 Name:_____

Roll Number _____

Please read the following before proceeding

1. 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 have always worked better alone."-- Claude Monet

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

*Signed*_____

Note: A pKa table is provided on the last page.

1. (40 points, 4 points each) Circle the correct answer. There is only one correct answer.

a. Which of the following is the strongest base?

A) CH_3OH
B) H_2O
C) CH_4
D) CH_3MgBr

b. What Grignard reagent is needed to convert 2-pentanone to 3-methyl-3-hexanol?

A) pentylmagnesium bromide
B) propylmagnesium bromide
C) butylmagnesium bromide
D) ethylmagnesium bromide
E) methylmagnesium bromide

c. Which of the following reactions would **not** give the indicated product? Mistake on first answer key. Will give credit for any answer. T-Square score will be revised.

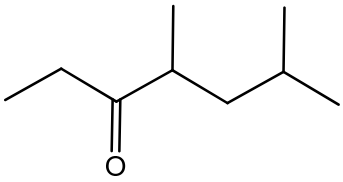
A) methylbenzoate + ammonia to give benzamide + methanol
B) acetic anhydride + methanol to give methyl acetate + acetic acid
C) propanamide + methanol to give methyl propanoate + ammonia
D) phenyl acetate + water to give methyl acetate + phenol
E) acetyl chloride + hydroxide to give acetic acid + chloride

d. Which of the following compounds, when heated in an acidic aqueous solution, will ***not*** form acetic acid?

A) Methyl acetate; CH_3COOCH_3
B) Acetamide; $CH_3CO\text{-}NHCH_3$
C) Acetonitrile; CH_3CN
D) Acetone; CH_3COCH_3
E) all of the above

_____/ 20

e. What is the systematic name of the following compound?



A) 4,6,6-trimethyl-3-hexanone
B) 2,4-dimethyl-5-heptanone
C) ethyl isohexyl ketone
D) 4,6-dimethyl-3-heptanone
E) 4-methyl-3-octanone

f. What product is formed from the reaction of propanal with a Grignard reagent followed by addition of H^+/H_2O?

A) a tertiary alcohol
B) a ketone
C) a primary alcohol
D) a carboxylic acid
E) a secondary alcohol

g. Which of the following is a hemiacetal?

A) CH_3-C(OH)(OCH_3)-CH_2CH_3
B) CH_3-CH(OCH_3)-CH_2CH_3
C) CH_3-CH(OH)(OCH_3)
D) CH_3-C(OCH_3)$_2$-CH_2CH_3
E) CH_3-CH(OH)$_2$

h. Aldehydes are more reactive than ketones toward nucleophilic attack because

A) aldehydes are more sterically hindered.
B) the carbonyl group of a ketone is attached to more electron-donating groups.
C) aldehydes have a better leaving group.
D) A and B
E) B and C

_____/ 16

i. Which of the following compounds is the <u>least</u> reactive to nucleophilic attack?

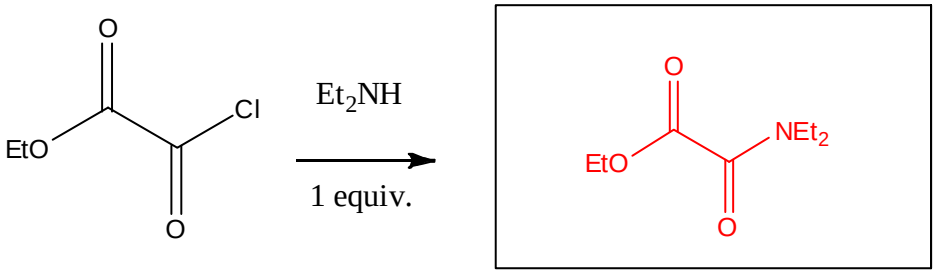
A) 2,2,4,4-tetramethyl-3-pentanone
B) 3-methyl-2-pentanone
C) 2-pentanone
D) 2,4-dimethyl-3-pentanone
E) 3-methyl-2-butanone

j. What product is formed when acetone (CH_3COCH_3) undergoes an aldol condensation in a heated, basic aqueous solution of acetone?

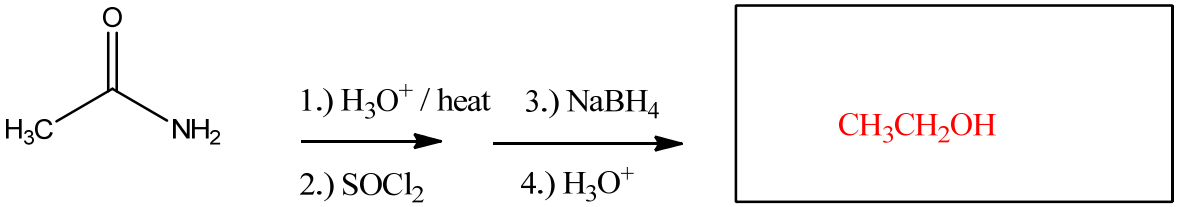
A) 4-methyl-4-penten-2-one
B) 4-methyl-3-penten-2-one
C) 3-methyl-3-penten-2-one
D) 2,4-pentanedione
E) 2-methyl-2,4-pentanediol

2. (40 points, 4 points each) SHORT ANSWER. Draw the structure, or write the word or phrase that best completes each statement or answers the question.

a. What is the product of the following reaction?



b. What is the product of the following reaction?



c. What is the product of the following reaction?

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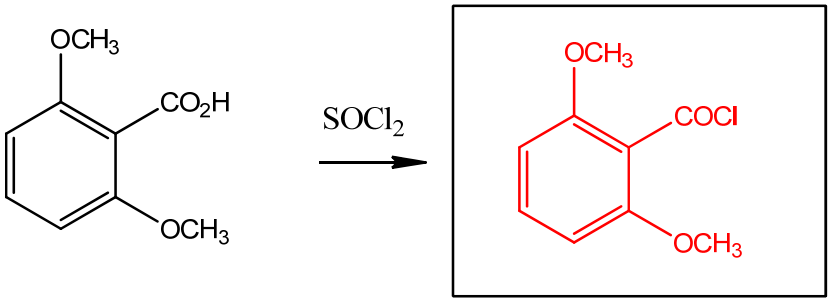
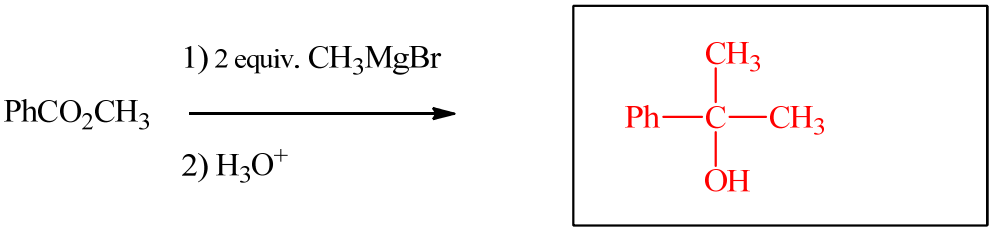
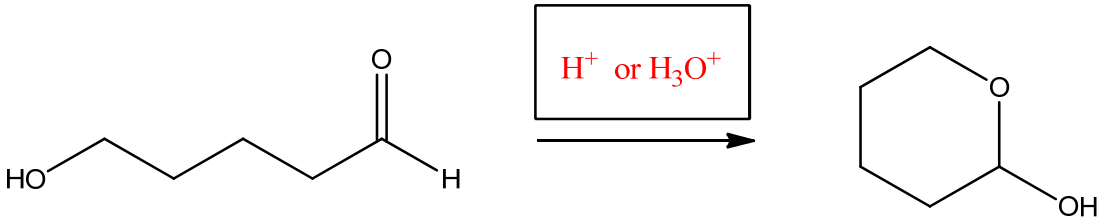


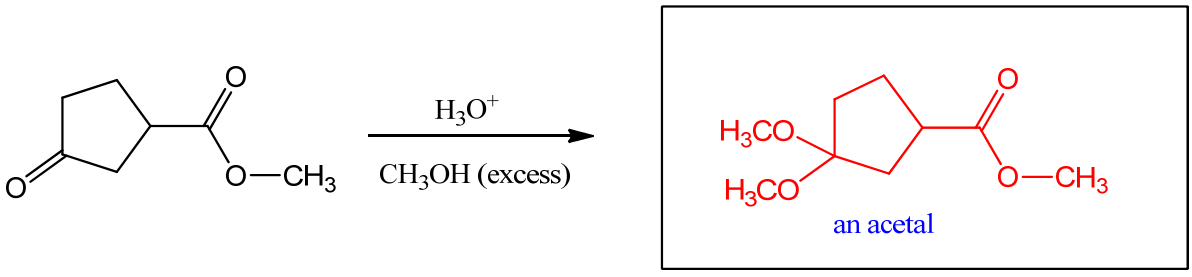
d. What is the product of the following reaction?



e. What reagent would be needed for the following transformation?

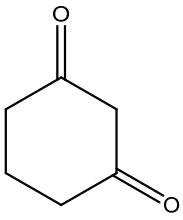


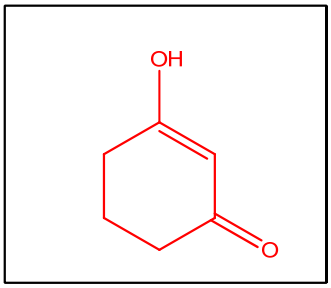
f. What is the product of the following reaction?

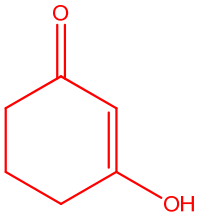


g. Draw a major enol tautomer of the following

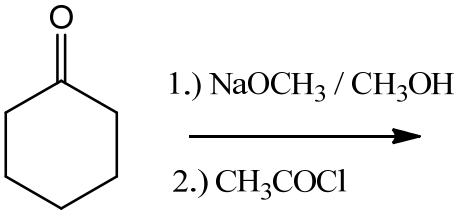
_____/ 16

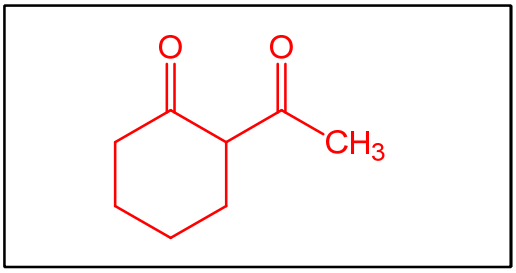




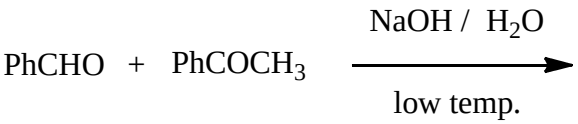


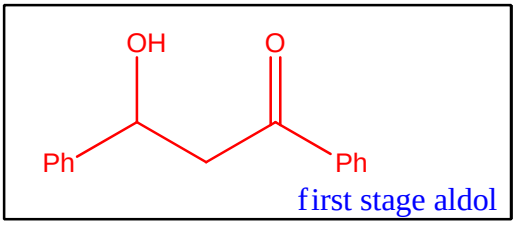
h. What is the product of the following reaction?



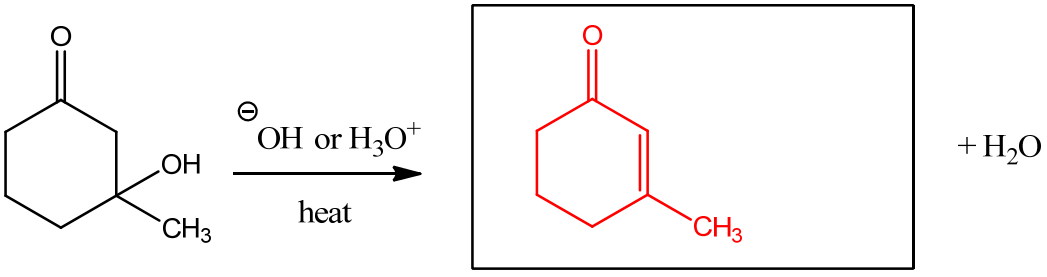


i. What is the product for the following reaction?





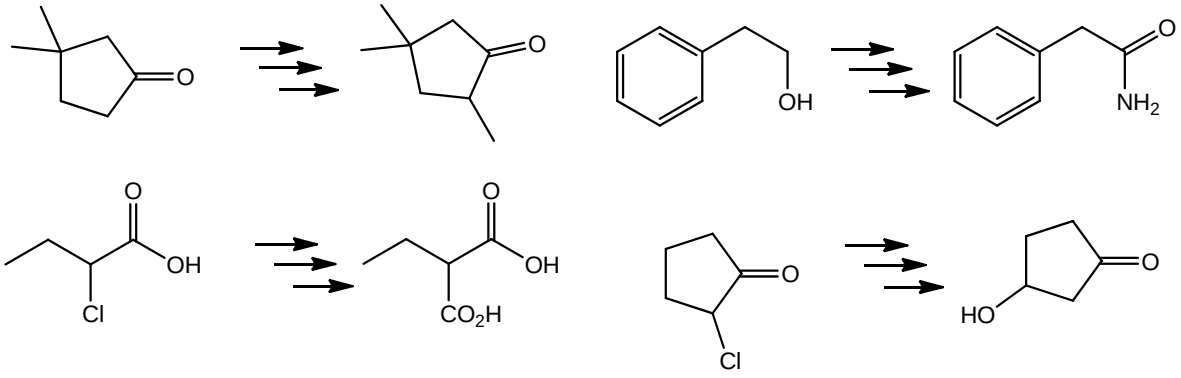
j. What is the product of the following reaction?

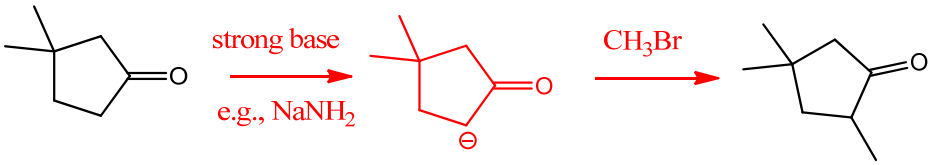


3. (10 points) **Multistep synthesis:** *Select one of the following four sequences*. Show how the starting material can be converted into any **ONE** of the following products. Provide a sequence of reactions to perform the transformation, showing the reagents and structures of

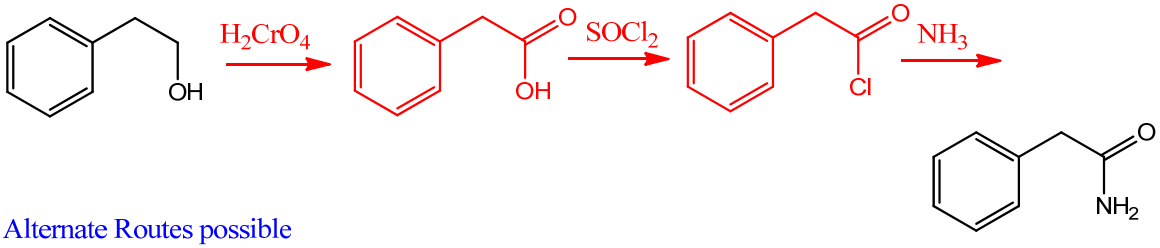
_____/ 16

all intermediates products. You may use any other substrate materials and/or reagents. ***Do not draw the mechanistic steps.*** Be specific. Points deducted for inadequate synthesis.

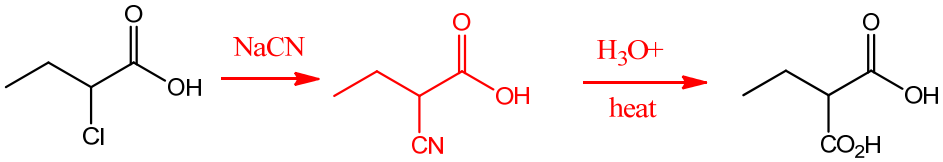




Alternate Routes possible



Alternate Routes possible



Alternate Routes possible

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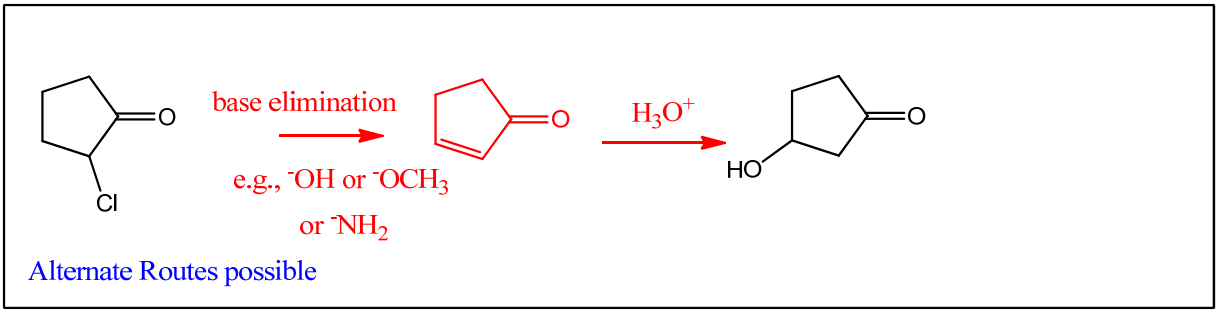
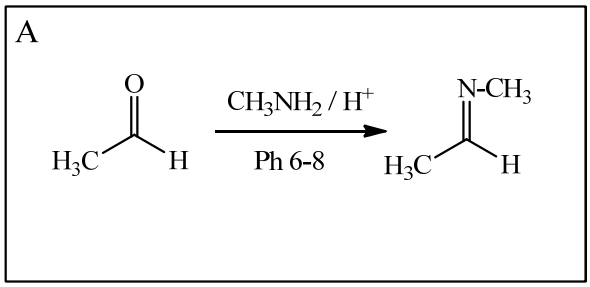
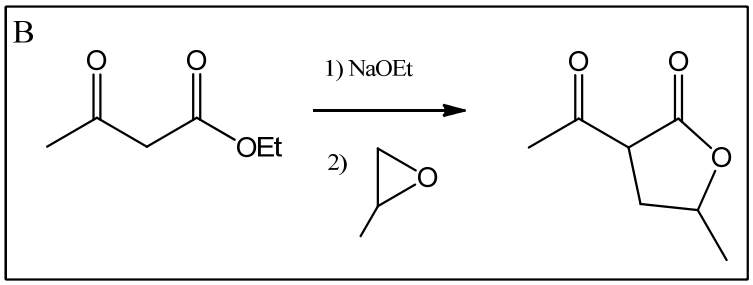
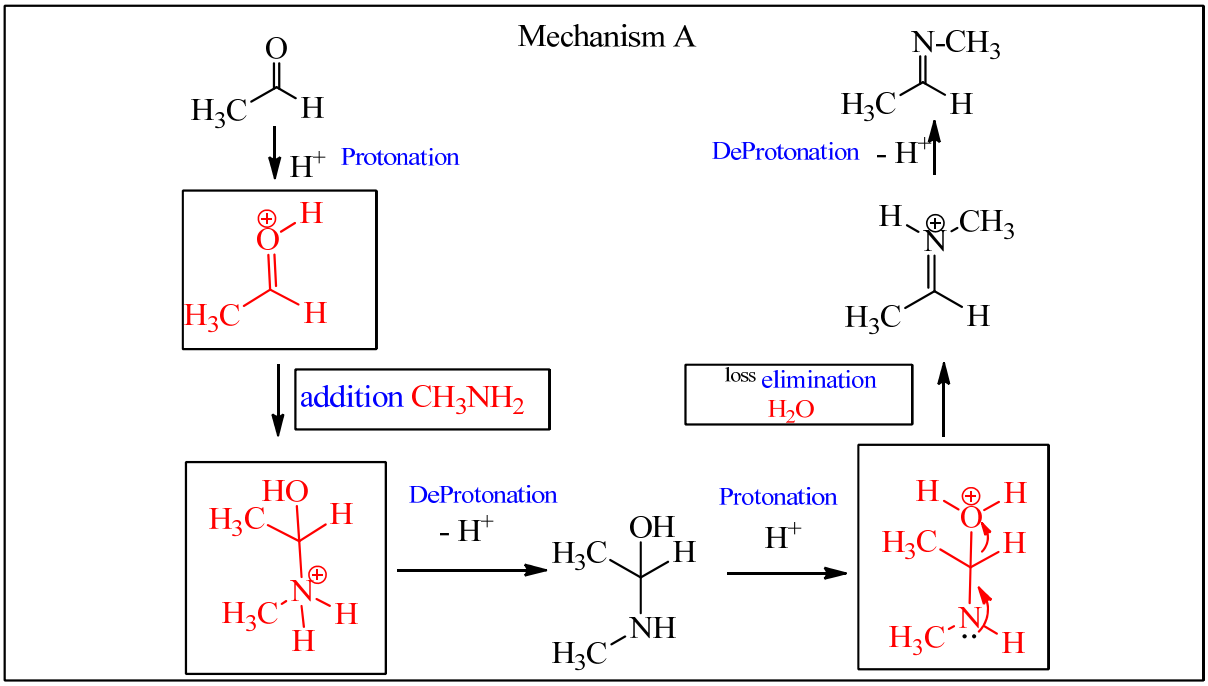
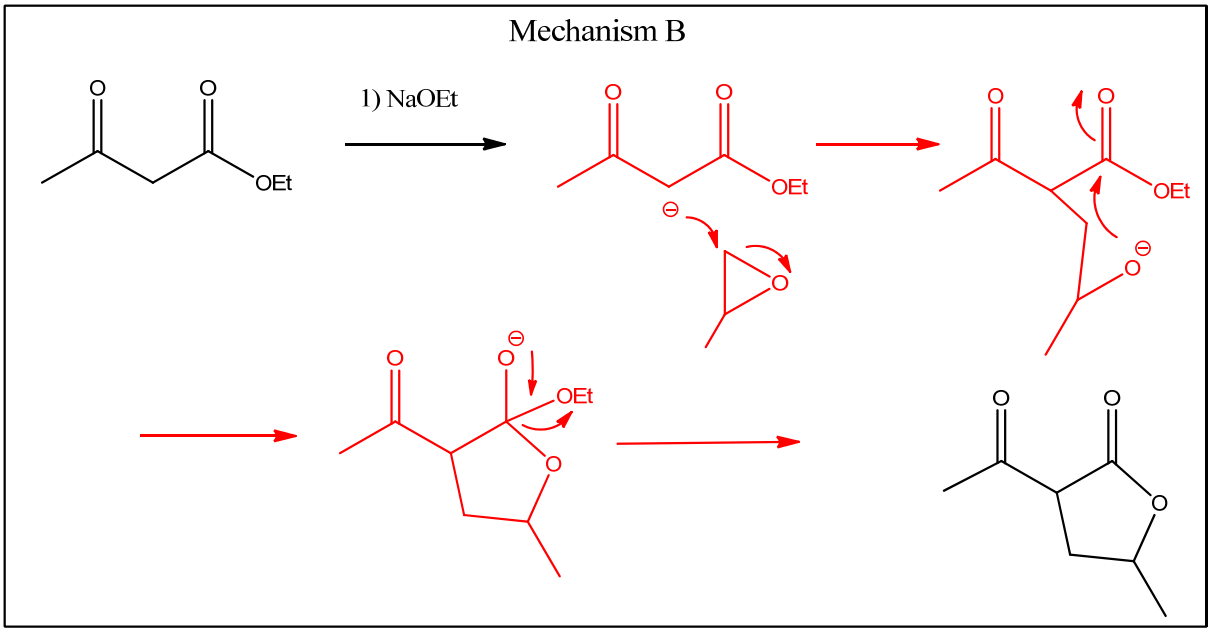


4. (10 points)) **Mechanistic Understanding:** Provide a step wise mechanism for ***one*** of the following ***two*** reactions. Use curved arrows to show the electron movement and show all intermediates. Select either Mechanism A or B only.









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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	$CH_3CO\bar{C}HCOCH_3$
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.

******* If you need to verify your class roll number, you can do this at the front of the room when you turn in your exam paper. *******

Roll Number _____

Page 2 (20)_____
Page 3 (20)_____
Page 4 (16)_____
Page 5 (16)_____
Page 6 (18)_____
Page 7 (10)_____

Total 100_____