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OpenCourseWare (2023)

CHEMISTRY II

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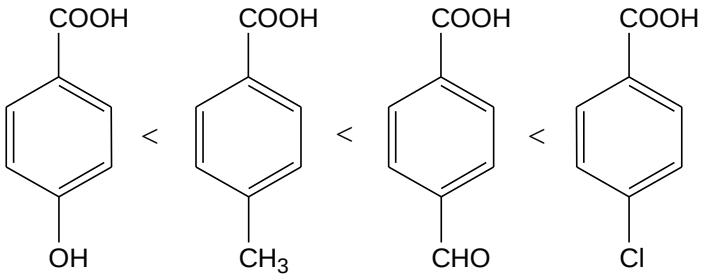
EVALUATION TEST 3

1. *(2 points)* Justify if the following statements are TRUE or FALSE. (Correct answers mark as **+ 0.4 points**).

A	The main products generated from the electrolysis of molten $CuBr_2$ are Cu and OH^-.

B	Crevice corrosion is favored in the metal region that has the lowest oxygen concentration.

C	S_N1 reaction presents an energy diagram with two transition states during which a carbocation intermediate is formed.

D	The effect that substituents have on acidity of the following *p*-substituted benzoic acids can be indicated as follows: 

E	The genetic code is the set of rules that link the RNA sequence to the encoded protein sequence.

2. *(1.5 points)* Given the following cell in basic medium (pH = 10):

$$Mn_2O_3(s) + Au^{3+}(ac) \rightarrow MnO_2(s) + Au(s)$$

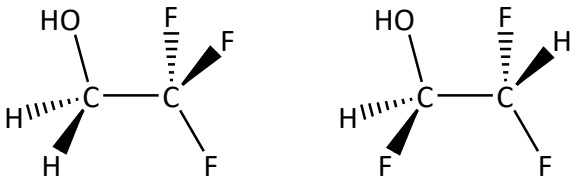
a) *(0.5 p)* Write the balanced oxidation and reduction half-reactions and the global reaction.

b) *(0.5 p)* Determine the standard potential at 25 °C if [Au^{3+}] = 0.1 M, and indicate if the reaction is spontaneous or not under these conditions.

c) *(0.5 p)* Determine the amount of metal deposited on the cathode if the charge which passes is 85000 C.

Data: $E^0(Au^{3+}/Au)$ = 1.470 V; $E^0(MnO_2/Mn_2O_3)$ = 0.118 V; F = 96500 C mol^{-1}; R = 8.314 J mol^{-1} K^{-1}; M(Au) = 197.0 g mol^{-1}.

3. *(1.75 points)* In the next figure, you may find the 3D structural formulas of compounds CF_3–CH_2(OH) and CF_2H–CH(OH)F. (Hint: group the O and H atoms in a single group)



CF_3-CH_2(OH) CF_2H-CH(OH)F

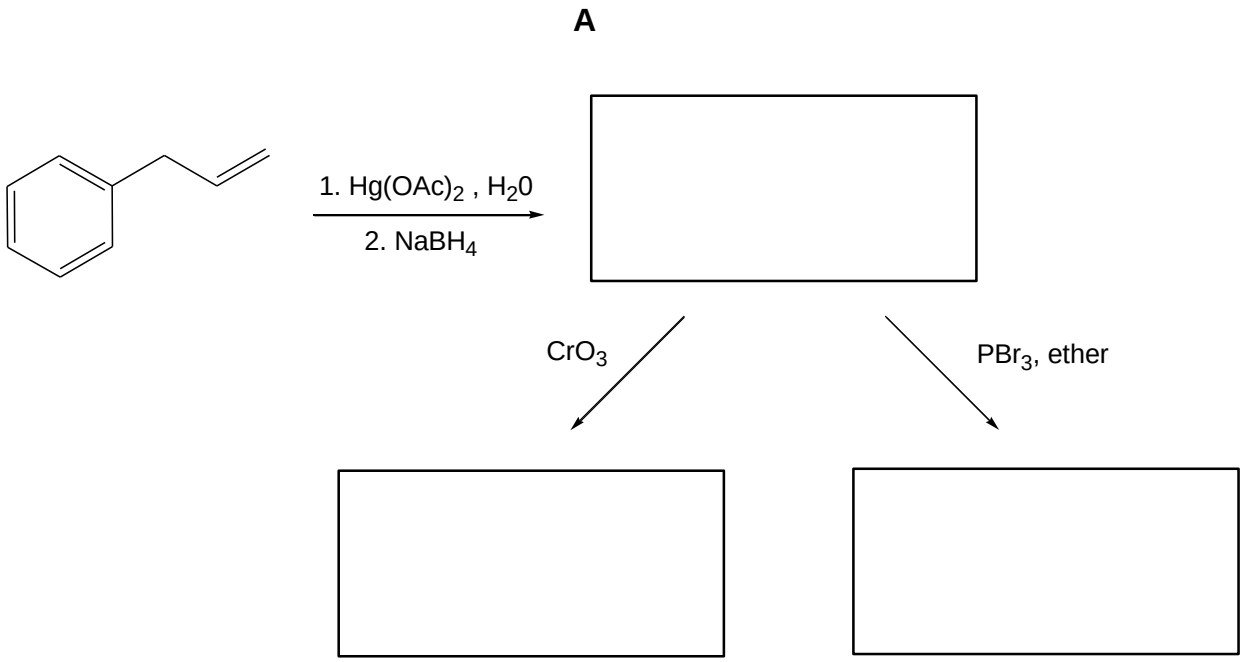
a) *(0.75 p)* Draw the Newman projections of both molecules along C-C axis and schematically draw the variation of the potential energy as a function of rotation angle in 60° steps. Assume that the main substituents (–OH and –F) have the same size.

b) *(0.5 p)* Explain the main differences between both molecules regarding their energy diagrams.

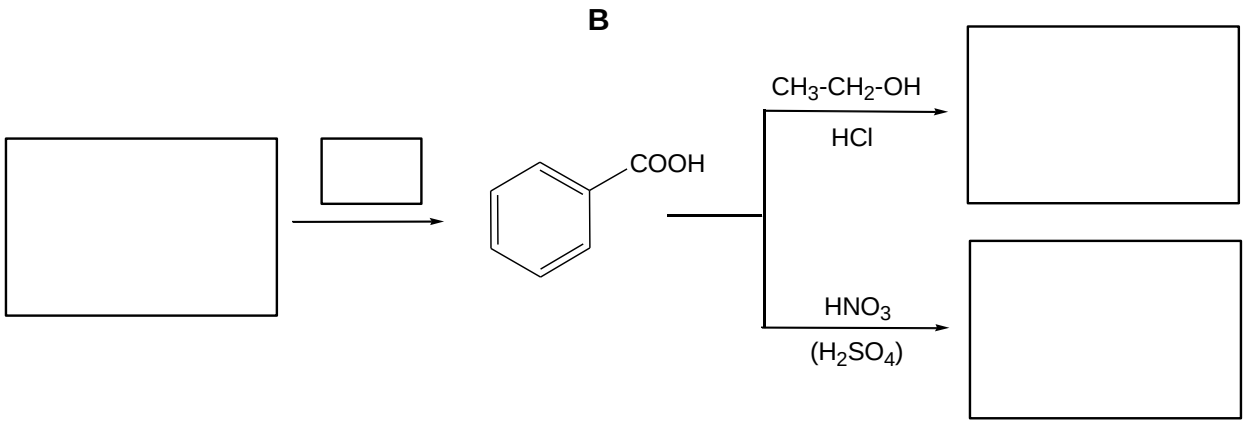
c) *(0.5 p)* Assign *R* or *S* configuration to the chiral carbon.

4. *(2.25 points)* Complete the following schemes. Each box corresponds to one compound.

a) *(0.75 p)*

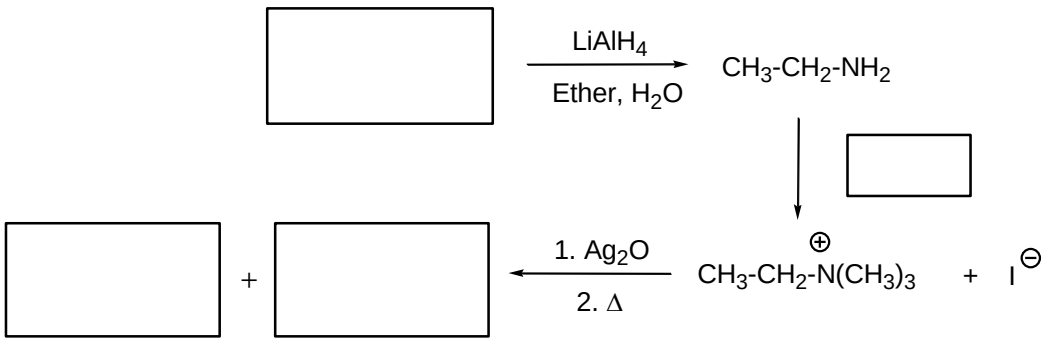


b) *(0.75 p)*



c) *(0.75 p)*

C



5. *(1.5 points)* A compound with the formula $C_{10}H_{12}O$ shows large intensity infrared absorption peak at around 1710 cm^{-1} and exhibits the following ^{1}H NMR spectrum:

CHEMICAL SHIFT (δ in ppm)	SPLITTING PATTERN	NUMBER OF HYDROGENS
2.09	Singlet	3 H
2.78	Triplet	2 H
2.83	Triplet	2 H
7.08	Triplet	1 H
7.12	Doublet	2 H
7.21	Triplet	2 H

a) *(1 p)* Deduce its structure.

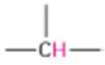
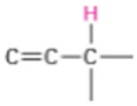
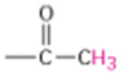
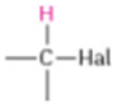
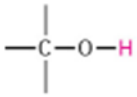
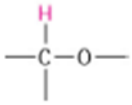
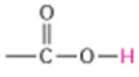
b) *(0.5 p)* Name the compound and number in the structure the carbons which will have resonance line in its ^{13}C NMR spectrum.

6. *(1 point)* Answer, briefly, the following questions:

a) What can reduce the effect of a competitive inhibitor of an enzyme?
b) According to the Michaelis-Menten model, at which reaction rate does K_m equal the substrate concentration?
c) In a cyclized monosaccharide, how is the most oxidized chiral carbon named?
d) Indicate two factors that will influence the melting point of lipids and how that influence will be.
e) How could denaturation of a protein take place?

ANNEX

Chemical Shifts in ^1H NMR

Type of hydrogen		Chemical shift (δ)
Reference	$Si(CH_3)_4$	0
Alkyl (primary)	$-CH_3$	0.7–1.3
Alkyl (secondary)	$-CH_2-$	1.2–1.6
Alkyl (tertiary)		1.4–1.8
Allylic		1.6–2.2
Methyl ketone		2.0–2.4
Aromatic methyl	Ar–CH_3	2.4–2.7
Alkynyl	$-C\equiv C-H$	2.5–3.0
Alkyl halide		2.5–4.0
Alcohol		2.5–5.0
Alcohol, ether		3.3–4.5
Vinylic		4.5–6.5
Aryl	Ar–H	6.5–8.0
Aldehyde		9.7–10.0
Carboxylic acid		11.0–12.0

Characteristic IR bands of some common functional groups:

Functional Group		Absorption (cm^{-1})	Intensity
Alkane	C–H	2850–2960	Medium
Alkene	=C–H	3020–3100	Medium
	C=C	1640–1680	Medium
Alkyne	≡C–H	3300	Strong
	C≡C	2100–2260	Medium
Alkyl halide	C–Cl	600–800	Strong
	C–Br	500–600	Strong
Alcohol	O–H	3400–3650	Strong, broad
	C–O	1050–1150	Strong
Arene	C–H	3030	Weak
Aromatic ring		1660–2000	Weak
		1450–1600	Medium
Amine	N–H	3300–3500	Medium
	C–N	1030–1230	Medium
Carbonyl compound	C=O	1670–1780	Strong
	Aldehyde	1730	Strong
	Ketone	1715	Strong
	Ester	1735	Strong
	Amide	1690	Strong
	Carboxylic acid	1710	Strong

IMAGE CREDITS

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