

Write your recitation section number: _____ and TA name: _____

Sign the Honor Code pledge even though you've taken the quiz 😊

I pledge that on my honor, as a University of Colorado at Boulder student, I have neither given nor received unauthorized assistance on this exam.

Signature _____

General Instructions: There are 6 pages of questions plus this cover sheet. Be sure you have them all. Read each question carefully so that you know exactly what is being asked and what you need to write or draw. **DO NOT USE COLORED INK.** Your work on scratch pages will not be graded, so be sure everything you want graded is written on the exam itself.

1A 2A

3A 4A 5A 6A 7A 8A

hydrogen 1 H 1.0079																	helium 2 He 4.0026						
lithium 3 Li 6.941	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	neon 10 Ne 20.180
sodium 11 Na 22.990	magnesium 12 Mg 24.305																	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	argon 18 Ar 39.948
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	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80						
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	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	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29						
cesium 55 Cs 132.91	barium 56 Ba 137.33	* 57-70	lutetium 71 Lu 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]					
francium 87 Fr [223]	radium 88 Ra [226]	* * 89-102	lawrencium 103 Lr [262]	rutherfordium 104 Rf [261]	dubnium 105 Db [262]	seaborgium 106 Sg [263]	bohrium 107 Bh [264]	hassium 108 Hs [265]	meitnerium 109 Mt [268]	unnilium 110 Uun [271]	ununium 111 Uuu [272]	unbinium 112 Uub [277]	ununquadium 114 Uuq [289]										

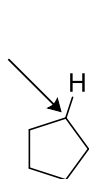
* Lanthanide series

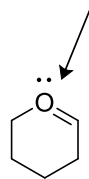
lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70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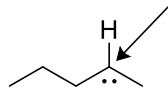
** Actinide series

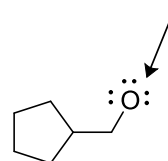
actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]
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- 1) Calculate the formal charge on the indicated atom in each structure. All necessary lone pairs and hydrogen atoms are drawn for you. Write your answers in the boxes under the structures. (8 pts)



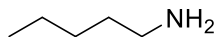


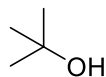


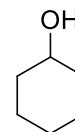


- 2) Classify each alkyl halide, alcohol, or amine as primary (1°), secondary (2°), or tertiary (3°). Write your answers in the boxes under the structures. (8 pts)

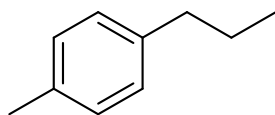




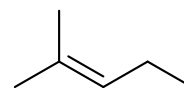




- 3) Indicate how many benzylic or allylic carbons there are in each structure by writing a number on the line below the structure. (4 pts)



___ benzylic carbons



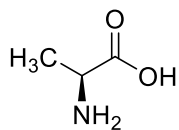
___ allylic carbons

4) Using the labels (A, B, C, etc.) from the list of functional groups provided, identify the functional groups present in each of the molecules. Some choices may be used more than once, and some may not be used. Write your answers (**letters only, no names**) in the box under each compound. Use only these labels (i.e. if a group appears that is not on the list, you do not need to include it). (20 pts)

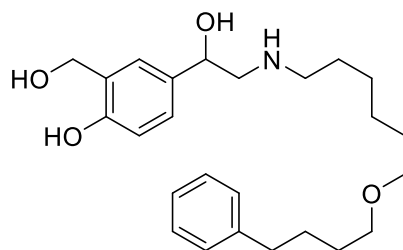
A Alkyne
B Alcohol
C Ether
D Epoxide
E Aldehyde

F Ketone
G Carboxylic acid
H Acid halide
I Anhydride
J Ester

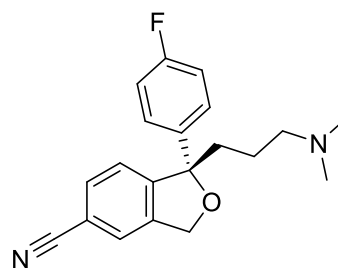
K Amide
L Amine
M Nitrile
N Alkene
O Aromatic



Alanine
 an amino acid



Salmeterol (Advair)
 Treats airway constriction



Escitalopram (Lexapro)
 Anti-depressant

- 5a) Draw the requested molecules in the boxes provided and circle the correct choice underneath each name to classify the compound. (8 pts)

1-bromo-2-isopropylcyclopentane

Classify this alkyl halide
(circle one):

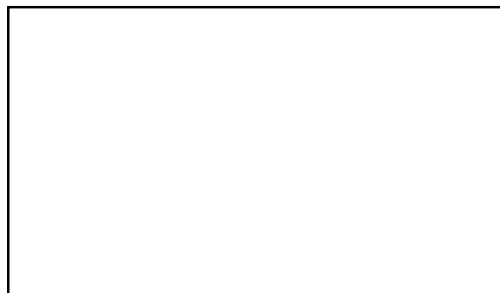
1° 2° 3°



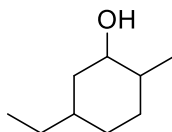
**3-methylpentan-3-ol
(3-methyl-3-pentanol)**

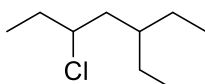
Classify this alcohol
(circle one):

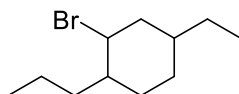
1° 2° 3°



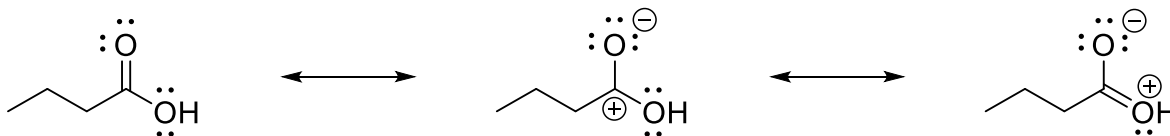
- 5b) Provide an acceptable IUPAC name for each of these compounds. (15 pts)



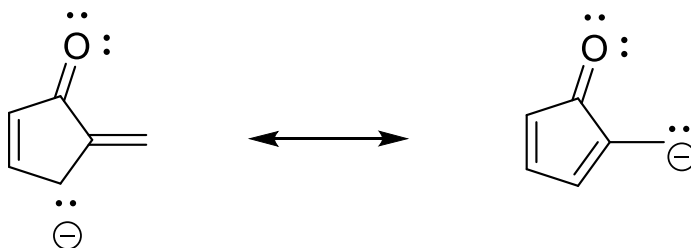




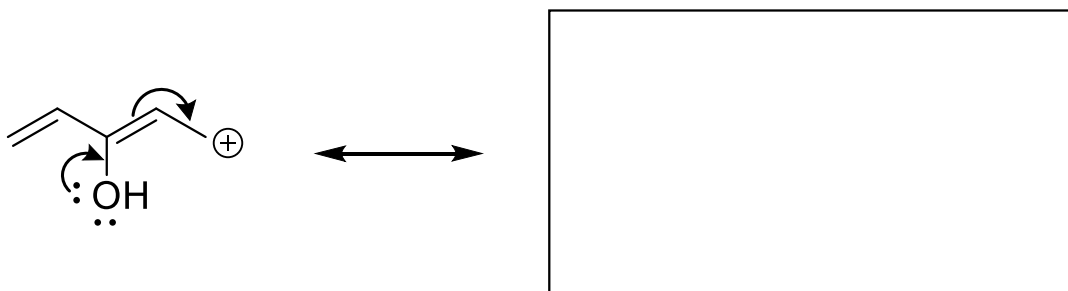
- 6a) Here is a set of resonance contributors. Put a circle around the major (most important) contributor. Put an X through the most minor (least important) contributor. (2 pts)



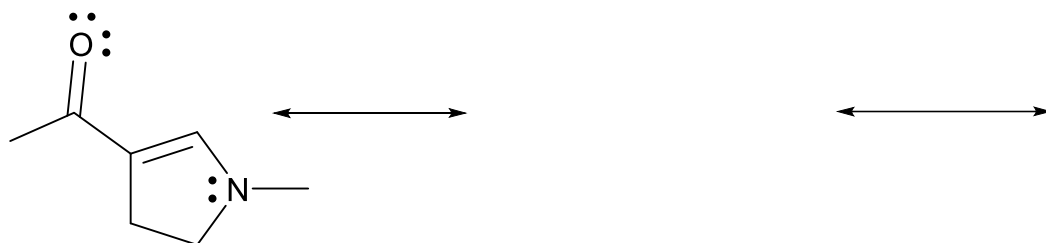
- 6b) Draw curved arrows on the first structure to show how you arrive at the other resonance contributor. (4 pts)



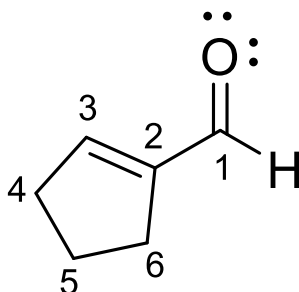
- 6c) Draw the resonance structure that is the result of the curved arrows shown. Include all lone pair electrons and nonzero formal charges in your structure. (4 pts)



- 7) Draw two additional *reasonable* resonance structures for the compound shown. Include in your drawings all necessary curved arrows, lone pair electrons and nonzero formal charges for full credit. (Be sure to draw curved arrows on the original structure to show how to get to your first new structure.) (14 pts)



- 8) Indicate the orbitals that are overlapping to create each of the indicated bonds according to valence bond theory. The carbon atoms are numbered for reference. (10 pts)



C1 – C2 σ : _____ on C1 and _____ on C2

C2 – C3 π : _____ on C2 and _____ on C3

C4 – H σ : _____ on C4 and _____ on H

C1 – O σ : _____ on C1 and _____ on O

C5 – C6 σ : _____ on C5 and _____ on C6

What are the valence orbitals on C2? List them on the line. (4 pts)
