

Chemistry 130, Midterm Exam 1

Instructor: Bergdahl

Spring 2019

Name: _____

Be prepared to show ID upon request.

****Any use of any electronic devices is prohibited during the test** ****

Be prepared to show ID upon request.

My student I.D. (red I.D.) number is:

Good Luck!!

Part A. 1-25 Questions. Each correct answer is 3 points. (Part 1 max 75 points)

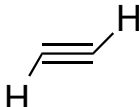
1) What is the electron configuration of negatively charged carbon atom?

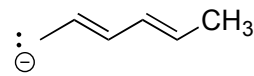
- A) $1s^2 2s^2 2p^2$
- B) $1s^2 2s^2 2p^3$
- C) $1s^2 2s^2 2p^4$
- D) $1s^2 2s^2 2p^5$

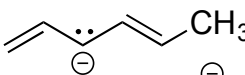
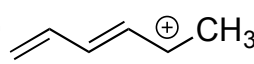
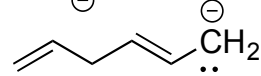
2) Which of the following bonds is ionic?

- A) C—F
- B) Li—F
- C) H—H
- D) C—H

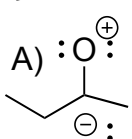
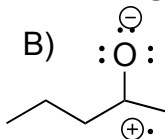
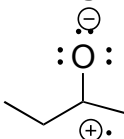
3) Which representation of ethyne (HCCH) is correct.

- A) $H \equiv H$ B)  C) $H \blacktriangleright \equiv \cdots H$ D) $H = = H$

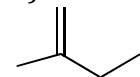
4) Which of the following structures is a valid resonance structure of 

- A)  B) 
 C) 

5) Which of the following contributing resonance structures of butanone is more stable

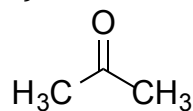
- A)  B)  C) 

6) The double bond in butene is formed from the overlap of what orbitals



- A) C sp^2 orbital overlapping with a C sp^2 orbital; and a C P orbital overlapping with an C P orbital.
- B) C sp^2 orbital overlapping with a C sp^2 orbital
- C) a C p orbital overlapping with an C p orbital.
- D) a C s orbital overlapping with an C s orbital.

7) The Carbon-Hydrogen bonds in acetone are made up of



- A) C sp^2 orbital overlapping with a O sp^2 orbital; and a C P orbital overlapping with an O P orbital.
- B) C sp^3 orbital overlapping with a H s orbital
- C) a C p orbital overlapping with an H p orbital.
- D) a C s orbital overlapping with an C s orbital.

8) Which of the following is the weakest Acid

- A) CH_4 B) H_2O C) NaH D) HI

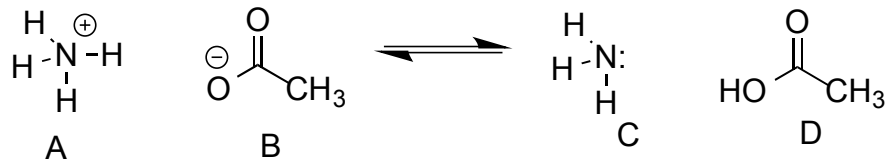
9) Which of the following is the strongest base

- A) NaOH B) $-\text{CH}_3$ C) Cl^- D) HCl

10) The higher the pK_a the _____ the Acid

- A) Weaker B) Stronger C) Lower pH D) higher pH

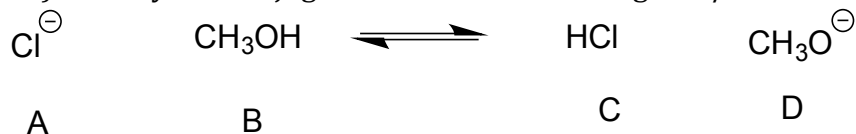
11) Identify the conjugate acid in the following acid Base reaction



12) The reaction in question 11 will have a k_{eq} of

- A) 1
- B) Greater than 1
- C) Less than 1

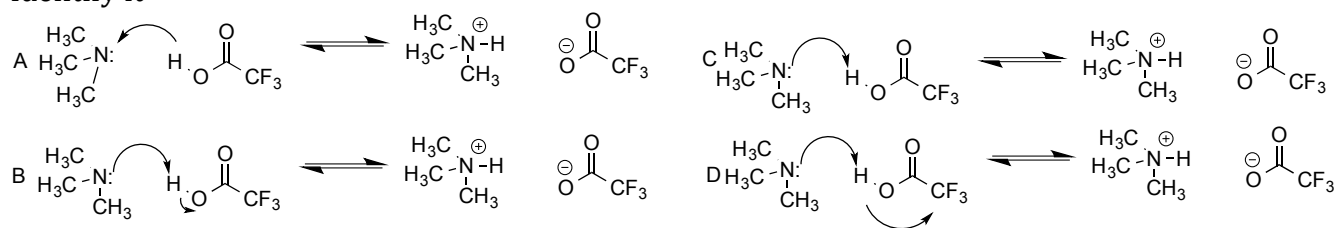
13) Identify the conjugate base in the following acid/base reaction



14) The reaction in question 20 will have a k_{eq} of

- A) 1
- B) Greater than 1
- C) Less than 1

15) Only one of the mechanisms of the below acid base reaction has the correct arrow pushing. Identify it



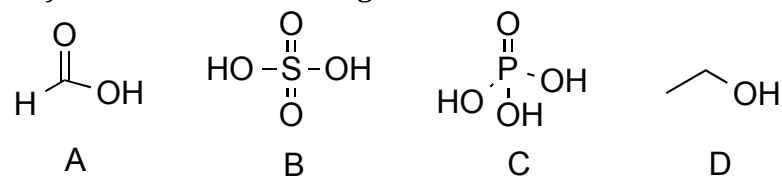
16) Why does HI have a pKa of -9 while HCl has a pKa of -7.

- A) More resonance
- B) I is more electronegative
- C) The inductive effect
- D) I has a larger atomic radius than Cl.

17) How many times more acidic is HI?

- A) 2 fold
- B) 10 fold
- C) 100 fold
- D) 1000 fold

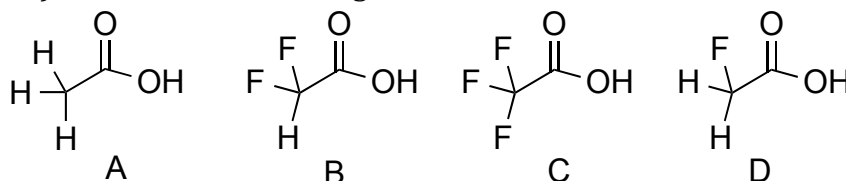
18) Which of the following is least acidic.



19) Your answer is least acidic because

- A) The conjugate base has no resonance stabilization
- B) The conjugate base is destabilized by the inductive effect
- C) The conjugate base is destabilized because the negative charge is on a more electronegative atom.
- D) The conjugate base is destabilized because there are more possible resonance structures, with one that contributes much more than the others to the hybrid.

20) Which of the following is most acidic.



21) Your answer is more acidic because

- A) The conjugate base is stabilized because there are more resonance structures that contribute substantially. Thus the negative charge is spread out more
- B) The conjugate base is most stabilized by the inductive effect
- C) The conjugate base is stabilized because the negative charge is on a more electronegative atom.
- D) A&B

22) Which of the following is more acidic.

- A) CH4
- B) CH3F
- C) CF3OH
- D) CH3OH

23) Your answer is more acidic because

- A) The conjugate base is stabilized because there are more resonance structures that contribute substantially. Thus the negative charge is spread out more
- B) The conjugate base is stabilized by the inductive effect
- C) The conjugate base is stabilized because the negative charge is on a more electronegative atom.
- D) B&C

24) A Linear alkane with 5 carbons is

- A) Hexane
- B) Pentane
- C) Propane
- D) Heptane

25) Constitutional isomers are

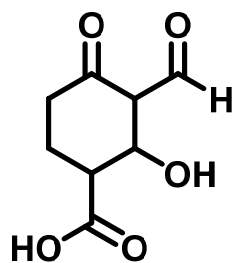
- A) Molecules with the same molecular formula and the same connectivity but a different spatial arrangement of atoms in three-dimensional space
- B) Molecules with the same connectivity but a different molecular formula
- C) Molecules with the same molecular formula but different connectivity of the atoms
- D) Molecules that have identical chemical properties

Part B. Short answer questions, 26-32, each problem is worth 5-10 points (total 61 points)

Problem 26. Draw the Lewis structure for Li_2CO_3 . Which bonds are ionic or covalent? (10p)

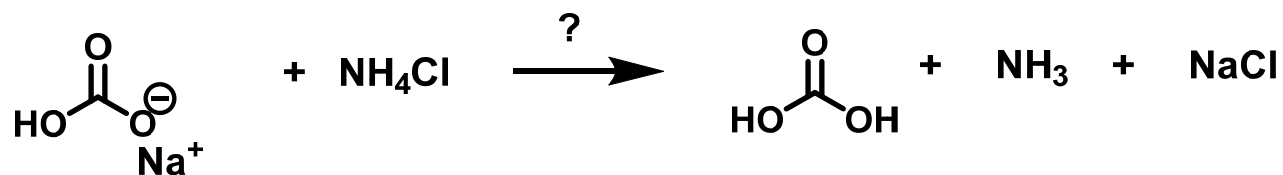
Problem 27. Draw the Lewis structure for TWO compounds with the molecular formula $\text{C}_7\text{H}_{17}\text{N}$, one tertiary amine and one primary amine. (10p)

Problem 28. Identify the functional groups in the following molecule: (8p)



Problem 29. Draw the relevant resonance structures for carbonmonoxide, CO. (8p)

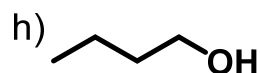
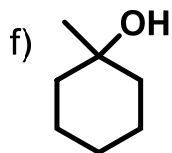
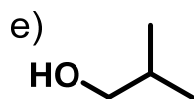
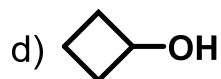
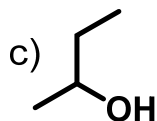
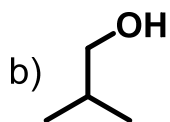
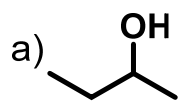
Problem 30. Predict if the following acid-base reaction favorable or unfavorable as indicated.
Justification is (One sentence max) (10p)



Problem 31. Draw a line-angle structure for the following condensed structural formula. (5p)
 $\text{CH}_3(\text{CH}_2)_3\text{CH}(\text{CH}_2\text{CH}_3)(\text{CH}_2)_6\text{CH}(\text{CH}_3)_2$

Problem 32. Which of the structural formulas below represent,

- A) The same compound
- B) Different compounds that are constitutional isomers
- C) Different compounds that are NOT constitutional isomers



PERIODIC TABLE OF THE ELEMENTS

		PERIODIC TABLE OF THE ELEMENTS																																		
PERIOD	GROUP																			18																
		1																	2																	
	1	1.008																	2.0026																	
		H																	He																	
		HYDROGEN																	HELIUM																	
		2																																		
		3	6.94	4	9.0122																															
	2	Li	Be																																	
	LITHIUM	BERYLLIUM																																		
	11	22.990	12	24.305																																
3	Na	Mg																																		
	SODIUM	MAGNESIUM																																		
	19	39.098	20	40.078	21	44.956	22	47.867	23	50.942	24	51.996	25	54.938	26	55.845	27	58.933	28	58.969	29	63.546	30	65.38	31	69.723	32	72.64	33	74.922	34	78.971	35	79.904	36	83.798
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr																		
	POTASSIUM	CALCIUM	SCANDIUM	TITANIUM	VANADIUM	CHROMIUM	MANGANESE	IRON	COBALT	NICKEL	COPPER	ZINC	GALLIUM	GERMANIUM	ARSENIC	SELENIUM	BROMINE	KRYPTON																		
	37	85.468	38	87.62	39	88.906	40	91.224	41	92.906	42	95.95	43	(98)	44	101.07	45	102.91	46	106.42	47	107.87	48	112.41	49	114.82	50	118.71	51	121.76	52	127.60	53	126.90	54	131.29
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe																		
	RUBIDIUM	STRONTIUM	YTRITIUM	ZIRCONIUM	NIOBIUM	MOLYBDENUM	TECHNETIUM	RUTHENIUM	RHODIUM	PALLADIUM	SILVER	CADMIUM	INDIUM	TIN	ANTIMONY	TELLURIUM	IODINE	XENON																		
	55	132.91	56	137.33	57-71	72	178.49	73	180.95	74	183.84	75	186.21	76	190.23	77	192.22	78	195.08	79	196.97	80	200.59	81	204.38	82	207.2	83	208.98	84	(209)	85	(210)	86	(222)	
6	Cs	Ba	La-Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn																		
	CAESIUM	BARIUM	Lanthanide	HAFNIUM	TANTALUM	TUNGSTEN	RENIUM	OSMIUM	IRIDIUM	PLATINUM	GOLD	MERCURY	THALLIUM	LEAD	BISMUTH	POLONIUM	ASTATINE	RADON																		
	87	(223)	88	(226)	89-103	104	(267)	105	(268)	106	(271)	107	(272)	108	(277)	109	(276)	110	(281)	111	(280)	112	(285)	113	(...)	114	(287)	115	(...)	116	(291)	117	(...)	118	(...)	
7	Fr	Ra	Ac-Lr	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Lv	Uus	Uuo																		
	FRANCIUM	RADIUM	Actinide	RUTHERFORDIUM	DUBNIUM	SEABORGIUM	BOHRNIUM	HASSIUM	MEITNERIUM	DARISTENIUM	ROENTGENIUM	COPERNICIUM	UNUNTRIUM	FLEROVIUM	UNUNPENTIUM	LIVERMORIUM	UNUNSEPTIUM	UNUNOCTIUM																		

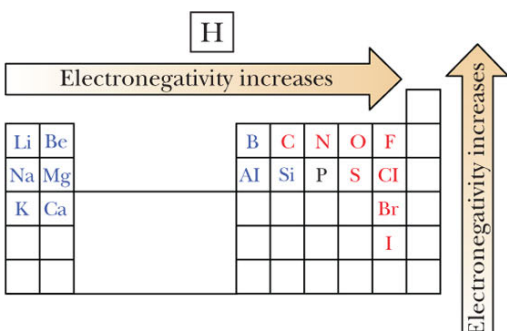


(1) Pure Appl. Chem., 88, 265-291 (2016)

LANTHANIDE															
57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	
LANTHANUM	CERUM	PRASEODYMIUM	NEODYMIUM	PROMETHIUM	SAMARIUM	EUROPIUM	GADOLINIUM	TERBIUM	DYSPROSIUM	HOLMIUM	ERBIUM	THULIUM	YTTTERBIUM	LUTETIUM	
ACTINIDE															
89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr	
ACTINIUM	THORIUM	PROTACTINIUM	URANIUM	NEPTUNIUM	PLUTONIUM	AMERICIUM	CURIUM	BERKELIUM	CALIFORNIUM	EINSTEINIUM	FERMIUM	MENDELEVIUM	NOBELIUM	LAWRENCIUM	

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TABLE 1.4 Electronegativity Values and Trends for Some Atoms (Pauling Scale)



1A	2A											3A	4A	5A	6A	7A
Li 1.0	Be 1.5											B 2.0	C 2.5	N 3.0	O 3.5	F 4.0
Na 0.9	Mg 1.2											Al 1.5	Si 1.8	P 2.1	S 2.5	Cl 3.0
K 0.8	Ca 1.0	Sc 1.3	Ti 1.5	V 1.6	Cr 1.6	Mn 1.5	Fe 1.8	Co 1.8	Ni 1.8	Cu 1.9	Zn 1.6	Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8
Rb 0.8	Sr 1.0	Y 1.2	Zr 1.4	Nb 1.6	Mo 1.8	Tc 1.9	Ru 2.2	Rh 2.2	Pd 2.2	Ag 1.9	Cd 1.7	In 1.7	Sn 1.8	Sb 1.9	Te 2.1	I 2.5
Cs 0.7	Ba 0.9	La 1.1	Hf 1.3	Ta 1.5	W 1.7	Re 1.9	Os 2.2	Ir 2.2	Pt 2.2	Au 2.4	Hg 1.9	Tl 1.8	Pb 1.8	Bi 1.9	Po 2.0	At 2.2

<1.0
1.5 – 1.9
2.5 – 2.9
1.0 – 1.4
2.0 – 2.4
3.0 – 4.0

TABLE 2.2 pK_a Values for Some Organic and Inorganic Acids

	Acid	Formula	pK_a	Conjugate Base	
<div> <div>the weaker the acid, the stronger is its conjugate base</div> <div> <div>Weaker acid</div> <div>↓</div> <div>Stronger acid</div> </div> </div>	ethane	CH_3CH_3	51	$CH_3CH_2^-$	<div> <div>Stronger base</div> <div>↑</div> <div>Weaker base</div> </div>
	ammonia	NH_3	38	NH_2^-	
	ethanol	CH_3CH_2OH	15.9	$CH_3CH_2O^-$	
	water	H_2O	15.7	HO^-	
	methylammonium ion	$CH_3NH_3^+$	10.64	CH_3NH_2	
	bicarbonate ion	HCO_3^-	10.33	CO_3^{2-}	
	phenol	C_6H_5OH	9.95	$C_6H_5O^-$	
	ammonium ion	NH_4^+	9.24	NH_3	
	hydrogen cyanide	HCN	9.21	CN^-	
	carbonic acid	H_2CO_3	6.36	HCO_3^-	
	acetic acid	CH_3COOH	4.76	CH_3COO^-	
	benzoic acid	C_6H_5COOH	4.19	$C_6H_5COO^-$	
	phosphoric acid	H_3PO_4	2.1	$H_2PO_4^-$	
	hydronium ion	H_3O^+	-1.74	H_2O	
	sulfuric acid	H_2SO_4	-5.2	HSO_4^-	
	hydrogen chloride	HCl	-7	Cl^-	
	hydrogen bromide	HBr	-8	Br^-	
	hydrogen iodide	HI	-9	I^-	

the weaker the acid, the stronger is its conjugate base

the stronger the acid, the weaker is its conjugate base

Grading: **Part A _____/75 points**
 Part B _____/61 points
 Total _____/136 points
Adjusted _____/150 points