Please read the following before proceeding

1. The exam is divided into two parts.

   Part A is Scantron scored (with Extra credit 44 points)

   a. Bubble-in your GTID number correctly.
   b. Bubble-in the TEST FORM, located at the top of the page.

   Part B and C are free response (60 points)

   Exam 3 Total (104 points available)

2. Materials: Turn off cell phones and wireless PDA devices. Place all other materials on the floor. You will only need a pencil. Molecular models are optional.

2. Show your Buzz Card when you turn in your completed exam.

3. You must work alone.

4. This is a closed book exam. Give or take no assistance from other students. Recall the Georgia Tech Honor Code.

"I pledge my honor that I have not violated the Honor Code during this examination."

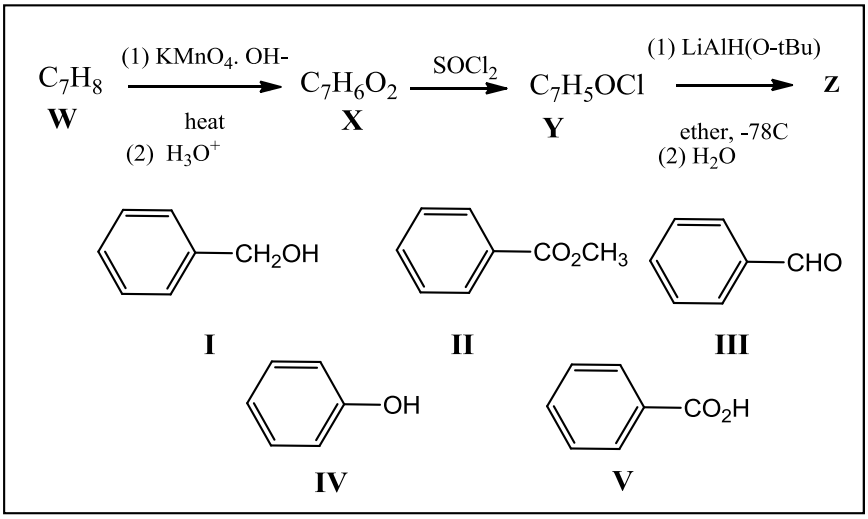
*Signed*_____

*****NOTE: Periodic and pKa tables are provided on the last page.*****

PART A – Scantron Scored

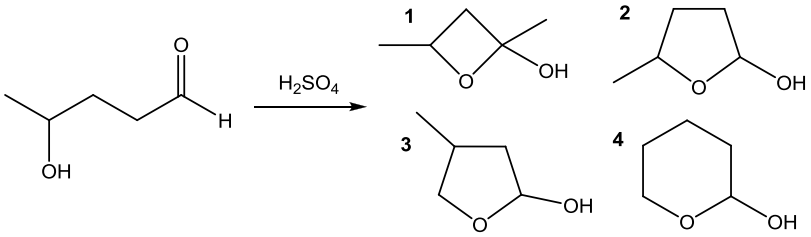
(40 points, 4 points each) Bubble-in the correct answer on the Scantron card. There is only one correct answer. Also circle your answer below for later review with the answer key.

1. What is the final product, Z, of the following synthesis?



A) I
B) II
C) III
D) IV
E) V

2. What is the major organic product obtained from the following reaction?

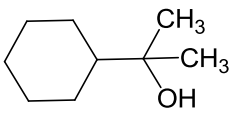


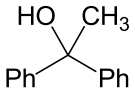
A) 1
B) 2
C) 3
D) 4

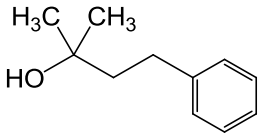
3. Which of the following compounds is the least reactive towards nucleophilic attack?

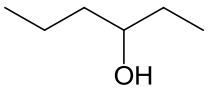
A) 3-hexanone
B) methyl propyl ketone
C) 4-methyl-3-hexanone
D) 2-butanone
E) propanal

4. Which of the following ***cannot*** be made by addition of a Grignard reagent to an ester?

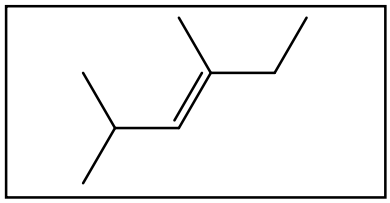
A) 

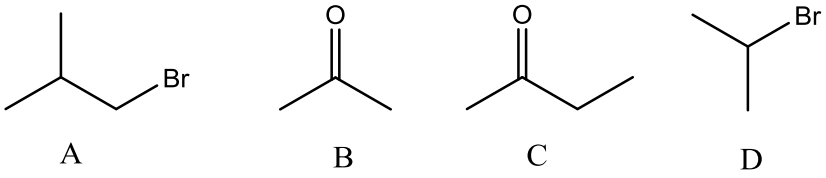
B) 

C) 

D) 

5. Which compounds from the list below would you select as starting materials to prepare the following alkene by the Wittig method?





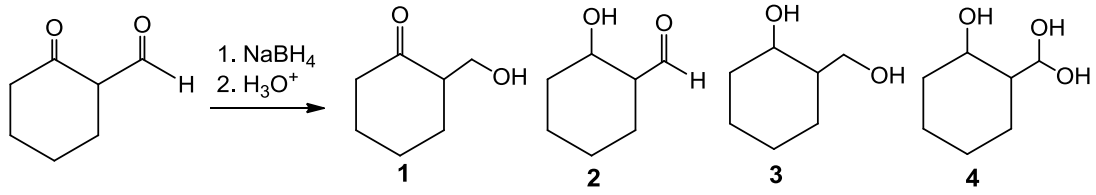
A B C D

A) A and B
B) A and C
C) B and D
D) C and D

6. Which reagent(s) will distinguish between 2-methyl-2-propanol and 2-propanol

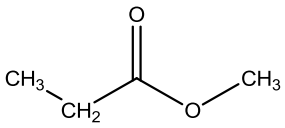
A) Br_2/CCl_4
B) OsO_4 (cold)
C) CrO_3/aqueous H_2SO_4
D) NaOH (aq)
E) $LiAlH_4$

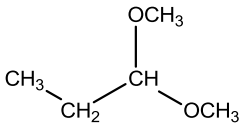
7. What is the major organic product obtained from the following reaction?

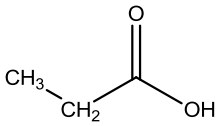


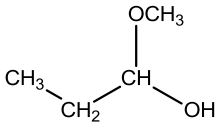
A) 1
B) 2
C) 3
D) 4

8. What new compound will be formed when gaseous HCl is added to a solution of propanal in methanol solvent?

A) 

C) 

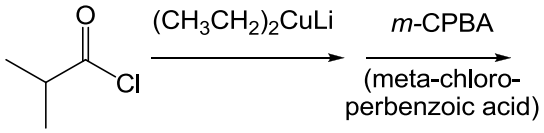
B) 

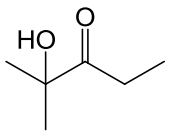
D) 

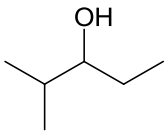
9. Your task is to synthesize 2-phenyl-2-pentanol through a Grignard synthesis. Which pairs of compounds listed below would you choose as starting materials?

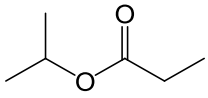
A) Methyl phenyl ketone and propyl bromide
B) Butanal and bromobenzene
C) Benzaldehyde and 2-bromobutane
D) More than one of these

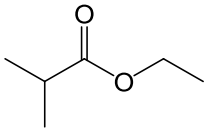
10. What is the major product of the following reaction sequence?



A) 

C) 

B) 

D) 

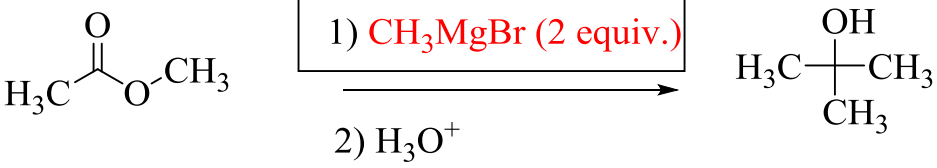
11. Which of the following is **not** true?

A) Nucleophiles react with aldehydes and ketones to form tetrahedral carbonyl addition intermediates.
B) A Grignard reagent is a good nucleophile
C) An acetal can only result from the acid-catalyzed addition of an alcohol to a hemiacetal.
D) Ketones react with Grignard reagents (followed by acid workup) to form secondary alcohols.
E) A hemiacetal can result from the acid-catalyzed or base-catalyzed addition of an alcohol to an aldehyde or ketone.

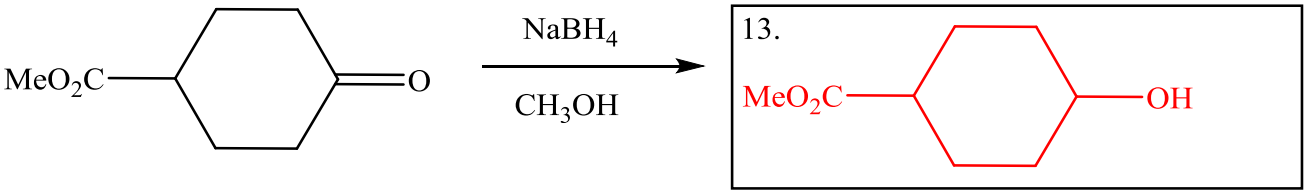
END of PART A – Scantron scored

BEGIN PART B – free response

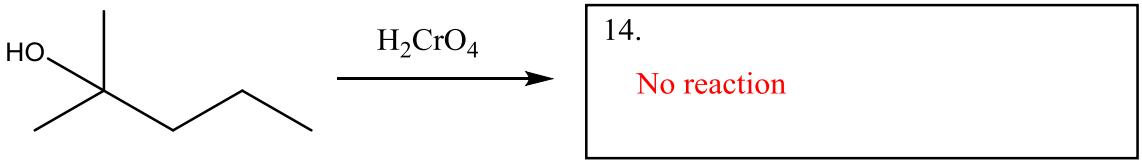
12.



13.

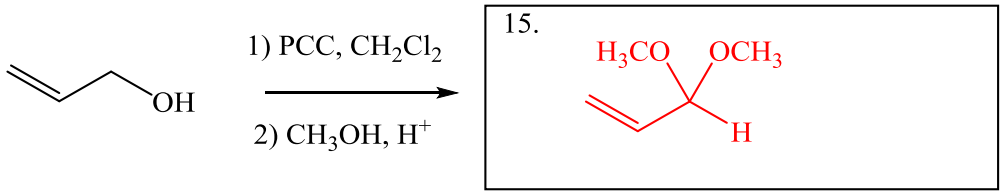


14.



No reaction

15.



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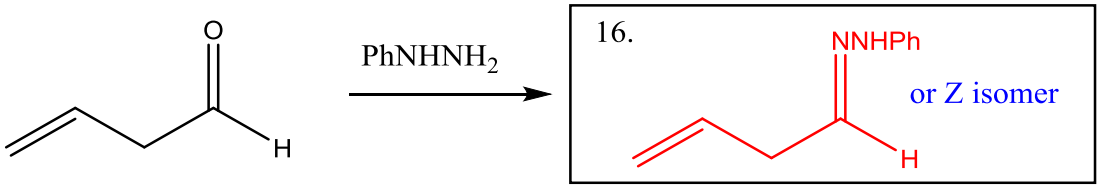
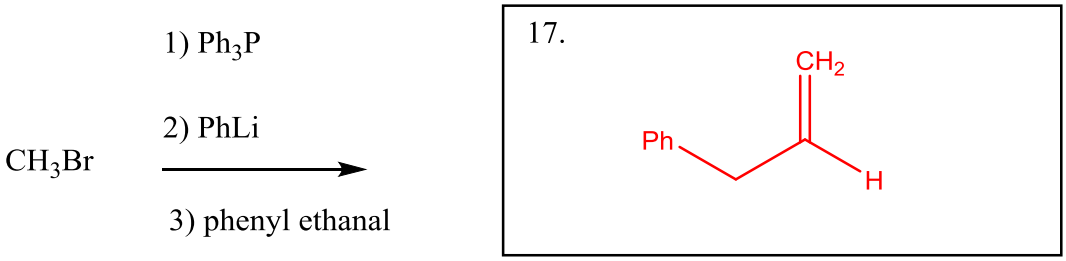
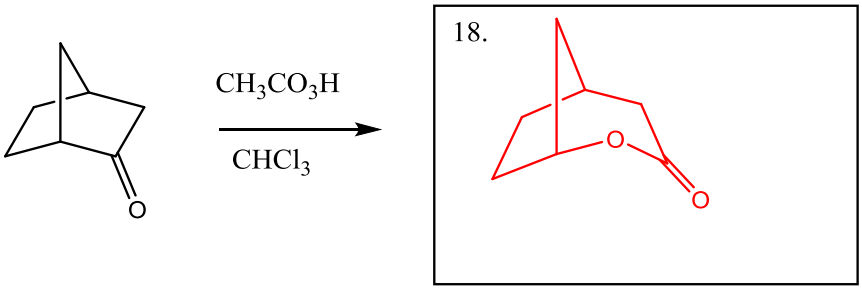
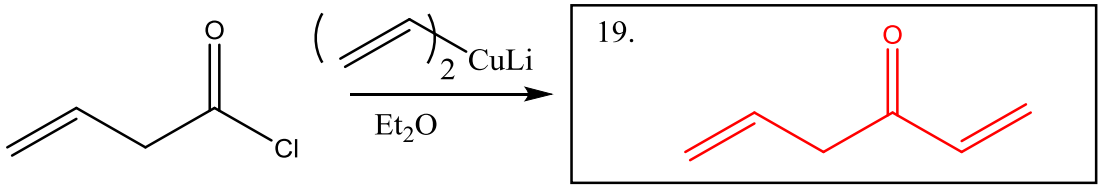
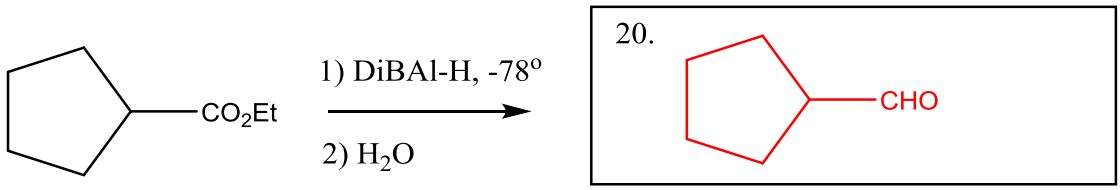










PhCH$_2$Br

1) KCN (aq)

2) LiAlH(O-t-Bu)$_3$

Et$_2$O, -78°C

3 H$_2$O

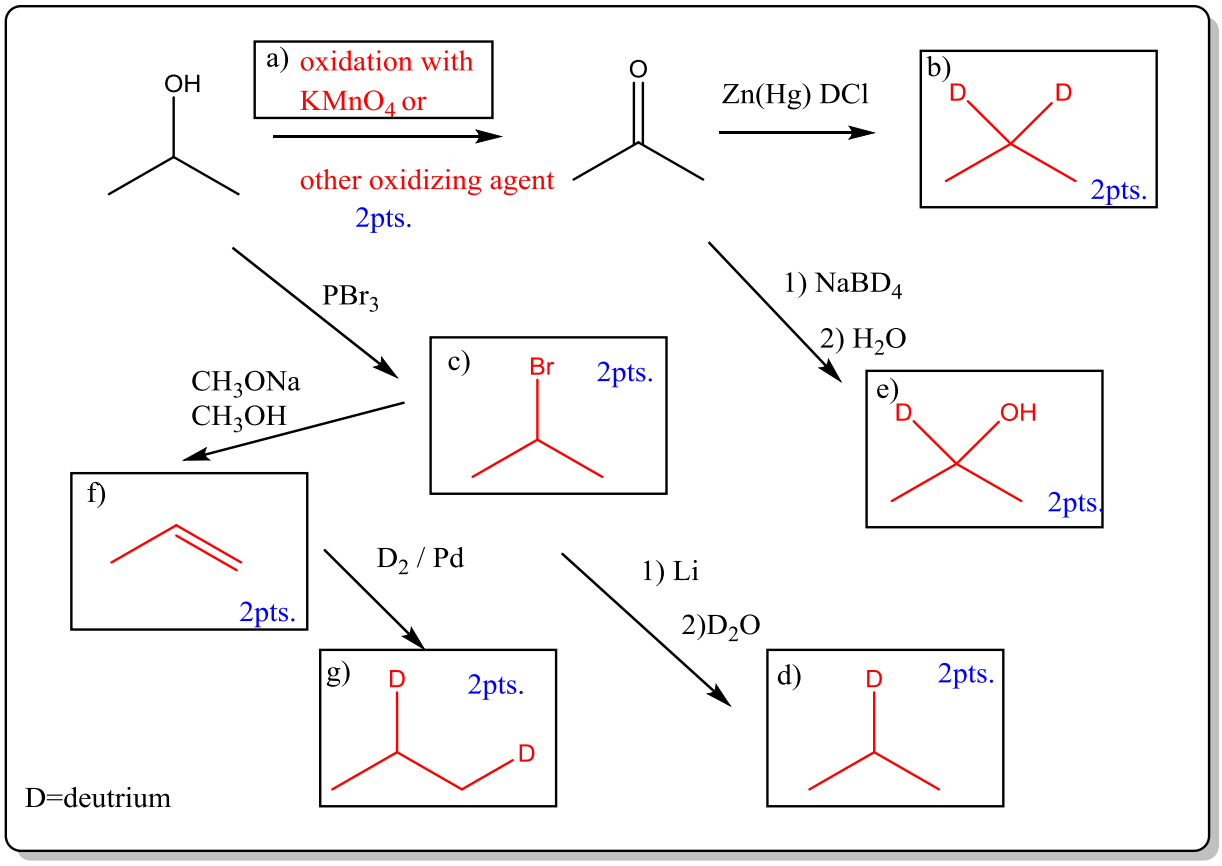
21. PhCH$_2$CHO

End Part B

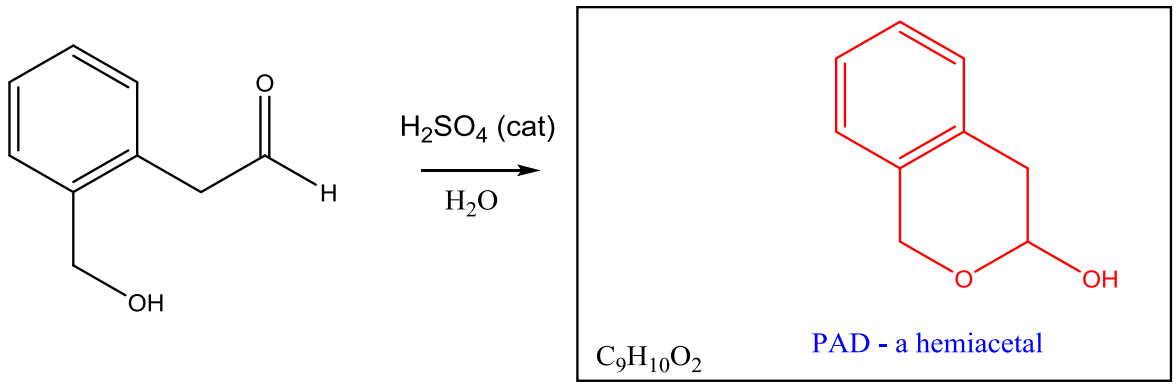
_____/ 24

Begin Part C

22. (14 points) **Multi-step Synthesis:** Complete the following set of reactions. Most involve isotopic labeling with deuterium (^{2}H = D). Do not show the mechanism.

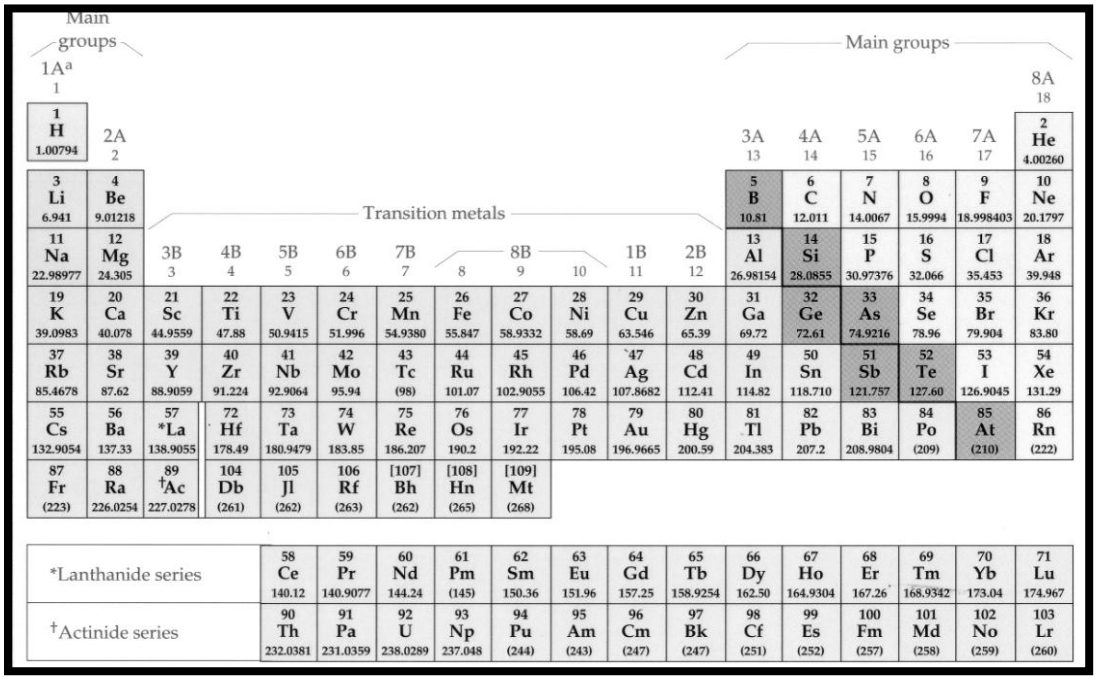


23. (6 points.) **Mechanistic Understanding:** You know the mechanism. What is the product of the following reaction?



END OF PART C

_____/ 20



Main groups 1A[a] 1												Main groups 3A 13	4A 14	5A 15	6A 16	7A 17	8A 18
1 H 1.00794	2A 2						Transition metals										2 He 4.00260
3 Li 6.941	4 Be 9.01218											5 B 10.81	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.998403	10 Ne 20.1797
11 Na 22.98977	12 Mg 24.305	3B 3	4B 4	5B 5	6B 6	7B 7	8B 8	8B 9	8B 10	1B 11	2B 12	13 Al 26.98154	14 Si 28.0855	15 P 30.97376	16 S 32.066	17 Cl 35.453	18 Ar 39.948
19 K 39.0983	20 Ca 40.078	21 Sc 44.9559	22 Ti 47.88	23 V 50.9415	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.69	29 Cu 63.546	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.9059	40 Zr 91.224	41 Nb 92.9064	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.9055	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.41	49 In 114.82	50 Sn 118.710	51 Sb 121.757	52 Te 127.60	53 I 126.9045	54 Xe 131.29
55 Cs 132.9054	56 Ba 137.33	57 *La 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.85	75 Re 186.207	76 Os 190.2	77 Ir 192.22	78 Pt 195.08	79 Au 196.9665	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.9804	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.0254	89 †Ac 227.0278	104 Db (261)	105 Jl (262)	106 Rf (263)	[107] Bh (262)	[108] Hn (265)	[109] Mt (268)									

*Lanthanide series	58 Ce 140.12	59 Pr 140.9077	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.9254	66 Dy 162.50	67 Ho 164.9304	68 Er 167.26	69 Tm 168.9342	70 Yb 173.04	71 Lu 174.967
†Actinide series	90 Th 232.0381	91 Pa 231.0359	92 U 238.0289	93 Np 237.048	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

Acid	Approximate pK_a	Conjugate Base
$HSbF_6$	< -12	SbF_6^-
HI	-10	I^-
H_2SO_4	-9	HSO_4^-
HBr	-9	Br^-
HCl	-7	Cl^-
$C_6H_5SO_3H$	-6.5	$C_6H_5SO_3^-$
$(CH_3)_2\overset{+}{O}H$	-3.8	$(CH_3)_2O$
$(CH_3)_2C{=}\overset{+}{O}H$	-2.9	$(CH_3)_2C{=}O$
$CH_3\overset{+}{O}H_2$	-2.5	CH_3OH
H_3O^+	-1.74	H_2O
HNO_3	-1.4	NO_3^-
CF_3CO_2H	0.18	$CF_3CO_2^-$
HF	3.2	F^-
CH_3CO_2H	4.75	$CH_3CO_2^-$
H_2CO_3	6.35	HCO_3^-
$CH_3COCH_2COCH_3$	9.0	$CH_3C\overline{O}CHCOCH_3$
NH_4^+	9.2	NH_3
C_6H_5OH	9.9	C_6H_5O-
HCO_3^-	10.2	CO_3^{2-}
$CH_3NH_3^+$	10.6	CH_3NH_2
H_2O	15.7	OH^-
CH_3CH_2OH	16	$CH_3CH_2O^-$
$(CH_3)_3COH$	18	$(CH_3)_3CO^-$
CH_3COCH_3	19.2	$^-CH_2COCH_3$
$HC{\equiv}CH$	25	$HC{\equiv}C^-$
H_2	35	H^-
NH_3	38	NH_2^-
$CH_2{=}CH_2$	44	$CH_2{=}CH^-$
CH_3CH_3	50	$CH_3CH_2^-$

Write your class roll number on (1) the top of the first page and (2) below.

Class Roll number _____

Part A Scantron scored (44 points)

Page 5 (16)_____
Page 6 (24)_____
Page 7 (20)_____

Total (Part B only) _____ (60)