomer of the first.

- d) Indicate which are diastereomers of the first.  
 e) Indicate if any of the isomers are meso compounds.

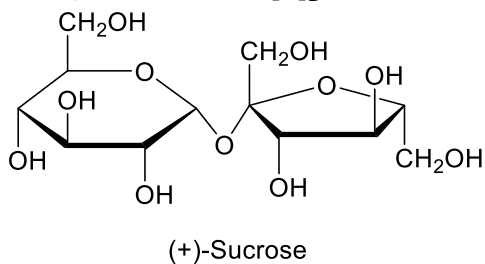
4. **(7 points)** Determine if the following compound is chiral or not.



5. **(12 points)** Cholesterol is one of the important component of animal cell membrane. Label circled chiral centers as R/S, and circle the rest of chiral centers in this compound.



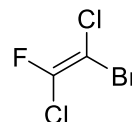
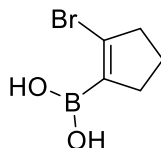
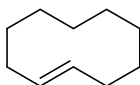
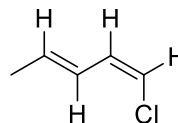
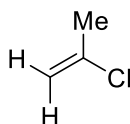
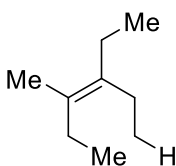
6. **(6 points)** Sucrose is one of the most abundant sugar in the world. About 185 million tonnes of sugar were produced worldwide in 2017. Sucrose is a chiral compound and enantio-pure sucrose has specific rotation  $[\alpha]_D^{20} = +66.5^\circ$ .



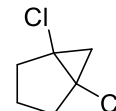
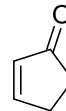
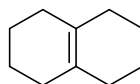
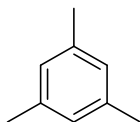
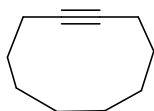
A sample of synthesized sucrose from organic chemistry lab was tested, and the specific rotation of the sample is  $[\alpha]_D^{20} = +60.1^\circ$ .

- determine the enantiomeric excess (ee) of the sample.
- calculate the ratio of two enantiomers
- draw the structure of the minor enantiomer in the sample.

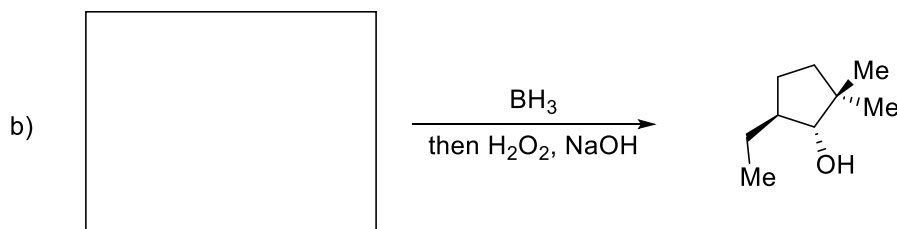
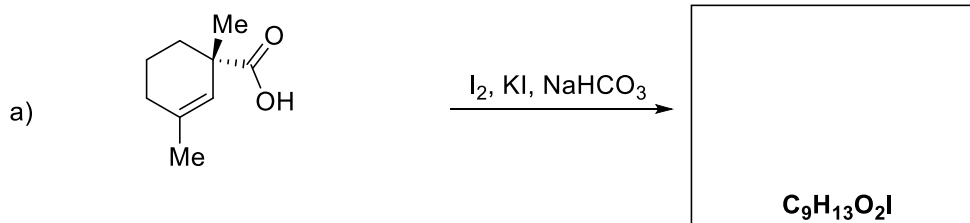
7. **(6 points)** Label all the C=C double bonds as Z/E in the following compounds (if there is no Z/E isomer, mark as *no isomer*).

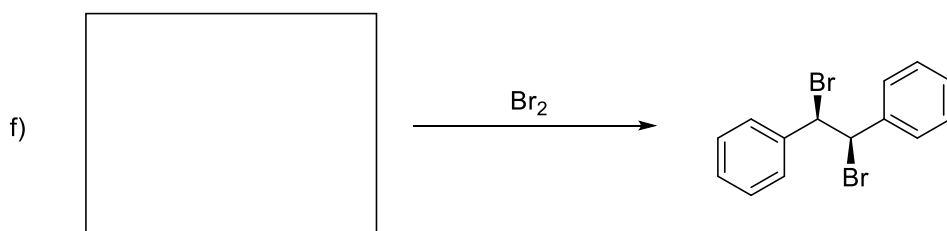
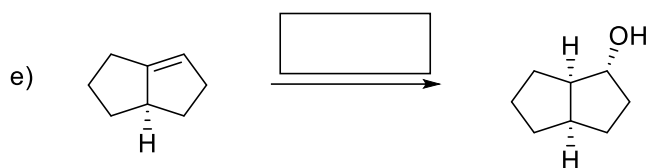
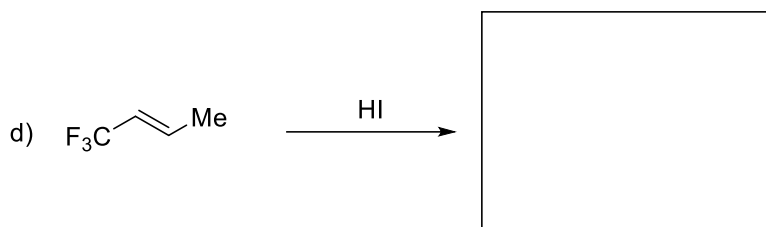
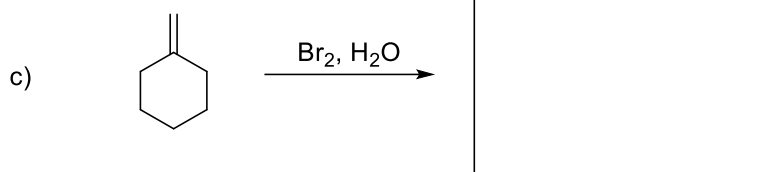


8. **(10 points)** Calculate the degree of unsaturation for the following compounds



9. **(18 points)** Draw the structure of product, substrate or condition in the following reactions (should clearly show the stereochemistry).





10. (11 points) Draw a reasonable mechanism for the following reaction (cat. = catalytic amount).

