Chemistry 131
Final Exam

Name:

SSN:

Exam Rules & Guidelines

- **Show your work.** No credit will be given for an answer unless your work is shown. Indicate your answer with a box or a circle.

- Enter the correct letter of the answer to each question on the scantron sheet provided. There is only one correct answer to each question.

- **TURN OFF** your cell phone. If it rings, your exam will be collected and graded as is.

- **Calculators:** You may not share calculators during the exam.
1. On January 15, 2004, the temperature reached -45º F on Mt. Washington in New Hampshire. What is this temperature expressed in K?

(A) – 77 K  
(B) 135 K  
(C) 230 K  
(D) 273 K

2. Convert 3 kilograms to milligrams.

(A) 3 X 10⁶  
(B) 3 X 10⁵  
(C) 3 X 10⁻³  
(D) 3 X 10⁻⁶

3. Lithium is a soft, gray solid that has the lowest density of any metal. It is an essential component of some advanced batteries, such as the one in your laptop. If a small slab of lithium weighs 1.49 grams and a volume of 2.76 mL, what is the density (g/mL) of the piece of lithium?

(A) 540.  
(B) 0.540  
(C) 1.85  
(D) 0.00185

4. Which of the following represents a physical change?

(A) dripping water on a hot skillet and converting it to steam  
(B) boiling an egg  
(C) striking a match  
(D) lighting a gas grill

5. Which set of numbers correctly completes the following table?

<table>
<thead>
<tr>
<th>Number of Electrons</th>
<th>Number of Protons</th>
<th>Number of Neutrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>54 Cr</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(A) 24, 24, 24  
(B) 54, 24, 30  
(C) 24, 24, 54  
(D) 24, 24, 30
6. What is the sum of the following three volumes reported to the correct number of significant figures? (Note the units.)

\[ 0.135 \text{ L} + 15 \text{ mL} + 1.7 \text{ mL} = \underline{\quad} \text{ mL} \]

(A) 152 mL  
(B) 16.84 mL  
(C) 30.2 mL  
(D) cannot be determined since the units are not the same

Questions 7 through 9 refer to the diagram shown below:

```
A  B  C  D  E  F  G  H  I
```

7. Which group of elements is most likely to form ions with a –1 charge?

(A) A  
(B) D  
(C) F  
(D) H

8. When elements in column B react with elements in column G, the general formula for the compound formed is:

(A) BG  
(B) B₂G  
(C) BG₂  
(D) B₂G₃

9. When elements from column A combine with a sulfate ion, the general formula for the compound formed is:

(A) ASO₄  
(B) A₂SO₄  
(C) A₂(SO₄)₃  
(D) A(SO₄)₂
10. When 0.4200 inches is converted to cm, how many significant figures should be used to express the answer?

(A) 2  
(B) 3  
(C) 4  
(D) 5

11. If you measure a line to be 0.4200 inches, how many meters is that?

(A) 0.1650  
(B) 0.00106  
(C) 1.067  
(D) 0.01067

12. \( \text{N}_2\text{O}_3 \) is:

(A) Nitrogen oxide  
(B) Nitrogen (III) oxide  
(C) Nitrogen trioxide  
(D) Dinitrogen trioxide

13. How many moles of \( \text{Fe}_2\text{O}_3 \) are there in 17.0 g of \( \text{Fe}_2\text{O}_3 \)?

(A) 9.39 mol  
(B) 1.06 mol  
(C) 0.212 mol  
(D) 0.106 mol

14. 9.0 grams of water (\( \text{H}_2\text{O} \)) contains how many water molecules?

(A) 1.5  
(B) 3.0  
(C) \( 3.0 \times 10^{23} \)  
(D) \( 1.8 \times 10^{24} \)

15. What is the coefficient on ammonia (\( \text{NH}_3 \)) when the following equation is completed and balanced using whole number coefficients?

\[
\text{NH}_3 + \ O_2 \rightarrow \ \text{NO} + \ \text{H}_2\text{O}
\]

(A) 1  
(B) 2  
(C) 3  
(D) 4
16. Which of the following is not soluble in water?

(A) KCl  
(B) Ba(NO₃)₂  
(C) CaCO₃  
(D) NH₄Cl

17. Which one of the following is NOT a strong electrolyte in aqueous solution?

(A) CH₄  
(B) NaOH  
(C) H₂SO₄  
(D) KCl

18. Identify the what type the following reaction is:

\[ 2 \text{P}_2\text{O}_5(s) \rightarrow \text{P}_4(s) + 5 \text{O}_2(g) \]

(A) combination reaction  
(B) decomposition reaction  
(C) single replacement reaction  
(D) double replacement reaction

For Questions 19 & 20, consider the decomposition of hydrogen peroxide:

\[ 2 \text{H}_2\text{O}_2(l) \rightarrow 2 \text{H}_2\text{O}(l) + \text{O}_2(g) \]

19. If 2.0 moles of O₂(g) are formed, how many moles of H₂O(l) will also be formed?

(A) 1.0  
(B) 2.0  
(C) 3.0  
(D) 4.0

20. If 5.0 grams of peroxide (H₂O₂) decomposes, how many grams of O₂(g) are produced?

(A) 2.4 g  
(B) 1.2 g  
(C) 4.7 g  
(D) 9.4 g
21. Exactly 25.0 mL of 12.0 M HCl is diluted to give a total volume of 250.0 mL. What is the new molarity of the diluted HCl solution?

(A) 0.0750 M  
(B) 0.833 M  
(C) 521 M  
(D) 1.20 M

22. How many Joules of heat are required to warm 25.0 g of ice from –30.0 °C to –10.0 °C? The specific heat of ice is 4.18 J/g-°C.

(A) 1.03 X 10³ J  
(B) 2.09 X 10³ J  
(C) 209 J  
(D) 103 J

23. How many calories of heat are released when 56.5 grams of liquid water is converted to steam?

(A) 3.05 X 10⁴  
(B) 4.52 X 10³  
(C) 1.89 X 10⁴  
(D) 236

24. A sample of 1 mole of argon gas occupies 105 mL at 0.871 atm. If the temperature remains constant, what is the volume (in Liters) at 0.2596 atm?

(A) 352 L  
(B) 0.352 L  
(C) 0.0313 L  
(D) 31.3 L

25. A volume of 0.0315 L of H₂SO₄ (aq) of an unknown concentration was used to neutralize 0.0239 L of a 0.0134 M solution NaOH (aq). What was the concentration (M) of the acid?

(A) 0.0102 M  
(B) 0.0051 M  
(C) 0.0204 M  
(D) 0.102 M
26. If 35g of HNO$_3$ (Molar Mass = 63.0g/mol) is dissolved in 400 mL of water, the Molarity of the resulting solution is

(A) 0.22 M  
(B) 0.56 M  
(C) 0.72 M  
(D) 1.4 M

27. Fill in the blank in the following bombardment reaction. Identify the new nucleus that is formed:

\[
\begin{array}{ccc}
12 & 16 & 0 \\
C & O & \rightarrow \\
6 & 8 & 0 \\
\end{array}
\]

(A) N  
(B) Si  
(C) Al  
(D) Cannot be determined

28. The following symbol:

\[
\begin{array}{c}
\text{He} \\
2 \\
\end{array}
\]

indicates which type of radioactive particle?

(A) alpha particle  
(B) beta particle  
(C) gamma ray  
(D) positron
Chemistry 131
Final Exam Information

General Formulas

Temperature:
°F = 1.8(°C) + 32
K = °C + 273

Conversions:
1 inch = 2.54 cm
1 m = 1.094 yards
1 km = 0.62 miles
1 lb = 454 grams
1 kg = 2.205 lb
1 cm³ = 1 mL
1 cal = 4.18 J
1 atm = 760 mm Hg = 760 torr

Equations:
heat = grams * ΔT * specific heat
heat = grams * heat fusion
heat = grams * heat vaporization
Molarity = \(\frac{\text{moles}}{\text{Liters}}\)

\[M_1V_1 = M_2V_2\]

\[M_AV_A(\text{#H}) = M_BV_B(\text{#OH})\]

\[\frac{P_1}{T_1} = \frac{P_2}{T_2}\]

\[\frac{V_1}{T_1} = \frac{V_2}{T_2}\]

\[\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}\]

Constants:
Avogadro’s Number: 1 mole = 6.02 X 10²³ particles

Heat of Fusion: \(\frac{80 \text{ cal}}{\text{g}}\) or \(\frac{334 \text{ J}}{\text{g}}\)

Heat of Vaporization: \(\frac{540 \text{ cal}}{\text{g}}\)
### Polyatomic Ions

<table>
<thead>
<tr>
<th>Charge</th>
<th>Ion Symbol</th>
<th>Ion Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1+</td>
<td>NH₄⁺</td>
<td>ammonium ion</td>
</tr>
<tr>
<td></td>
<td>H₃O⁺</td>
<td>hydronium ion</td>
</tr>
<tr>
<td>1-</td>
<td>HCO₃⁻</td>
<td>bicarbonate ion</td>
</tr>
<tr>
<td></td>
<td>NO₃⁻</td>
<td>nitrate ion</td>
</tr>
<tr>
<td></td>
<td>NO₂⁻</td>
<td>nitrite ion</td>
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<tr>
<td></td>
<td>CN⁻</td>
<td>cyanide ion</td>
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<tr>
<td></td>
<td>ClO₃⁻</td>
<td>chlorate ion</td>
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<tr>
<td></td>
<td>ClO₄⁻</td>
<td>perchlorate ion</td>
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<tr>
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<td>OH⁻</td>
<td>hydroxide ion</td>
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<td>2⁻</td>
<td>CO₃²⁻</td>
<td>carbonate ion</td>
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<td></td>
<td>SO₄²⁻</td>
<td>sulfate ion</td>
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<tr>
<td></td>
<td>SO₃²⁻</td>
<td>sulfite ion</td>
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<tr>
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<td>PO₄³⁻</td>
<td>phosphate ion</td>
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<tr>
<td>3⁻</td>
<td>NO₂⁻</td>
<td>nitrite ion</td>
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<tr>
<td></td>
<td>SO₃²⁻</td>
<td>sulfite ion</td>
</tr>
<tr>
<td></td>
<td>CrO₄²⁻</td>
<td>chromate ion</td>
</tr>
</tbody>
</table>

### Solubility of Ionic Compounds

#### Soluble Ionic Compounds

<table>
<thead>
<tr>
<th>Compounds Containing</th>
<th>Important Exceptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO₃⁻</td>
<td>None</td>
</tr>
<tr>
<td>Compounds containing Group IA ions and NH₄⁺</td>
<td>None</td>
</tr>
<tr>
<td>CH₃COO⁻</td>
<td>None</td>
</tr>
<tr>
<td>Cl⁻, Br⁻, and I⁻</td>
<td>Compounds of Ag⁺, Hg₂²⁺, and Pb²⁺</td>
</tr>
<tr>
<td>SO₄²⁻</td>
<td>Compounds of Sr²⁺, Ba²⁺, and Pb²⁺</td>
</tr>
</tbody>
</table>

#### Insoluble Ionic Compounds

<table>
<thead>
<tr>
<th>Compounds Containing</th>
<th>Important Exceptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>S²⁻</td>
<td>Compounds of NH₄⁺, the alkali metals, &amp; Ca²⁺, Sr²⁺, and Ba²⁺</td>
</tr>
<tr>
<td>CO₃²⁻</td>
<td>Compounds containing NH₄⁺ and the alkali metals</td>
</tr>
<tr>
<td>PO₄³⁻</td>
<td>Compounds containing NH₄⁺ and the alkali metals</td>
</tr>
<tr>
<td>OH⁻</td>
<td>Compounds containing the alkali metals &amp; Ca²⁺, Sr²⁺, and Ba²⁺</td>
</tr>
</tbody>
</table>