

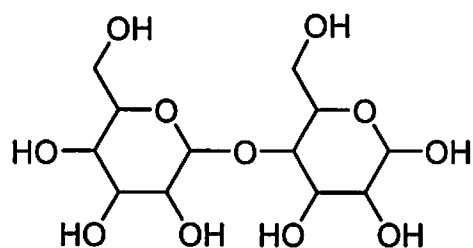
Name _____

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1-10 Are True/False (10pts)

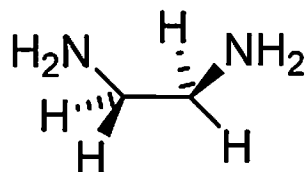
- 1) Cyclopentane has zero ring strain.
- 2) Lewis Acids are two electron acceptors.
- 3) The rate determining step is the slowest step in a multistep process.
- 4) A π bond is formed by the sideways overlap of p orbitals.
- 5) Chair and Boat are two possible conformations for Cyclohexane.
- 6) Hexane and Cyclohexane have the same molecular formula.
- 7) The methyl radical ($\bullet\text{CH}_3$) will have H-C-H bond angles of 120° .
- 8) Bond dissociation energy is the energy required to break a covalent bond into radicals.
- 9) Endothermic reaction steps have late (product like) transitions states.
- 10) Fluorine has 9 valence electrons.

11) (6pts) For the molecule below in line angle diagram (stick figure) form, calculate the number of:



- Carbon atoms
- Hydrogen atoms
- Oxygen atoms
- Pairs of non-bonding electrons (lone pairs)
- sp^2 hybridized Carbons
- sp^3 hybridized Oxygens

12) (2+1pts) i) Draw the following molecule using a Newman projection.

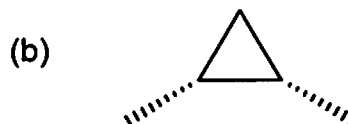
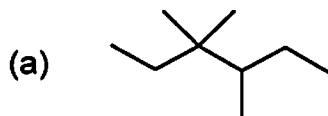


ii) What name is given to the above conformation where the C-N and C-N bonds have a dihedral angle of 60° ?

13) (3pts) Using “fish hook” arrows (which represent the movement of ONE electron), draw the *mechanism* for this reaction.



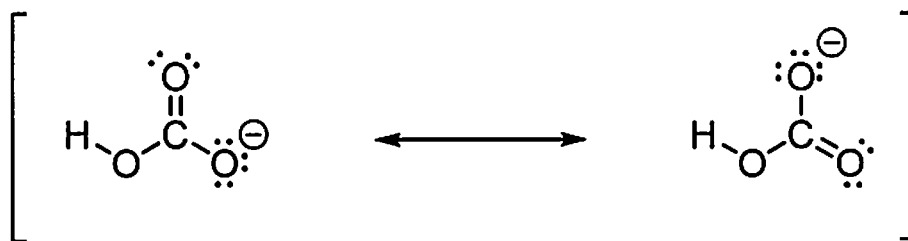
14) (3+4pts) Name the following compounds in IUPAC form.



15) (3pts) Draw *1,1-diethylcyclobutane* using a line angle formula (stick figure) representation.

16) (1+2+1=4pts) i) Why (or when) do we use resonance structures?

ii) For the below resonance structures, draw the electron movement (curly arrows) that converts the left hand side structure into the other.



iii) Which resonance structure is of lower energy?

17) (5pts) a) What is meant by the term “favorable reaction”?

b) What is meant by the term “kinetics”?

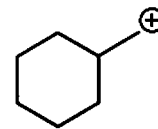
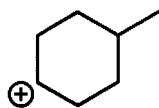
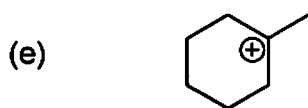
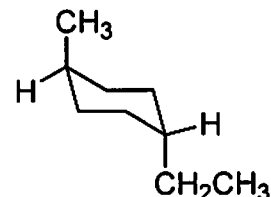
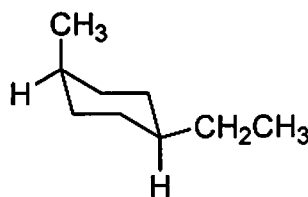
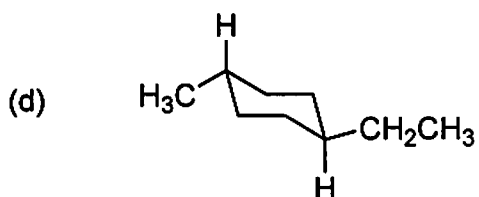
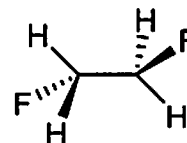
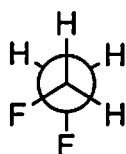
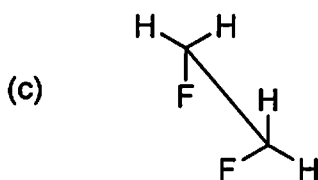
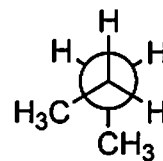
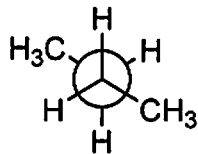
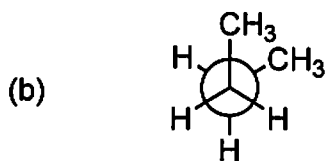
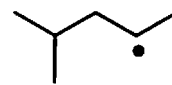
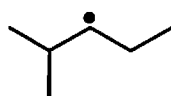
In the famous equation $\Delta G = \Delta H - T\Delta S$

c) What does the Δ mean?

d) What does G represent?

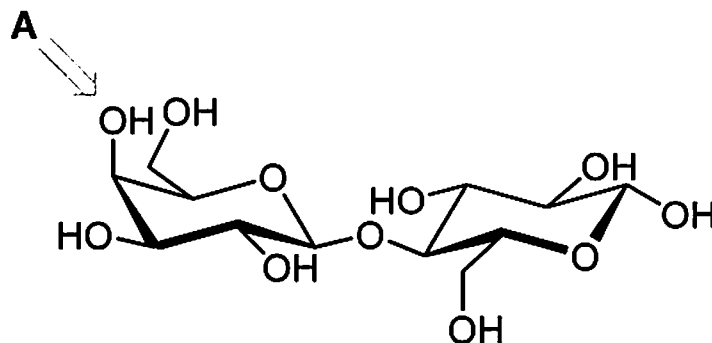
e) What does H represent?

18) (5pts) Circle the lowest energy member in each threesome.



19) (1pt) What term describes molecules that are different, but have the same molecular formula?

20) (3pts) The molecule from Question 11 exists in the following three dimensional conformation.



- How many 6 membered rings are there?
- Is OH group labelled "A" in an *axial* or *equatorial* position?
- How many axial C-H bonds are there in total?

*****BONUS QUESTIONS (Up to 3 points)*****

The above molecule is actually a sugar found in dairy products. Most humans do not have the enzyme needed to break down this sugar, and are therefore "intolerant" to this molecule resulting in abdominal pain, bloating, diarrhea, gas, and nausea.

What is the common name of the above molecule?

Guess the percentage of global population that are intolerant to this molecule. (2 points for exact %, 1 point if you are within 5%; according to a 2017 "Current Gastroenterology Report").

hydrogen 1 H	1.0079	beryllium 4 Be	9.0122	lithium 3 Li	6.941	boron 5 B	10.811	carbon 6 C	12.011	nitrogen 7 N	14.007	oxygen 8 O	15.999	fluorine 9 F	18.998	helium 2 He	4.0026
lithium 3 Li	6.941	beryllium 4 Be	9.0122	beryllium 4 Be	9.0122	boron 5 B	10.811	carbon 6 C	12.011	nitrogen 7 N	14.007	oxygen 8 O	15.999	fluorine 9 F	18.998	helium 2 He	4.0026
sodium 11 Na	22.990	calcium 20 Ca	40.078	sodium 11 Na	22.990	aluminum 13 Al	26.982	silicon 14 Si	28.086	phosphorus 15 P	30.974	sulfur 16 S	32.065	chlorine 17 Cl	35.453	neon 10 Ne	20.180
potassium 19 K	39.098	scandium 21 Sc	44.956	potassium 19 K	39.098	argon 18 Ar	39.948	germanium 32 Ge	72.61	arsenic 33 As	74.922	seleonium 34 Se	78.96	bromine 35 Br	79.904	argon 18 Ar	39.948
rubidium 37 Rb	85.468	titanium 22 Ti	47.867	rubidium 37 Rb	85.468	copper 29 Cu	63.546	gallium 31 Ga	69.723	cadmium 48 Cd	112.41	indium 49 In	114.82	tin 50 Sn	118.71	potassium 19 K	39.098
cesium 55 Cs	132.91	vanadium 23 V	50.942	cesium 55 Cs	132.91	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	mercury 80 Hg	200.59	thallium 81 Tl	204.38	lead 82 Pb	207.2	calcium 20 Ca	40.078
francium 87 Fr	1223	chromium 24 Cr	51.996	francium 87 Fr	1223	nickel 28 Ni	58.693	silver 47 Ag	107.87	gold 79 Au	196.97	mercury 80 Hg	200.59	thallium 81 Tl	204.38	beryllium 4 Be	9.0122
		manganese 25 Mn	54.938			cobalt 27 Co	58.933	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		iron 26 Fe	55.845			iron 26 Fe	55.845	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		cobalt 27 Co	58.933			cobalt 27 Co	58.933	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		nickel 28 Ni	58.693			nickel 28 Ni	58.693	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		copper 29 Cu	63.546			copper 29 Cu	63.546	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		zinc 30 Zn	65.39			zinc 30 Zn	65.39	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		gallium 31 Ga	69.723			gallium 31 Ga	69.723	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		germanium 32 Ge	72.61			germanium 32 Ge	72.61	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		arsenic 33 As	74.922			arsenic 33 As	74.922	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		seleonium 34 Se	78.96			seleonium 34 Se	78.96	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		bromine 35 Br	79.904			bromine 35 Br	79.904	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		krypton 36 Kr	83.80			krypton 36 Kr	83.80	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		rubidium 37 Rb	85.468			rubidium 37 Rb	85.468	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		strontium 38 Sr	87.62			strontium 38 Sr	87.62	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		yttrium 39 Y	88.906			yttrium 39 Y	88.906	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		zirconium 40 Zr	91.224			zirconium 40 Zr	91.224	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		niobium 41 Nb	92.906			niobium 41 Nb	92.906	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		molybdenum 42 Mo	95.94			molybdenum 42 Mo	95.94	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		technetium 43 Tc	98.906			technetium 43 Tc	98.906	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		ruthenium 44 Ru	101.07			ruthenium 44 Ru	101.07	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		rhodium 45 Rh	102.91			rhodium 45 Rh	102.91	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		iridium 77 Ir	192.22			iridium 77 Ir	192.22	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		platinum 78 Pt	195.08			platinum 78 Pt	195.08	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		gold 79 Au	196.97			gold 79 Au	196.97	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		mercury 80 Hg	200.59			mercury 80 Hg	200.59	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		thallium 81 Tl	204.38			thallium 81 Tl	204.38	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		lead 82 Pb	207.2			lead 82 Pb	207.2	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		bismuth 83 Bi	208.98			bismuth 83 Bi	208.98	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		uranium 92 U	238.03			uranium 92 U	238.03	nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		actinide series				actinide series		nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122
		actinide series				actinide series		nickel 28 Ni	58.693	copper 29 Cu	63.546	zinc 30 Zn	65.39	cadmium 48 Cd	112.41	beryllium 4 Be	9.0122

* Lanthanide series

** Actinide series

lanthanum 57 La	138.91	cerium 58 Ce	140.12	praseodymium 59 Pr	140.91	neodymium 60 Nd	144.24	promethium 61 Pm	145	europium 63 Eu	151.96	gadolinium 64 Gd	157.25	terbium 65 Tb	158.93	dyprosium 66 Dy	162.50	holmium 67 Ho	164.93	erbium 68 Er	167.26	thulium 69 Tm	168.93	ytterbium 70 Yb	173.04
actinium 89 Ac	227	thorium 90 Th	232.04	protactinium 91 Pa	231.04	uranium 92 U	238.03	neptunium 93 Np	237	americium 95 Am	243	curium 96 Cm	247	berkelium 97 Bk	247	californium 98 Cf	251	einsteinium 99 Es	252	fermium 100 Fm	257	mendelevium 101 Md	258	nobelium 102 No	259

Name

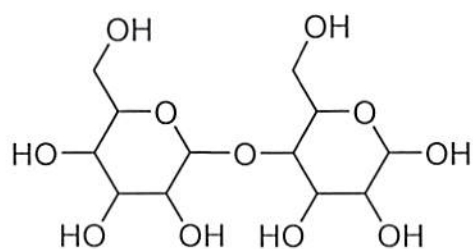
SUNIL TANYA

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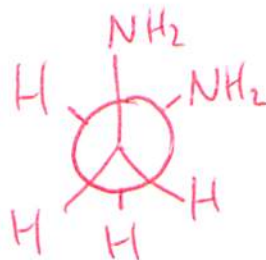
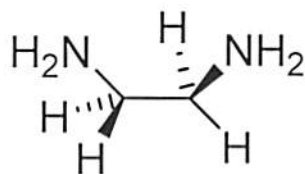
- 1) Cyclopentane has zero ring strain. *False*
- 2) Lewis Acids are two electron acceptors. *T*
- 3) The rate determining step is the slowest step in a multistep process. *T*
- 4) A π bond is formed by the sideways overlap of p orbitals. *T*
- 5) Chair and Boat are two possible conformations for Cyclohexane. *T*
- 6) Hexane and Cyclohexane have the same molecular formula. *False*
- 7) The methyl radical ($\bullet\text{CH}_3$) will have H-C-H bond angles of 120° . *T*
- 8) Bond dissociation energy is the energy required to break a covalent bond into radicals. *T*
- 9) Endothermic reaction steps have late (product like) transitions states *T*
- 10) Fluorine has 9 valence electrons. *False*

11) (6pts) For the molecule below in line angle diagram (stick figure) form, calculate the number of:



- a) Carbon atoms 12
- b) Hydrogen atoms 22
- c) Oxygen atoms 11
- d) Pairs of non-bonding electrons (lone pairs) 22
- e) sp^2 hybridized Carbons 0
- f) sp^3 hybridized Oxygens 11

12) (2+1pts) i) Draw the following molecule using a Newman projection.



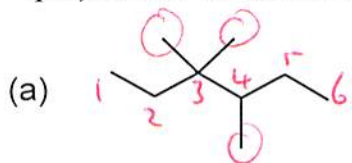
ii) What name is given to the above conformation where the C-N and C-N bonds have a dihedral angle of 60° ?

Gauche

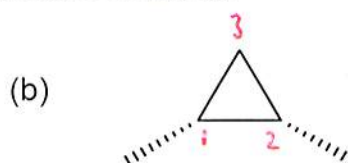
13) (3pts) Using “fish hook” arrows (which represent the movement of ONE electron), draw the *mechanism* for this reaction.



14) (3+4pts) Name the following compounds in IUPAC form.

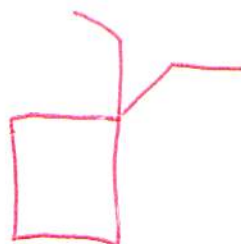


3,3,4-TRIMETHYL HEXANE



CIS-1,2-DIMETHYL CYCLOPROPANE

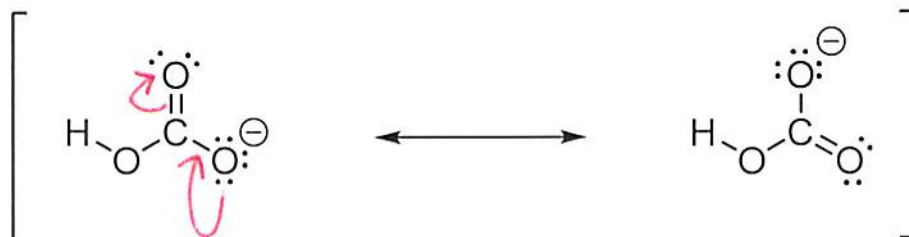
15) (3pts) Draw *1,1-diethylcyclobutane* using a line angle formula (stick figure) representation.



16) (1+2+1=4pts) i) Why (or when) do we use resonance structures?

For delocalized, hybrid, non-classical species where one single Lewis structure cannot accurately portray the structure.

ii) For the below resonance structures, draw the electron movement (curly arrows) that converts the left hand side structure into the other.



iii) Which resonance structure is of lower energy?

They are the same energy.

17) (5pts) a) What is meant by the term "favorable reaction"?

A reaction that gives more product than starting material, where $K_{eq} > 1$, or ΔG is negative.

b) What is meant by the term "kinetics"?

Kinetics deals with the speed of reactions. How quickly products appear, and how quickly SM disappear.

In the famous equation

$$\Delta G = \Delta H - T\Delta S$$

c) What does the Δ mean?

Δ or delta means "the change in".

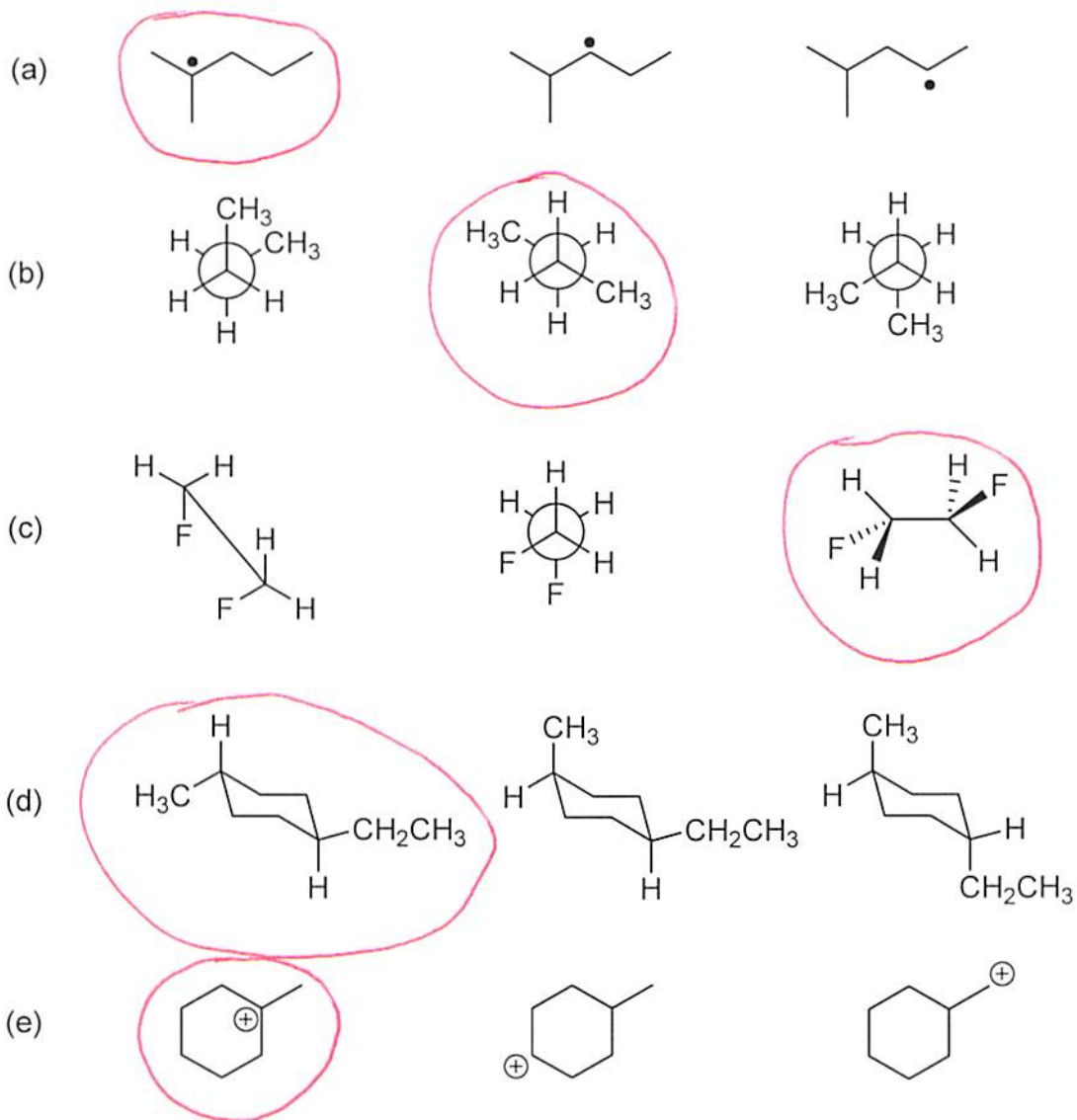
d) What does G represent?

Gibbs Free Energy

e) What does H represent?

Enthalpy

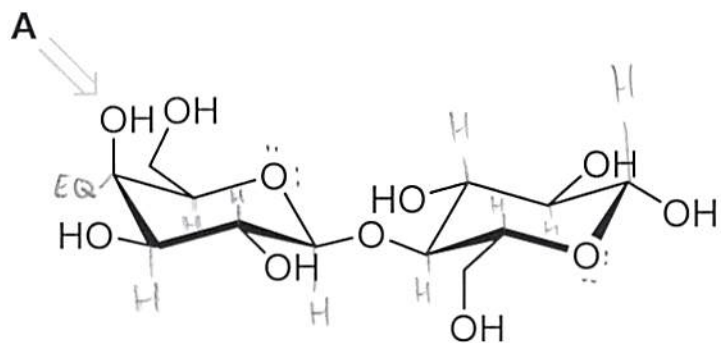
18) (5pts) Circle the lowest energy member in each threesome.



19) (1pt) What term describes molecules that are different, but have the same molecular formula?

ISOMER

20) (3pts) The molecule from Question 11 exists in the following three dimensional conformation.



a) How many 6 membered rings are there?

TWO

b) Is OH group labelled "A" in an *axial* or *equatorial* position?

AXIAL

c) How many axial C-H bonds are there in total?

9

BONUS QUESTIONS (Up to 3 points)

The above molecule is actually a sugar found in dairy products. Most humans do not have the enzyme needed to break down this sugar, and are therefore "intolerant" to this molecule resulting in abdominal pain, bloating, diarrhea, gas, and nausea.

What is the common name of the above molecule?

Lactose

Guess the percentage of global population that are intolerant to this molecule. (2 points for exact %, 1 point if you are within 5%; according to a 2017 "Current Gastroenterology Report").

65%