

Chemistry 130, Midterm Exam 3

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.

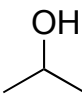
My student I.D. (red I.D.) number is:

Good Luck!!

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

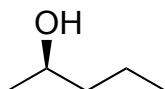
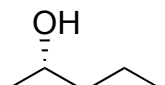
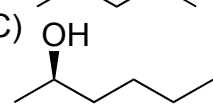
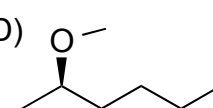
1) The oxygen in a hydroxyl group is ___ hybridized and has bond angles of ___

- A) sp , 180
- B) sp^3 , 109.5
- C) sp^2 , 120
- D) sp^3 , 120

2) The IUPAC name of  is:

- A) isopropanol
- B) 1-propanol
- C) 2-propanol
- D) 2-isopropanol

3) Which molecule below is *S*-2-pentanol

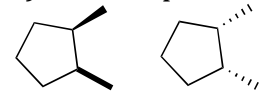
- A) 
- B) 
- C) 
- D) 

4) The compounds below are



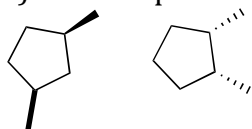
- A) Constitutional Isomers
- B) Enantiomers
- C) Diastereomers
- D) Geometric Isomers
- E) the same molecule

5) The compounds below are



- A) Constitutional Isomers
- B) Enantiomers
- C) Diastereomers
- D) Geometric Isomers
- E) the same molecule

6) The compounds below are



- A) Constitutional Isomers
- B) Enantiomers
- C) Diastereomers
- D) Geometric Isomers
- E) the same molecule

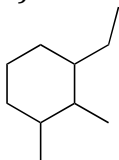
7) Enantiomers are

- A) Superposable mirror images
- B) Non-superposable mirror images
- C) Molecules that have the same connectivity but a different orientation of atoms in 3-dimensional space
- D) Molecules that have the same molecular formula but a different connectivity.

8) The physical properties of enantiomers are identical except for

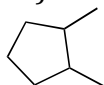
- A) Boiling point
- B) how they rotate light
- C) melting point
- D) polarity

9) How many possible stereoisomers does the compound below have?

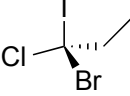


- A) 2
- B) 6
- C) 8
- D) 12

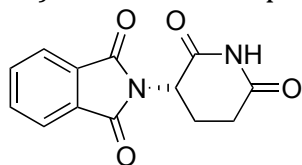
10) How many actual stereoisomers exist for the below molecule



- A) 4
- B) 3
- C) 2
- D) 1

- 11)  Is in the ____ configuration
 A) R
 B) S

- 12) The below compound is the ____ enantiomer of thalidomide

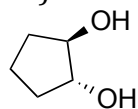


- A) R
 B) S
 C) E
 D) Z

- 13) enantiomers of drugs

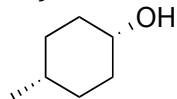
- A) behave the same
 B) behave like completely different drugs

- 14) The stereocenters in the below molecule are in the _____ configuration



- A) S,S
 B) R,R
 C) R,S
 D) S,R
 E) none of the above because molecule is not chiral

- 15) The stereocenters in the below molecule are in the _____ configuration

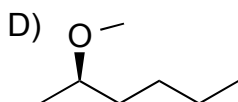
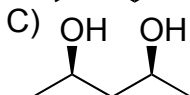
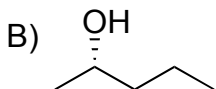
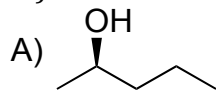


- A) S,S
 B) R,R
 C) R,S
 D) S,R
 E) none of the above because molecule is not chiral

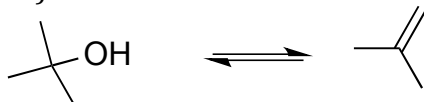
16) Alcohols have higher boiling points than comparably sized alkanes because:

- A) the lone pairs of electrons on the oxygens repel each other
- B) alcohols are more polar (But C is the major reason)
- C) alcohols form attractive H-bonding interactions with each other
- D) alcohols form more vanderwaal interactions

17) Which of the compounds below will have the highest boiling point



18) What conditions would be needed for the following transformation

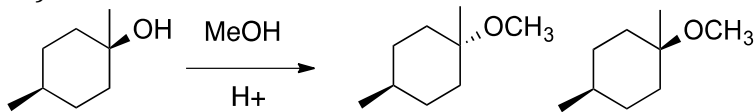


- A) HCl
- B) H₂SO₄/H₂O, Heat
- C) H₂SO₄/H₂O,
- D) HBr

19) How many steps are there in the mechanism of a SN1 nucleophilic displacement reaction?

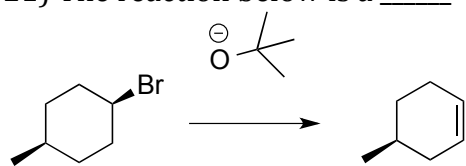
- A) 1
- B) 2
- C) 3
- D) 4

20) The reaction below is a _____



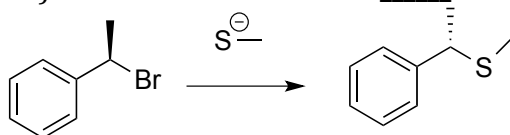
- A) SN1
- B) E1
- C) SN2
- D) E2

21) The reaction below is a _____



A) SN1 B) E1 C) SN2 D) E2

22) The reaction below is a _____

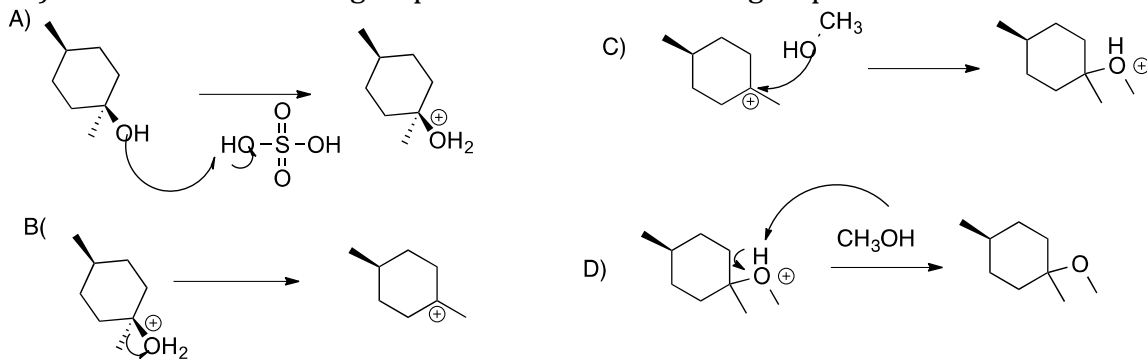


A) SN1 B) E1 C) SN2 D) E2

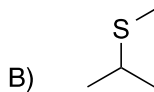
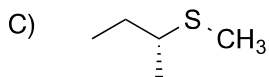
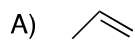
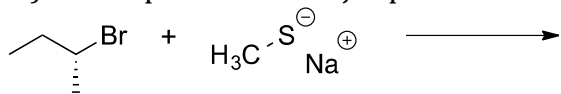
23) Which of the below is the worst leaving group

A) I⁻ B) Br⁻ C) Cl⁻ D) F⁻

24) Which of the following steps is the rate determining step of an SN1 reaction is



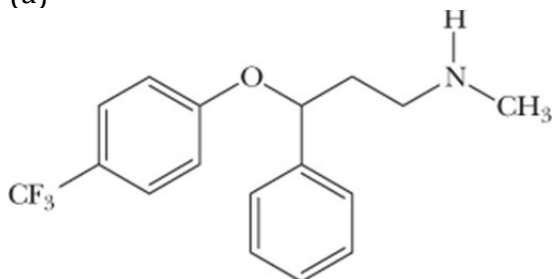
25) Please predict the major product form the below reaction



Part B. Short answer questions, 26-32, each problem is worth 5-12 points (total 61 points)

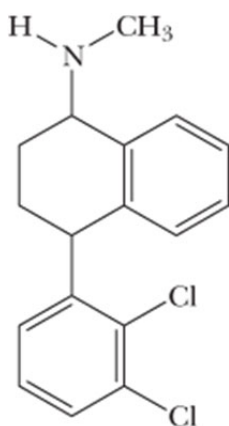
Problem 26. Following are structural formulas for three of the most widely prescribed drugs used to treat depression. Label all stereocenters in each compound and tell how many stereoisomers are possible for each compound. (9p)

(a)



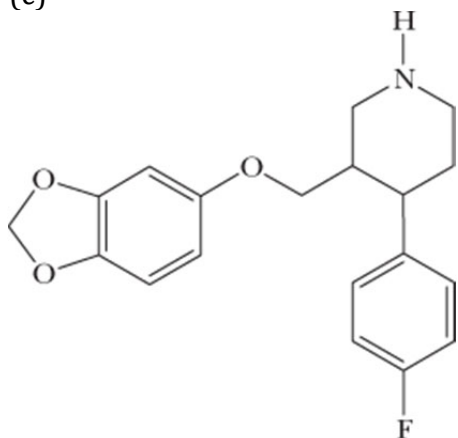
Fluoxetine
(Prozac®)

(b)



Sertraline
(Zoloft®)

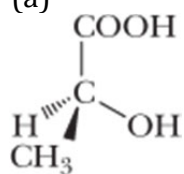
(c)



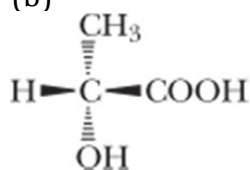
Paroxetine
(Paxil®)

Problem 27. (12p) Following are eight stereo representations of lactic acid. Take (a) as a reference structure. Which stereo representations are identical with (a) and which are mirror images of (a)?

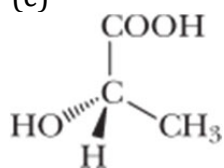
(a)



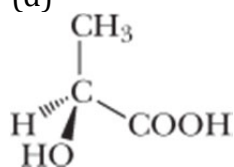
(b)



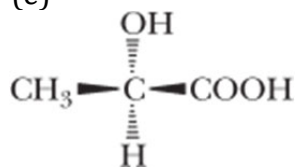
(c)



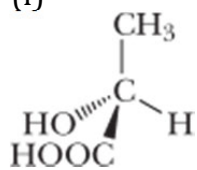
(d)



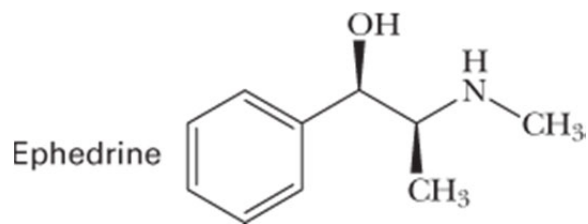
(e)



(f)



Problem 28. For centuries, Chinese herbal medicine has used extracts of *Ephedra sinica* to treat asthma. Investigation of this plant resulted in the isolation of ephedrine, a potent dilator of the air passages of the lungs. The naturally occurring stereoisomer is levorotatory and has the following structure.



Assign an R or S configuration to each stereocenter. (8p)

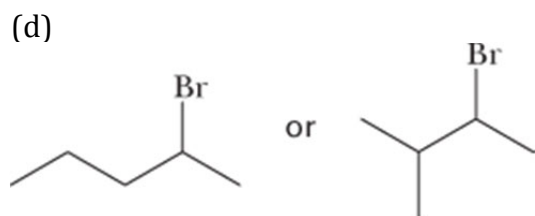
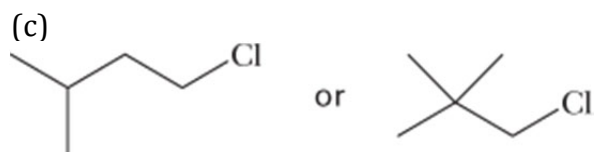
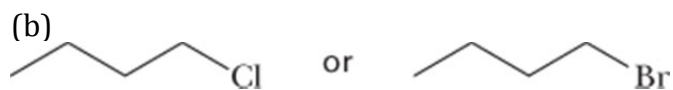
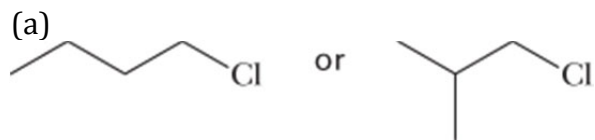
Problem 29. Draw a structural formula for each compound (given are IUPAC names). (6p)

(a) 3-Bromopropene

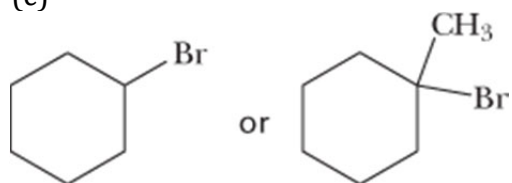
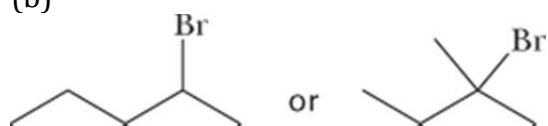
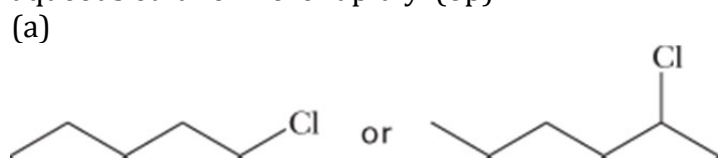
(b) (R)-2-Chloropentane

(c) meso-3,4-Dibromohexane

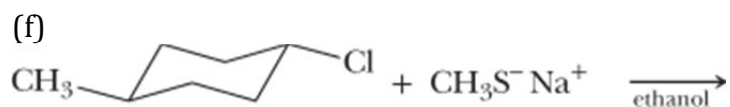
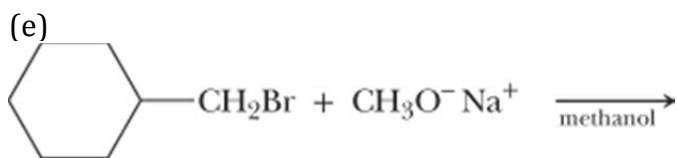
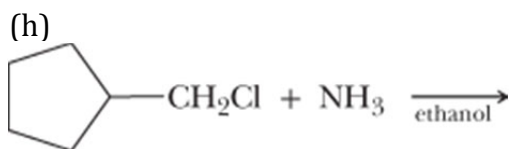
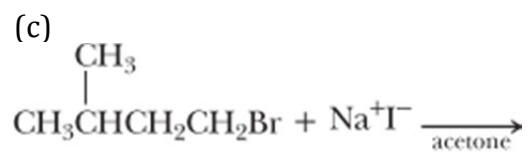
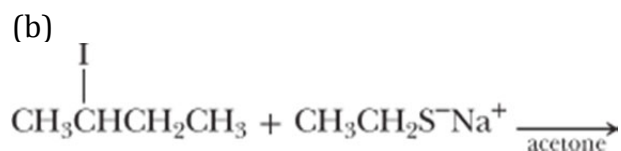
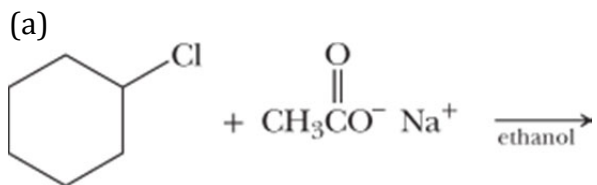
Problem 30. Select the member of each pair that shows the greater rate of S_N2 reaction with KI in acetone. (8p)



Problem 31. Select the member of each pair that undergoes nucleophilic substitution in aqueous ethanol more rapidly. (6p)



Problem 32. Complete these S_N2 reactions. (12p)



PERIODIC TABLE OF THE ELEMENTS

PERIOD	GROUP NUMBERS IUPAC RECOMMENDATION (1985)										GROUP NUMBERS CHEMICAL ABSTRACT SERVICE (1986)									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
1	1 H HYDROGEN											2 He HELIUM								
2	3 Li LITHIUM	4 Be BERYLLIUM											5 B BORON	6 C CARBON	7 N NITROGEN	8 O OXYGEN	9 F FLUORINE	10 Ne NEON		
3	11 Na SODIUM	12 Mg MAGNESIUM											13 Al ALUMINIUM	14 Si SILICON	15 P PHOSPHORUS	16 S SULPHUR	17 Cl CHLORINE	18 Ar ARGON		
4	19 K POTASSIUM	20 Ca CALCIUM	21 Sc SCANDIUM	22 Ti TITANIUM	23 V VANADIUM	24 Cr CHROMIUM	25 Mn MANGANESE	26 Fe IRON	27 Co COBALT	28 Ni NICKEL	29 Cu COPPER	30 Zn ZINC	31 Ga GALLIUM	32 Ge GERMANIUM	33 As ARSENIC	34 Se SELENIUM	35 Br BROMINE	36 Kr KRYPTON		
5	37 Rb RUBIDIUM	38 Sr STRONTIUM	39 Y YTTRIUM	40 Zr ZIRCONIUM	41 Nb NIOBIUM	42 Mo MOLYBDENUM	43 Tc TECHNETIUM	44 Ru RUTHENIUM	45 Rh RHODIUM	46 Pd PALLADIUM	47 Ag SILVER	48 Cd CADMIUM	49 In INDIUM	50 Sn TIN	51 Sb ANTIMONY	52 Te TELLURIUM	53 I IODINE	54 Xe XENON		
6	55 Cs CAESIUM	56 Ba BARIUM	57-71 La-Lu Lanthanide	72 Hf HAFNIUM	73 Ta TANTALUM	74 W TUNGSTEN	75 Re RHENIUM	76 Os OSMIUM	77 Ir IRIDIUM	78 Pt PLATINUM	79 Au GOLD	80 Hg MERCURY	81 Tl THALLIUM	82 Pb LEAD	83 Bi BISMUTH	84 (209) Po	85 (210) At	86 (222) Rn		
7	87 Fr FRANCIUM	88 (226) Ra	89-103 Ac-Lr Actinide	104 (267) Rf	105 (268) Db	106 (271) Sg	107 (272) Bh	108 (277) Hs	109 (276) Mt	110 (281) Ds	111 (280) Rg	112 (285) Cn	113 (...) Uut	114 (287) Fl	115 (...) Uup	116 (291) Lv	117 (...) Uus	118 (...) Uuo		

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

LANTHANIDE														
57 138.91 La LANTHANUM	58 140.12 Ce CERIUM	59 140.91 Pr PRASEODYMIUM	60 144.24 Nd NEODYMIUM	61 (145) Pm PROMETHIUM	62 150.36 Sm SAMARIUM	63 151.96 Eu EUROPIUM	64 157.25 Gd GADOLINIUM	65 158.93 Tb TERBIUM	66 162.50 Dy DYSPROSIUM	67 164.93 Ho HOLMIUM	68 167.26 Er ERBIUM	69 168.93 Tm THULIUM	70 173.05 Yb YTTERIUM	71 174.97 Lu LUTETIUM

ACTINIDE														
89 (227) Ac ACTINIUM	90 232.04 Th THORIUM	91 231.04 Pa PROTACTINIUM	92 238.03 U URANIUM	93 (237) Np NEPTUNIUM	94 (244) Pu PLUTONIUM	95 (243) Am AMERICIUM	96 (247) Cm CURIUM	97 (247) Bk BERKELIUM	98 (251) Cf CALIFORNIUM	99 (252) Es EINSTEINIUM	100 (257) Fm FERMIUM	101 (258) Md MENDELEVIUM	102 (259) No NOBELIUM	103 (262) Lr LAWRENCIUM

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	3B	4B	5B	6B	7B	8B					1B	2B	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	
Weaker acid Stronger acid	ethane	CH_3CH_3	51	$CH_3CH_2^-$	Stronger base Weaker base
	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