

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

In the meantime, read this...

You will write all of your answers on the Answer Sheet(s). At the end of the exam, turn in **your Answer Sheet(s) and your Scantron card**. You may keep the rest of the Exam booklet for your records.

-  **Write your name** on the “Free-Response Answer Sheet(s)” and
-  **Write your name, Chem 105-75 E1, Fall 16** on the Scantron card. If you normally attend the Day section, you can write a note telling us where to return your exam.
- If you are a student in the ONLINE section, please write a note telling how you would like your exam returned: US mail (include address), scan/email (include preferred address), or pickup in office.

You may use your calculator and a pen and/or pencil. Please do not use green or red. Please use a pencil on the Scantron, as the machine does not score ink reliably.

Put all notes, books, etc away and out of sight. Turn off audible signals on cell phones, Apple watches, and all other communication devices, and put them away and out of sight. **Electronic devices (other than calculators) must be 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.

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! It's good to 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, it certainly will be easier to see later where mistakes were made.

**Cheating 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 actually caught cheating earn a failing grade.**

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Periodic Table of the Elements

1A	2A											3A	4A	5A	6A	7A	8A		
1 H 1.008																1 H 1.008	2 He 4.003		
3 Li 6.941	4 Be 9.012		3B	4B	5B	6B	7B	8B				1B	2B	5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31													13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.41	31 Ga 69.72	32 Ge 72.64	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80		
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc [98]	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3		
55 Cs 132.9	56 Ba 137.3	57 La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po [209]	85 At [210]	86 Rn [222]		
87 Fr [223]	88 Ra [226]	89 Ac [227]	104 Rf [261]	105 Db [262]	106 Sg [266]	107 Bh [264]	108 Hs [277]	109 Mt [268]	110 Ds [281]	111 Rg [272]	112 [285]	113 [284]	114 [289]	115 [288]	116 [292]				
		Lanthanides																	
		58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm [145]	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0				
		Actinides																	
		90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np [237]	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 [262]				

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:

$$C_1V_1 = C_2V_2 \quad 1\% \text{ w/v} = 1\text{g}/100 \text{ mL} = 1 \text{ g/dL}$$

$$1 \text{ ppm} = 1 \mu\text{g}/\text{mL} \quad 1 \text{ ppb} = 1 \text{ ng}/\text{mL}$$

$$6.022 \times 10^{23}$$

$$\text{equivalents} = \text{moles} \times \text{charge}$$

$$\text{pH} = -\log[\text{H}^+] \quad [\text{H}^+] = 10^{-\text{pH}} \quad \text{in water, } [\text{H}^+] \times [\text{OH}^-] = 1.0 \times 10^{-14}$$

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Name: \_\_\_\_\_

**Free-Response ANSWER SHEET**

(MC score \_\_\_\_\_ FR score \_\_\_\_\_ Total raw \_\_\_\_\_ total % \_\_\_\_\_)

1. Give a **reasonable** estimate, with **appropriate metric** unit, for each of the following. [2 each]

a. the mass of your little finger. \_\_\_\_\_

b. the height of a coffee cup. \_\_\_\_\_

c. the volume of your textbook. \_\_\_\_\_

2. Give the symbol of an element that fits each description. In some cases, there may be more than one acceptable answer; choose **one**. [2 each]

\_\_\_\_\_ the alkali metal in period 2

\_\_\_\_\_ a metal in the same group with silicon

\_\_\_\_\_ a transition metal in Period 4

\_\_\_\_\_ an element whose neutral atoms have 6 valence electrons

\_\_\_\_\_ an atom that normally forms 3 bonds in covalent compounds

4. Give a **correct systematic name** for each formula. [2 each]

\_\_\_\_\_  $S_2F_6$ \_\_\_\_\_  $Fe_2S_3$ \_\_\_\_\_  $PCl_3$ \_\_\_\_\_  $NH_4OH$ \_\_\_\_\_  $CH_4$ \_\_\_\_\_  $N_2O_3$ \_\_\_\_\_  $Al_2(CO_3)_3$ 

5. Give the correct **chemical formula** for each substance named. [2 each]

\_\_\_\_\_ ethyne

\_\_\_\_\_ ammonia

\_\_\_\_\_ magnesium phosphide

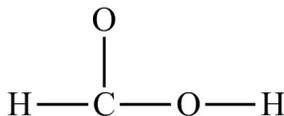
\_\_\_\_\_ silicon tetrabromide

\_\_\_\_\_ zinc nitrate

\_\_\_\_\_ calcium sulfate

\_\_\_\_\_ copper(II) phosphate

3. [5 pts] **Complete the structure:** Add lone pair electrons, or turn single bonds into double or triple bonds, as needed so that every atom has its normal electron arrangement. (**Do not** add any atoms to the molecule.)

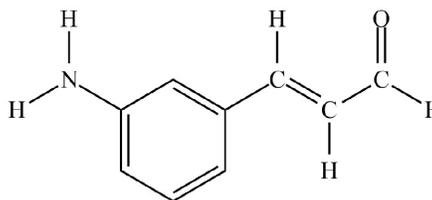


6. Fill in the blanks in the table below. [1 point each]

formula	atomic number	mass number	# of protons	# of electrons	# of neutrons	charge
		33			17	0
	29			28	35	
$Tl^{3+}$					124	

7. [10 pts] In the space below, draw the structure of **3,3-diethyl-4-methyl-1-hexene**.

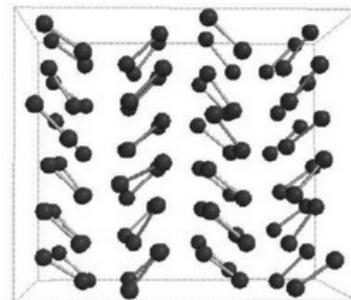
8. In the structure below, circle and appropriately label all **functional groups**. [8 pts]



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

- 1 Which of the following is a characteristic of a sample of a **mixture**?
- A All atoms have the same number of protons
  - B All atoms have the same number of neutrons
  - C Is made up of other, simpler substances in a fixed ratio
  - D Is made up of other, simpler substances in a variable ratio
  - E Appears in the periodic table
- 2 Which of the following properties is generally true of a **halogen**?
- A conducts electricity
  - B usually solid at room temperature
  - C forms anions in ionic compounds
  - D combines with other nonmetals to form ionic compounds
  - E relatively unreactive and does not form compounds
- 3 Which of the following is the name of an **organic compound**?
- A carbon disulfide
  - B silicon carbide
  - C propane
  - D carbon
  - E sodium carbonate
- 4 From the following list, which statement could possibly be **correct** based on the size of the measurement?
- A A mouse is 9 cm long.
  - B My kitchen sink has a capacity of 22  $\mu\text{L}$  of water.
  - C The width of Bob's classroom is 8.1 mm.
  - D This plastic drinking cup weighs 85 kg.
- 5 You have an atom that contains 16 protons, 17 neutrons, and 18 electrons. What is its **mass number**?
- A -2
  - B 16
  - C 17
  - D 32.07
  - E 33

- 6 The sample pictured is best classified as:
- A an element.
  - B an ionic compound.
  - C a covalent/molecular compound.
  - D a homogeneous mixture.
  - E a heterogeneous mixture.



- 7 Which of the following statements is the most accurate description of the substance  $\text{PH}_3$ ?
- A  $\text{PH}_3$  is an ionic compound, containing  $\text{P}^{3+}$  and  $\text{H}^-$  ions.
  - B  $\text{PH}_3$  is an ionic compound, containing  $\text{P}^{3-}$  and  $\text{H}^+$  ions.
  - C  $\text{PH}_3$  is a covalent compound, containing P atoms and  $\text{H}_3$  molecules.
  - D  $\text{PH}_3$  is a covalent compound, in which P and H are connected through covalent bonds.
- 8 Which of these is a **saturated organic** molecule?
- A propene
  - B carbon dioxide
  - C octane
  - D ethyne
  - E cyclopentene

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Items 9-18 refer to the following five options. You may use each option once, more than once, or not at all.

A N

B Cl

C Ne

D Na

E Fe

- 9 Which element forms a +1 ion exclusively?
- 10 Which element forms a -3 ion?
- 11 Which element combines in a 1:1 ratio with potassium to form an ionic compound?
- 12 Which element does not form compounds?
- 13 Which element forms cations that need Roman numerals to specify their charges in the names of compounds?
- 14 If you have a 1-mole sample of each element, which sample has the greatest mass?
- 15 Which element is a halogen?
- 16 Which of the elements is a transition metal?
- 17 Which element has one valence electron in its neutral atoms?
- 18 Which element has the highest electronegativity?

The descriptions in Items 19-23 refer to the following five options. You may use each option once, more than once, or not at all.

A Na

B O<sub>2</sub>

C Cl

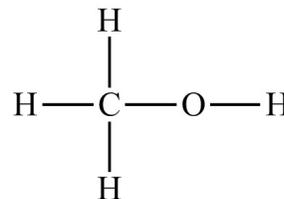
D NaCl

E ClO<sub>2</sub>

- 19 A diatomic molecule
- 20 A substance with a molar mass of 32 g
- 21 A metallic element
- 22 A molecular/covalent compound
- 23 An ionic compound

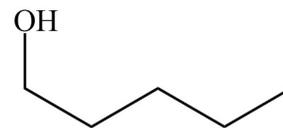
24 How many **bonding electrons** are there in a molecule of methanol (shown at right)?

- A 4                      B 5                      C 10                      D 14                      E 18

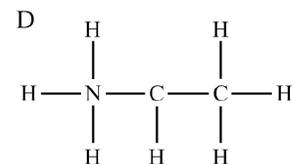
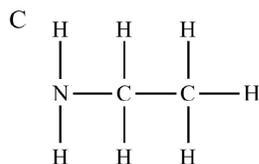
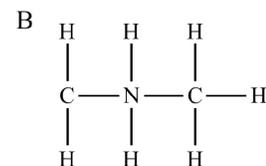
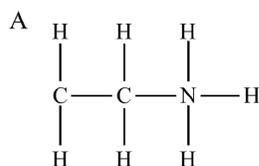


25 How many **carbon atoms** are there in the molecule shown at right?

- A 0 (this molecule does not contain carbon)  
 B 5                      C 6                      D 10                      E 22



26 Based on the normal bonding patterns of the atoms involved, which of the structures shown is most likely to exist?



27 Mark **both** the “A” and “E” spaces on your Scantron card. (This item is a form identifier and will not be scored.)