PRACTICE Midterm 1
120 pts
This was once a REAL Exam; it is intended to be given in an 90 minute time frame; Take it as such!
NO answers will be provided; come by and ask questions if you have them
PLEASE NOTE: This is a PRACTICE exam and the real thing may be different!

These are the REAL instructions you will see on the exam

<table>
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<th>INSTRUCTIONS</th>
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<tr>
<td>1. Put your Name and ID number on this page. PUT THE SAME INFORMATION ON YOUR SCANTRON AS WELL.</td>
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<td>2. FOR CALCULATION QUESTIONS ALL WORK GOES ON THIS EXAM.</td>
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<td>3. When finished, bring BOTH your scantron and this exam to front of class</td>
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<td>4. CLOSED BOOK EXAM. You are allowed only the periodic table provided. Non-graphing, non-programmable calculators are allowed but may NOT be shared. Violations will be treated with the harshest response allowed by the University.</td>
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KEEP YOUR EXAM COVERED AT ALL TIMES.
CALCULATION QUESTIONS (Pts as listed). All work goes on this exam. Show all work to receive any credit. No work = no points.

1A. (20 pts) One of the favorite ‘diversions’ of theoretical organic chemists is to try to make unusual organic hydrocarbons (compounds containing only carbon and hydrogen) in attempts to test the limits of bonding theory, structural theory, etc. One of these molecules is “fenstane”. Combustion of 95.0 mg of “fenstane” produced 313.09 mg of carbon dioxide and 85.46 mg of water. Given that the molar mass of “fenstane” is 120.20 g/mol, calculate its empirical and molecular formula.

2A. When aqueous cobalt (III) nitrate is reacted with sodium sulfide a black precipitate of cobalt (III) sulfide is formed, along with aqueous sodium nitrate.

a) (5 pts) Write a balanced equation for this reaction (NOTE: If you want, the answer to this part can be ‘bought’ for 5 points)

b) (10 pts) Calculate the expected yield of cobalt (III) sulfide if 15.30 g of cobalt (III) nitrate is reacted with 20.22 g of sodium sulfide

c) (5 pts) If the actual yield is 88%, calculate the amount of cobalt (III) sulfide actually formed.

Multiple Choice Problems (Point values as indicated). Select the best answer from the choices given and MARK IT ON YOUR SCANTRON.

Questions 1-14 are worth 6 points each

1. Calculate the number of oxygen atoms in 29.34 g of sodium sulfate, Na₂SO₄.
   a. 1.244 × 10²³ O atoms  
   b. 4.976 × 10²³ O atoms  
   c. 2.409 × 10²⁴ O atoms  
   d. 2.915 × 10²⁴ O atoms  
   e. 1.166 × 10²⁵ O atoms

2. Hydroxylamine nitrate contains 29.17 mass % N, 4.20 mass % H, and 66.63 mass O. If its molar mass is between 94 and 98 g/mol, what is its molecular formula?
   a. NH₂O₅  
   b. N₂H₄O₄  
   c. N₃H₃O₃  
   d. N₄H₈O₂  
   e. N₂H₄O₄

3. If 10.0 mL of 1.20 M AgNO₃(aq) are added to 64.00 mL of 0.200 M HCl(aq), how many moles of AgCl(s) are produced?
   a) 0.0128 mol  
   b) 0.200 mol  
   c) 0.0120 mol  
   d) 0.0240 mol  
   e) 1.20 mol
4. Aluminum reacts with oxygen to produce aluminum oxide which can be used as an adsorbent, desiccant or catalyst for organic reactions.

\[ 4\text{Al}(s) + 3\text{O}_2(g) \rightarrow 2\text{Al}_2\text{O}_3(s) \]

A mixture of 82.49 g of aluminum \((M = 26.98 \text{ g/mol})\) and 117.65 g of oxygen \((M = 32.00 \text{ g/mol})\) is allowed to react. Identify the limiting reactant and determine the mass of the excess reactant present in the vessel when the reaction is complete.

a. Oxygen is the limiting reactant; 19.81 g of aluminum remain.
b. Oxygen is the limiting reactant; 35.16 g of aluminum remain.
c. Aluminum is the limiting reactant; 16.70 g of oxygen remain.
d. Aluminum is the limiting reactant; 35.16 g of oxygen remain.
e. Aluminum is the limiting reactant; 44.24 g of oxygen remain.

5. Lead is obtained from the mineral galenite. The storage bin for the galenite must be able to hold 50,000 kg of galenite. If the density of galenite is 7.51 g/cm\(^3\), what volume does the storage bin need to be so as to hold the galenite?

a) \(376 \text{ m}^3\)  
b) \(6.66 \text{ m}^3\)  
c) \(150 \text{ m}^3\)  
d) \(6.66 \times 10^{-3} \text{ m}^3\)  
e) \(6.66 \times 10^4 \text{ m}^3\)

6. Barium fluoride is used in embalming and in glass manufacturing. Which of the following gives the formula and bonding for barium fluoride?

a. \(\text{BaF}_2\), ionic compound  
b. \(\text{BaF}_2\), covalent compound  
c. \(\text{BaF}\), ionic compound  
d. \(\text{BaF}\), covalent compound  
e. \(\text{Ba}_2\text{F}\), ionic compound

7. Lithium forms compounds which are used in dry cells and storage batteries and in high-temperature lubricants. It has two naturally occurring isotopes, \(^{6}\text{Li}\) (isotopic mass = 6.015121 amu) and \(^{7}\text{Li}\) (isotopic mass = 7.016003 amu). Lithium has an atomic mass of 6.9409 amu. What is the percent abundance of lithium-6?

a. 92.50%  
b. 86.66%  
c. 46.16%  
d. 7.503%  
e. 6.080%

8. Calculate the molar mass of \(\text{Ca(BO}_2)_2\cdot6\text{H}_2\text{O}\).

a. 273.87 g/mol  
b. 233.79 g/mol  
c. 183.79 g/mol  
d. 174.89 g/mol  
e. 143.71 g/mol

9. Which of the following is a metalloid?

a. carbon, \(Z = 6\)  
b. sulfur, \(Z = 16\)  
c. germanium, \(Z = 32\)  
d. iridium, \(Z = 77\)  
e. bromine, \(Z = 35\)

10. The colorless substance, \(\text{MgF}_2\), is used in the ceramics and glass industry. What is its name?

a. magnesium difluoride  
b. magnesium fluoride  
c. magnesium(II) fluoride  
d. monomagnesium difluoride  
e. none of the above, since they are all misspelled
11. What is the percent yield for the reaction if 119.3 g of PCl₅ \((M = 208.2 \text{ g/mol})\) are formed when 61.3 g of Cl₂ \((M = 70.91 \text{ g/mol})\) reacts with excess PCl₃?

\[
\text{PCl}_3(g) + \text{Cl}_2(g) \rightarrow \text{PCl}_5(g)
\]

a. 195%  
 b. 85.0%  
 c. 66.3%  
 d. 51.4%  
 e. 43.7%

12. The chemical formula Ga₂O₃ indicates

a) two atoms of gallium and three atoms of oxygen
b) three atoms of gallium and two atoms of oxygen
c) six atoms of each element
d) five atoms of each element
e) none of these

13. Potassium perchlorate can be produced from the reactions below.

\[
\begin{align*}
\text{Cl}_2(g) + 2\text{KOH(aq)} &\rightarrow \text{KCl(aq)} + \text{KClO(aq)} + \text{H}_2\text{O(l)} \\
3\text{KClO(aq)} &\rightarrow 2\text{KCl(aq)} + \text{KClO}_3(aq) \\
4\text{KClO}_3(aq) &\rightarrow 3\text{KClO}_4(s) + \text{KCl(aq)}
\end{align*}
\]

How many moles of KClO₄(s) are produced from 10.0 mol of KOH(aq)?

a) 1.67 mol  
 b) 10.0 mol  
 c) 1.25 mol  
 d) 5.00 mol  
 e) 15.0 mol

14. Calculate the mass of sodium sulfate required to make 2.50 L of a 1.09 M Na₂SO₄(aq) solution.

a) 379 g  
 b) 72.0 g  
 c) 450 g  
 d) 2.73 g  
 e) 180 g

15. (4 Pts) This is Version A. Mark “A” as the answer to this question and bubble it in the “TEST FORM” box on your scantron (below ID number): (4 points ONLY if you do BOTH)

VERSION A = a