

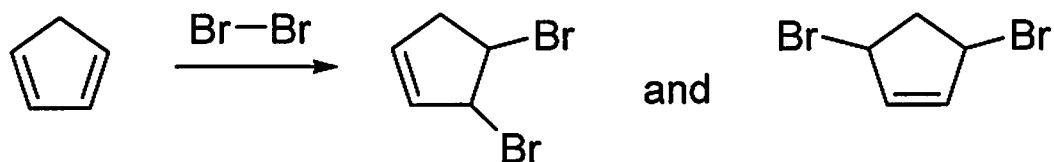
Name: _____

(1-10) are True/False. (10pts)

- 1) “*Conjugation*” means three or more, consecutive, aligned and interacting p orbitals.
- 2) Aromatic systems show enhanced stability because of their very stable π electron arrangement.
- 3) *Kinetic control* means the major product will be the one that is most stable.
- 4) Pyridine is a stronger base than pyrrole.
- 5) In organic chemistry, *Heterocyclic* refers to a ring structure with at least one ring atom other than Carbon.
- 6) The Woodward-Hoffmann rules describe the *allowed* and *forbidden* HOMO/LUMO interactions which control pericyclic reactions.
- 7) [2+2] Pericyclic cycloadditions are thermally forbidden.
- 8) The Sulfonic acid group ($-\text{SO}_3\text{H}$) is a deactivating, meta directing substituent for EAS reactions.
- 9) LUMO means *highest occupied molecular orbital*.
- 10) Cyclohexa-1,3-diene is more stable than cyclohexa-1,4-diene.

- 11) Draw *Ethoxycyclopentane* in line angle (*stick figure*) form. (2pts)

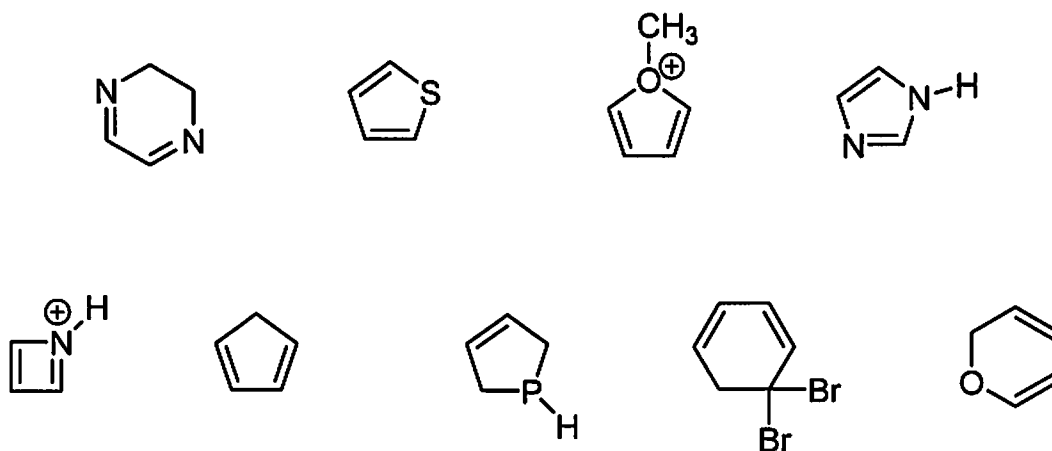
12) (2+4=6pts) For the following bromination which produces both the 1,2 and 1,4-addition products:



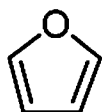
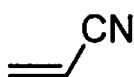
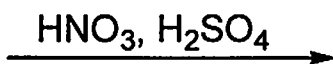
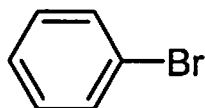
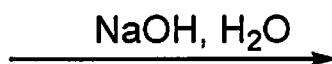
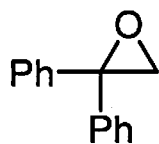
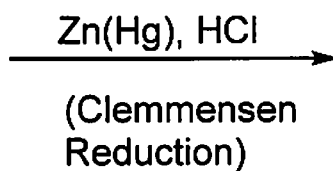
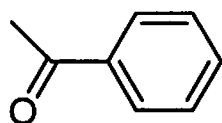
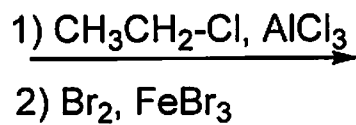
i) Label the 1,2 and 1,4-addition products.

ii) Provide the mechanism (*i.e. draw curly arrows and intermediates*).

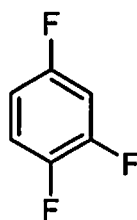
13) Indicate which of the following molecules are aromatic, non-aromatic or anti-aromatic. (Assume all the species are planar). (9pts)



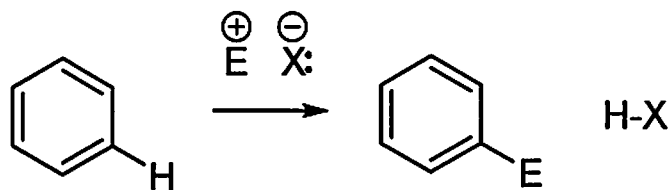
14) Predict the major products in the following reactions (if you believe **no reaction** will occur, indicate this!), paying attention to regio/stereo-chemistry where applicable. (5x2=10pts)



15) (2pts) Name in **IUPAC** terms the following molecule.

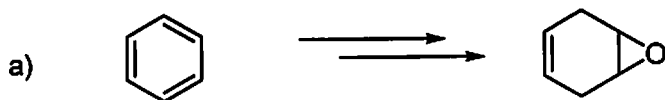


16) Write the mechanism (i.e. curly arrows) for the following generic Electrophilic Aromatic Substitution. (You do *not* need to draw all the resonance structures of the intermediate sigma complex). (4pts)

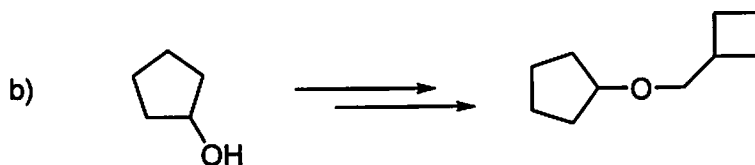


17) Provide the reagents to achieve **either** of the following transformations. (2pts)

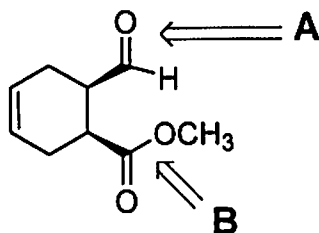
EITHER



OR



18) (1+1+1+2=5pts). The following product was produced in a [4+2] cycloaddition reaction.



- How many π bonds are in this molecule?
- What is the functional group at A?
- What is the functional group at B?
- If the diene used in this Diels-Alder reaction was *buta-1,3-diene*, draw the structure of the dienophile.

****BONUS Points (up to 2 points)****

Diels and Alder won the 1950 Nobel Prize in Chemistry for their pericyclic cycloaddition reaction. Match (with a line) their first to their last names.

Alisson

Otto

Trent

Virgil

Joel

Andy

Kurt

Jordan

Gini

Fabinho

Sadio

Bobby

Mohamed

Diels

Alder

hydrogen 1 H 1.0079	beryllium 4 Be 9.0122	lithium 3 Li 6.941	sodium 11 Na 22.990	magnesium 12 Mg 24.305	potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	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																										
							yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	niobium 41 Nb 92.906	technetium 43 Tc 98	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	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																										
							barium 56 Ba 137.33	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	mercury 75 Hg 200.59	osmium 76 Os 190.73	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	vanadium 23 V 50.942	chromium 24 Cr 51.996	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selecnium 34 Se 78.96	bromine 35 Br 79.904	argon 18 Ar 39.948															
							lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm 144.91	samarium 62 Sm 150.35	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	erbium 66 Er 167.26	thulium 67 Tm 168.93	ytterbium 70 Yb 173.04	cesium 55 Cs 132.91	barium 56 Ba 137.33	lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm 144.91	samarium 62 Sm 150.35	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	erbium 66 Er 167.26	thulium 67 Tm 168.93	ytterbium 70 Yb 173.04	radium 86 Ra 226	actinium 87 Ac 227	francium 87 Fr 223	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np 237	plutonium 94 Pu 244	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

* 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 144.91	samarium 62 Sm 150.35	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	erbium 66 Er 167.26	thulium 67 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	plutonium 94 Pu 244	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

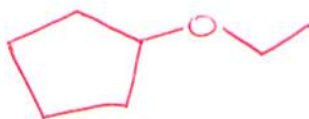
Summer 2019 Org II Exam 1 Chapters 14-17 (50 points)

Name: [4+2] = 6 (like LFC!)

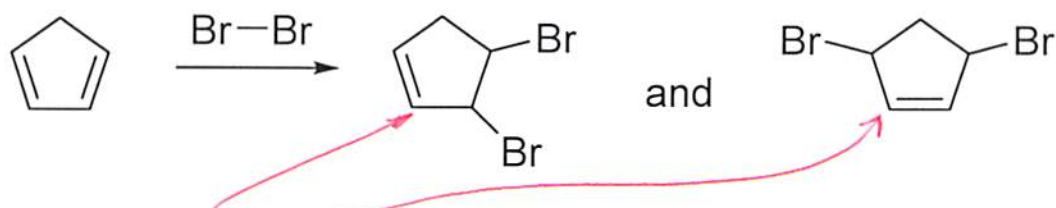
(1-10) are True/False. (10pts)

- 1) "Conjugation" means three or more, consecutive, aligned and interacting p orbitals. T
- 2) Aromatic systems show enhanced stability because of their very stable π electron arrangement. T
- 3) *Kinetic control* means the major product will be the one that is most stable. False
- 4) Pyridine is a stronger base than pyrrole. T
- 5) In organic chemistry, *Heterocyclic* refers to a ring structure with at least one ring atom other than Carbon. T
- 6) The Woodward-Hoffmann rules describe the *allowed* and *forbidden* HOMO/LUMO interactions which control pericyclic reactions. T
- 7) [2+2] Pericyclic cycloadditions are thermally forbidden. T
- 8) The Sulfonic acid group (-SO₃H) is a deactivating, meta directing substituent for EAS reactions. T
- 9) LUMO means *highest occupied molecular orbital*. False
- 10) Cyclohexa-1,3-diene is more stable than cyclohexa-1,4-diene. T

11) Draw *Ethoxycyclopentane* in line angle (*stick figure*) form. (2pts)

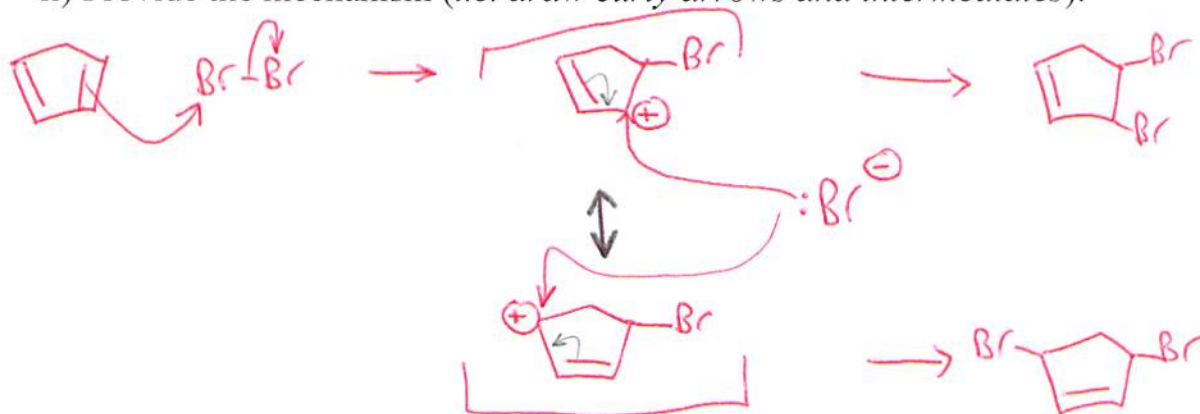


12) (2+4=6pts) For the following bromination which produces both the 1,2 and 1,4-addition products:

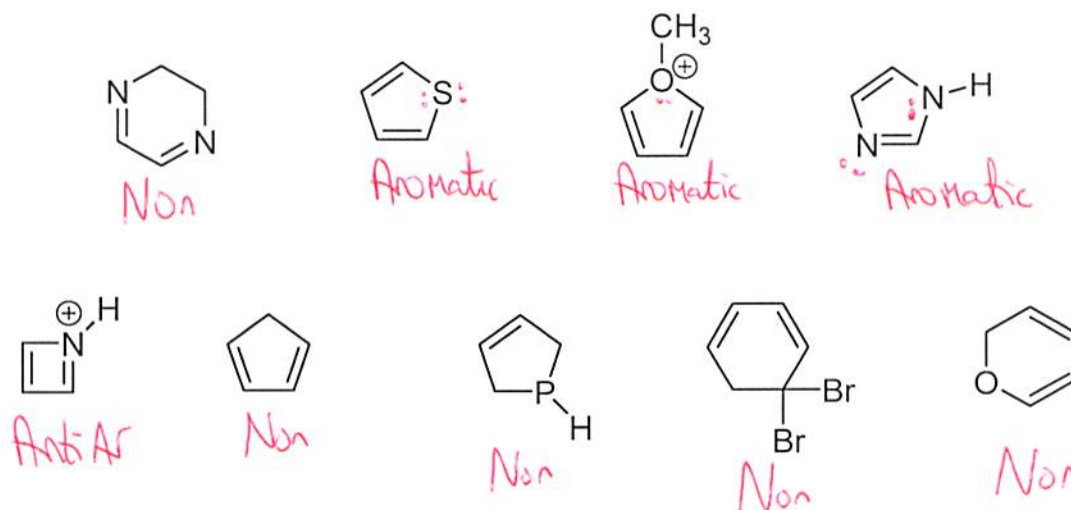


i) Label the 1,2 and 1,4-addition products.

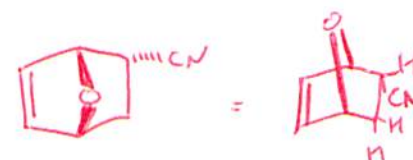
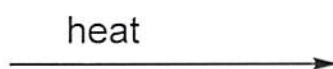
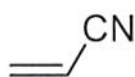
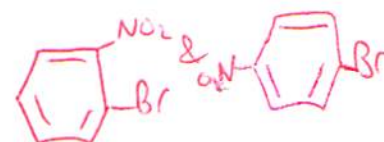
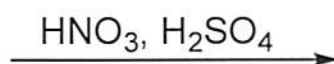
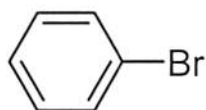
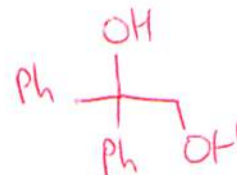
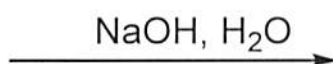
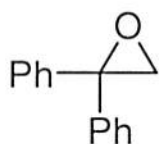
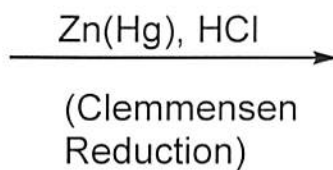
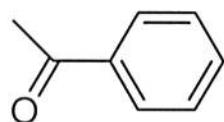
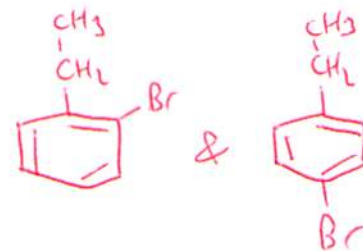
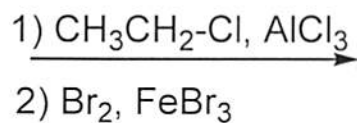
ii) Provide the mechanism (i.e. draw curly arrows and intermediates).



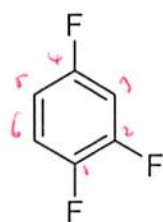
13) Indicate which of the following molecules are aromatic, non-aromatic or anti-aromatic. (Assume all the species are planar). (9pts)



14) Predict the major products in the following reactions (if you believe **no reaction** will occur, indicate this!), paying attention to regio/stereo-chemistry where applicable. (5x2=10pts)

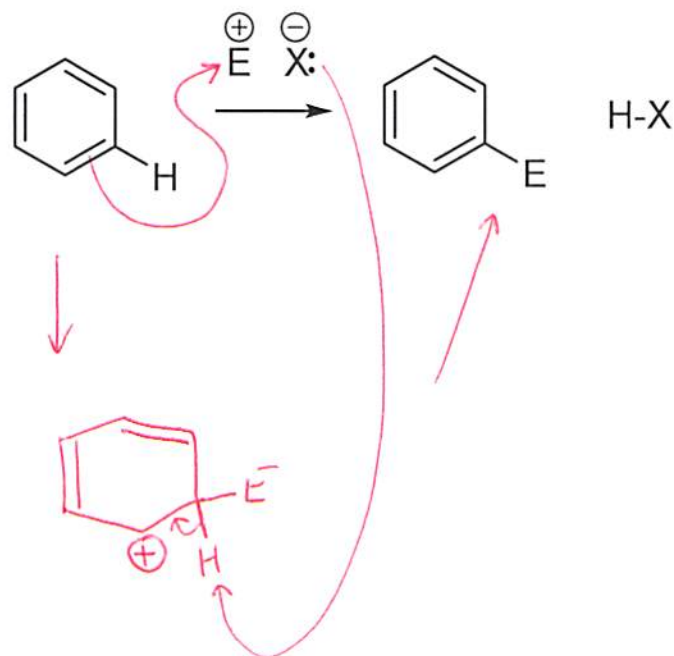


15) (2pts) Name in **IUPAC** terms the following molecule.



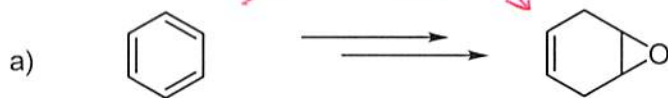
1,2,4-Trifluorobenzene.

16) Write the mechanism (i.e. curly arrows) for the following generic Electrophilic Aromatic Substitution. (You do **not** need to draw all the resonance structures of the intermediate sigma complex). (4pts)



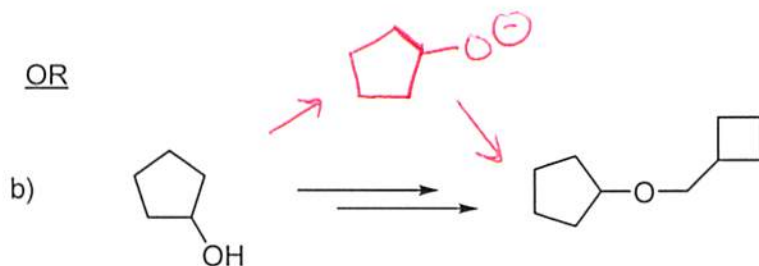
17) Provide the reagents to achieve **either** of the following transformations. (2pts)

EITHER



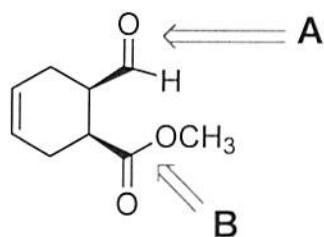
① Na, NH₃, CH₃CH₂OH
 ② m-CPBA

OR



① NaOH
 ② Br

18) (1+1+1+2=5pts). The following product was produced in a [4+2] cycloaddition reaction.

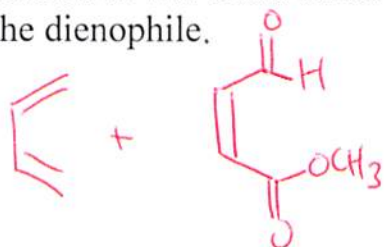


a) How many π bonds are in this molecule? 3

b) What is the functional group at A? Aldehyde

c) What is the functional group at B? Ester

d) If the diene used in this Diels-Alder reaction was *buta-1,3-diene*, draw the structure of the dienophile.



****BONUS Points (up to 2 points)****

Diels and Alder won the 1950 Nobel Prize in Chemistry for their pericyclic cycloaddition reaction. Match (with a line) their first to their last names.

Alisson

Otto

Trent

Virgil

Joel

Andy

Kurt

Jordan

Gini

Fabinho

Sadio

Bobby

Mohamed

Diels

Alder