Chemistry 105aL
Spring 1999
Exam 1
Tuesday, Feb. 2, 1999
Professor H.S. Taylor

First Letter of
Last name

PLEASE PRINT YOUR NAME IN BLOCK LETTERS

Name: ____________________________

Soc. Sec. #: _______________________

TA's Name: ________________________

Lab Day and Time: __________________

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<tr>
<th>QUESTION</th>
<th>MAXIMUM POINTS</th>
<th>SCORE</th>
<th>GRADER</th>
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<tbody>
<tr>
<td>I</td>
<td>40</td>
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<td>II</td>
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<td>Total</td>
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The following information may be useful:

Please Sign Below:

I certify that I have observed all the rules of Academic Integrity while taking this examination.

Signature: __________________________

1. You must use black ink.
2. There are 5 problems on 6 pages. Please count them before you begin.

Proton mass = 1.00728 amu
Neutron mass = 1.00866 amu
h = 6.626 x 10^-34 J·s Planck's Constant

Electron mass = 0.000549 amu
Avogadro's number = 6.02 x 10^{23} atoms/mole
C = 2.9979 x 10^8 m/s the speed of light
I. (40 pts.)

1. (4 pts.) Which of the following metric relationships is incorrect?
   a) 1 microliter = 10^{-6} liters
   b) 1 megagram = 10^6 grams
   c) 1 millimeter = 10^3 meters
   d) 1 kilogram = 10^3 grams
   e) 100 centimeters = 1 meter

   Answer: c) 1 millimeter = 10^3 meters

2. (4 pts.) A titration was performed to find the concentration of hydrochloric acid with the following results:

<table>
<thead>
<tr>
<th>Trial</th>
<th>Molarity</th>
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<tbody>
<tr>
<td>1</td>
<td>1.25 ± 0.01</td>
</tr>
<tr>
<td>2</td>
<td>1.24 ± 0.01</td>
</tr>
<tr>
<td>3</td>
<td>1.26 ± 0.01</td>
</tr>
</tbody>
</table>

   The actual concentration of HCl was determined to be 1.000 M; the results of the titration are:

   a) both accurate and precise.
   b) accurate but imprecise.
   c) precise but inaccurate.
   d) both inaccurate and imprecise.
   e) accuracy and precision are impossible to determine with the available information.

   Answer: c) precise but inaccurate.

3. (4 pts.) How many significant figures are there in the number 0.0322?
   a) 3
   b) 5
   c) 4
   d) 2
   e) 0

   Answer: a) 3
4. (8 pts.) A piece of indium with a mass of 16.6 g is submerged in 46.3 cm$^3$ of water in a graduated cylinder. The water level increases to 48.6 cm$^3$. The correct value for the density of indium from these data is:

a) 7.217 g/cm$^3$
b) 7.2 g/cm$^3$
c) 0.14 g/cm$^3$
d) 0.138 g/cm$^3$
e) more than 0.1 g/cm$^3$ away from any of these values.

Answer: **b) 7.2 g/cm$^3$**

5. (4 pts.) Using the rules of significant figures, calculate the following:

\[ 4.0021 - 0.004 \]

a) 3.998
b) 4
c) 3.9981
d) 4.00
e) 4.0

Answer: **a) 3.998**

6. (4 pts.) 100 seconds contain this many nanoseconds.

a) 1x10$^7$
b) 1x10$^{11}$
c) 1x10$^{10}$
d) 1x10$^{12}$
e) 1x10$^8$

Answer: **b) 1x10$^{11}$**

7. (4 pts.) Which of the following pairs of compounds can be used to illustrate the law of multiple proportions?

a) NH$_4$ and NH$_4$Cl
b) ZnO$_2$ and ZnCl$_2$
c) H$_2$O and HCl
d) NO and NO$_2$
e) CH$_4$ and CO$_2$

Answer: **d) NO and NO$_2$**
8. (8 pts.) $^{40}_{20}Ca^{2+}$ has

a) 20 protons, 20 neutrons, and 18 electrons.
b) 22 protons, 20 neutrons, and 20 electrons.
c) 20 protons, 22 neutrons, and 18 electrons.
d) 22 protons, 18 neutrons, and 18 electrons.
a) 20 protons, 20 neutrons, and 12 electrons.

Answer: a) 20 protons, 20 neutrons, and 18 electrons.

II. (10 pts.) Write the names of the following compounds:

1. FeSO$_4$ iron(II) sulfate
2. NaC$_2$H$_3$O$_2$ sodium acetate
3. KNO$_2$ potassium nitrite
4. Ca(OH)$_2$ calcium hydroxide
5. NiCO$_3$ nickel(II) carbonate

III. (10 pts.) Write the chemical formulas for the following compounds or ions.

1. nitrate ion $NO_3^-$
2. aluminum oxide $Al_2O_3$
3. ammonium ion $NH_4^+$
4. perchloric acid $HClO_4$
5. copper (II) bromide $CuBr_2$
IV. (20 pts.) Phenol is a compound that contains 76.5% carbon, 6.43% hydrogen, and 17.0% oxygen. The empirical formula of phenol is

1. CHO
2. CH₂O
3. C₃H₃O
4. C₂H₂O
5. C₆H₅O

\[
\text{Answer: } 5. \text{C}_6\text{H}_5\text{O}
\]

V. (20 pts.) When 125.0 g of ethylene (C₂H₄) burns in oxygen to give carbon dioxide and water, how many grams of CO₂ are formed?

1. 392.2 g
2. 250.0 g
3. 57.50 g
4. 425.6 g
5. 327.0 g

\[
\text{Answer: } 1. \text{392.2 g}
\]

\[
\text{C}_2\text{H}_4 + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 2\text{H}_2\text{O}
\]

\[
125.0\text{ g C}_2\text{H}_4 \times \frac{\text{mol C}_2\text{H}_4}{28.05\text{ g}} \times \frac{2\text{ mol CO}_2}{1\text{ mol C}_2\text{H}_4} \times \frac{44.01\text{ g CO}_2}{1\text{ mol CO}_2} = 392.2\text{ g CO}_2
\]