Name_____

University of Louisville **Chem 105 Day** **Fall 2015**

Exam 3 November 23

DO NOT OPEN THE EXAM UNTIL YOU ARE TOLD TO DO SO.

In the meantime, read this...

- Write your answers to Free-Response questions directly on the "Free-Response Answer Sheet." Record your answers to multiple-choice questions on the Scantron card provided.

- At the end of the exam, turn in **your entire test booklet, with Answer Sheet, and your Scantron card.**

✍ **Write your name**:

- ✍ on **every page of the exam**, and
- ✍ on the **Scantron card**.

Exams will be taken apart for processing, so it is important that you have your name on **every page**.

You may use your calculator, pens, and pencils. Please do not use green or red. Any other aids are prohibited.

Put all notes, books, etc away and out of sight. Turn off the ringers of electronic devices and put them away and out of sight. **Electronic devices (other than calculators) must be silenced and put away. Use of calculator functions on communication devices is not permitted. Sharing calculators is not permitted.** Points will be deducted for electronic devices in view or making noise, and devices will be confiscated.

No outside paper is allowed. If you need more scratch paper, ask one of the proctors.

Problems marked ** are taken directly from the homework problems in the Text or in-class worksheets.

Strategy hint: take a quick look over the whole exam before you start. If you see something that looks easy for you, go for it! Get a few points in the bag right away.

Strategy hints for multiple choice:

- When you have determined that an option is not correct, mark it off so you don't have to check it again!
- Even if you think you have found the right answer, look at the remaining answers to see if any of them are a better match.
- On calculation problems, show your work somewhere on the page. Even if you miss the problem, you will be able to see later where mistakes happened.

Looking at another student's work, intentionally or accidentally, will not be tolerated. Students who seem to have trouble keeping their eyes on their own papers will be moved to the front of the room. Students who cheat earn a failing grade.

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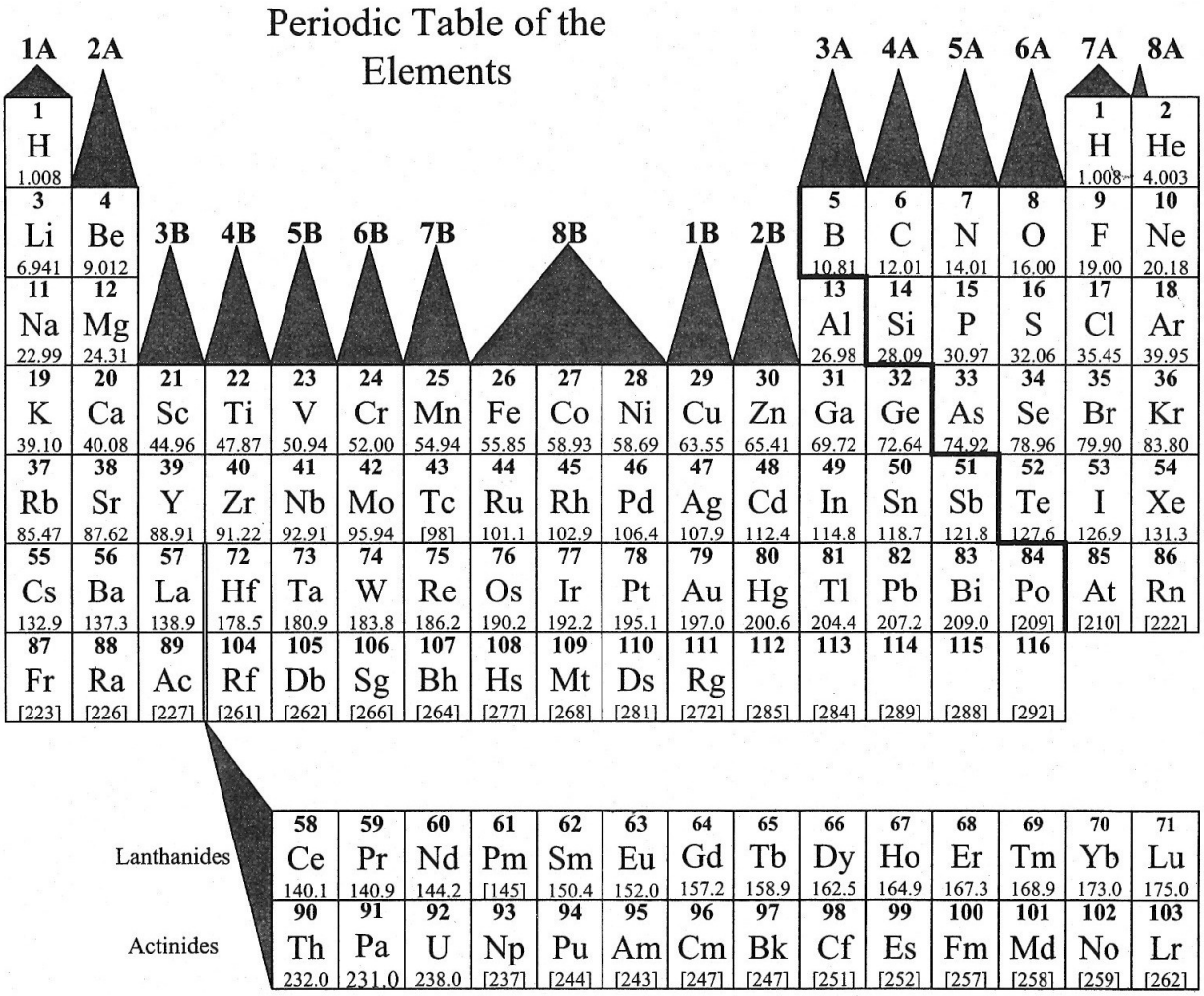

You may remove this page and use it as scratch paper and a cover sheet. If you need more scratch paper, you may get it from the proctor.

Potentially useful information:

$C_1V_1 = C_2V_2$ 1% w/v = 1g/100 mL = 1 g/dL 1% v/v = 1 mL/100 mL = 1 mL/dL

1 ppm = 1 μg/mL 1 ppb = 1 ng/mL

1 mole = 6.022×10^{23}

$pH = -\log[H^+]$ $[H^+] = 10^{-pH}$

in water, $[H^+] \times [OH^-] = 1.0 \times 10^{-14}$ $H_2O \rightleftharpoons H^+ + OH^-$

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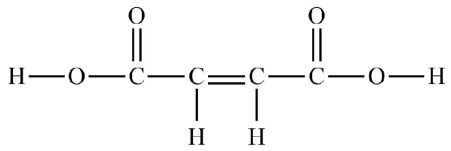
Free-Response ANSWER SHEET

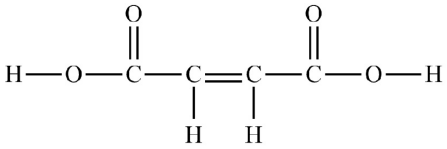
(MC score_____ FR score_____ Total raw_____ total %_____)

1. [4 pts] Sketch a **hydrogen bonding interaction** between the molecule below and a molecule of **water**.



2. The molecule below is commonly found in some fruits.

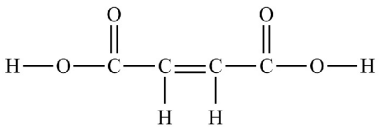
(a) [4 pts] **Circle** the hydrogen atom(s) that can be donated as H^+.



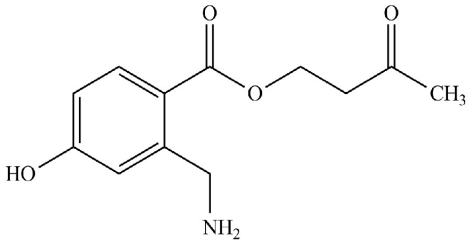
(b) [4 pts] Write the **molecular formula** for this compound, in a way that appropriately represents its behavior as an acid.

_____

3. [4 pts] In the space below, draw the organic molecule that is formed when the molecule shown undergoes **hydration.**



4. [9 pts] **Circle and name all functional groups** in the molecule below.



5. **[10 pts] In the space below, write the balanced equation, with appropriate phase labels, for the reaction between **H_3PO_4 and F^-** in aqueous solution.

(reminder--did you include phase labels?)

6. [2 pts] What is your instructor's name, with appropriate title? _____

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Multiple Choice [3 points each]. Choose the **best** answer and record it on your Scantron card.

1 Mark A on the Scantron card. (This item is a form identifier and will not be scored.)

Choose the reaction that best fits each description or classification. You may use each answer option once, more than once, or not at all.

A $HCl\ (aq) \rightarrow H^+\ (aq) + Cl^-\ (aq)$

B $H_2O\ (l) \rightleftharpoons H^+\ (aq) + OH^-\ (aq)$

C $2\ H_2\ (g) + O_2\ (g) \rightarrow 2\ H_2O\ (g)$

D $NH_3\ (aq) + HCN\ (aq) \rightleftharpoons NH_4^+\ (aq) + CN^-\ (aq)$

E $Na_3PO_4\ (aq) + CaCl_2\ (aq) \rightarrow NaCl\ (aq) + Ca_3(PO_4)_2\ (s)$

2 Acid-base neutralization

3 Combustion

4 Dissociation of a strong acid

5 A reaction equation that is not balanced

For the next few problems, assign each solution as **acidic, basic or neutral** *as appropriate.*

A acidic B basic C neutral

6 A solution with $[H^+] = 3.2 \times 10^{-8}$ M

7** A solution with pH = 1

8** A solution of sodium hydroxide

9 A solution of $H_2C_2O_4$

10 A solution with $[OH^-] = 1.0 \times 10^{-7}$ M

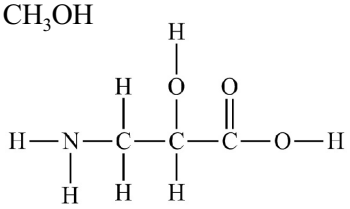
Decide whether each of the species below is acidic, basic, neutral, or amphiprotic in aqueous solution. You may use each option once, more than once, or not at all.

A acidic B basic C neutral D amphiprotic

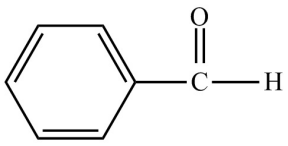
11 ** $H_2PO_4^-$

12 ** CH_3OH

13 **



14 **



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Exam 3 November 23

Use these options to answer the next several questions. You may use each option once, more than once, or not at all.

	Name	Formula
A	maleic acid	$H_2C_4H_2O_4$
B	hydrogen carbonate ion	HCO_3^-
C	phosphoric acid	H_3PO_4
D	phenol	HC_6H_5O
E	phosphate ion	PO_4^{3-}

15 Which of the formulas in the table represents a **triprotic acid**?

16 Which acid contains an aromatic functional group?

17 Which species forms when carbon dioxide dissolves in water?

18 What is the best representation of the **conjugate base** of phosphoric acid, H_3PO_4?

A OH^- B H_3PO_4 C $H_2PO_4^-$ D HPO_4^{2-} E PO_4^{3-}

19 If you breathe rapidly and shallowly, expelling CO_2 from your lungs more rapidly than usual, what effect will this have on your blood?

A Your blood will become more acidic.
B Your blood will become more basic.
C Your blood will become amphiprotic.
D Your blood will become hypertonic.
E Your blood will become isotonic.

20 Two chemical waste samples are tested. Sample A has pH 2.0, and Sample B has pH 4.0. Which statement is **true**?

A Sample A is acidic, and Sample B is basic.
B Sample A is approximately twice as basic as Sample B.
C Sample A is approximately twice as acidic as Sample B.
D Sample A is 100 times as acidic as Sample B.
E Sample A is 100 times as basic as Sample B.

21 What is the **pH** of a solution with $[H^+] = 0.044$ M?

A 2.2×10^{-13} B 0.044 C 1.36 D 2.49 E 11.51

22 What is the **$[OH^-]$** in a solution with $[H^+] = 3.2 \times 10^{-3}$ M?

A 3.1×10^{-12} B 0.044 C 1.36 D 2.49 E 11.51

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Exam 3 November 23

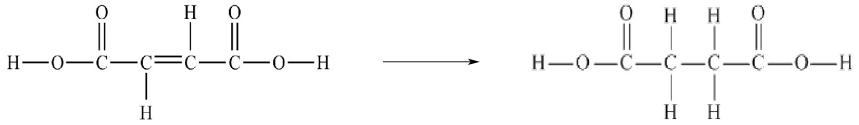
Choose the best term. You may use each answer option once, more than once, or not at all.

A hydration B dehydration
C hydrogenation D oxidation of alcohol
E condensation

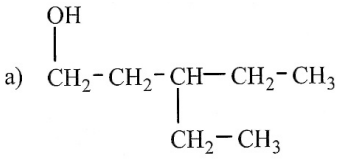
23 Turns an alkene into an alcohol

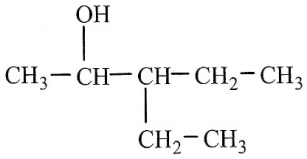
24 $CH_3–O–H + H–O–CH_3 \rightarrow CH_3–O–CH_3 + H–O–H$

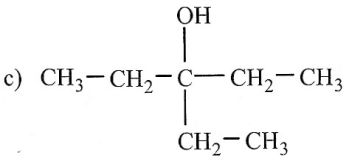
25 Turns an alcohol into a carbonyl

26 

The next several questions refer to these alcohols. You may use each option once, more than once or not at all.

a) 

b) 

c) 

d) more than one of these

27 Which molecule is a **primary alcohol**?

28 Which alcohol, when oxidized, forms a **ketone**?

29 Which of the alcohols can undergo **dehydration**?

Draw the five molecules listed below, then answer the questions about them.

A dimethylamine B acetic acid C dimethyl ether D hexanal E octanol

30 Which molecule is an isomer of ethanol?

31 Which compound forms a basic solution when dissolved in water?

32 Which compound contains a nitrogen atom?

33 Which compound will have the **highest** boiling point?

34 Which compound has the **strongest** dispersion forces between its molecules?

35 *Skip the remaining problems on the front side of your Scantron and flip it over; the remaining problems will be answered on the back of your Scantron card, beginning with #51.*

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Multiple Choice, continued. The remaining problems, **beginning with #51**, are scored at 1 point each.

*For each of the following pairs of solutions, tell which solution has the **higher** pH.*

**51 A a solution of NaOH B a solution of HCl

**52 A a 1.0 M solution of HCl B a 0.1 M solution of HCl

**53 A a 0.1 M solution of a strong acid B a 0.1 M solution of a weak acid

Assign the following statements as TRUE or FALSE.
A TRUE B FALSE

54 Both hydration and hydrogenation turn unsaturated molecules into saturated molecules.

55 Amines and amides are basic in aqueous solution.

56 Because of the self-ionization of water, H_2O is considered an ionic substance. $H_2O \rightleftharpoons H^+ + OH^-$

57 In an equilibrium reaction, if the forward reaction is endothermic, the reverse reaction is exothermic.

58 In an equilibrium reaction, molecular activity ceases when equilibrium is reached.

59 In a carbonyl group, the carbon atom carries a δ+ charge.

60 Most chemical reactions involve both breaking and forming bonds.

61 In a system at equilibrium, the concentration of products always equals the concentration of reactants.

Decide whether each combination below, when dissolved in aqueous solution, will form a buffer solution or not. Choose **B. buffer** or **C. not a buffer**.

62 $Cl^- + HCl$

63 $S^{2-} + HS^-$

64 $H_2CO_3 + HCO_3^-$

65 $HCl + HC_2H_3O_2$

66 $NH_3 + NH_4Cl$

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