# General Chemistry 1 (CHEM 1141)
## Shawnee State University – Fall 2019
### September 26, 2019

# Exam # 1 B

Name _____ KEY _____

*Please write your full name, and the exam version (1 B) that you have on the scantron sheet !*
*(Bubble in the best answer choice for each question on the green & white scantron sheet in pencil !)*

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Please ☑ check the box next to your correct section number.

**Section #:**   ☐ 1. (Monday Lab, 11:10 AM – 1:55 PM)   ☐ 2. (Wednesday Lab, 11:10 AM – 1:55 PM)

☐ 3. (Monday Lab, 2:30 PM – 5:20 PM)   ☐ 4. (Wednesday Lab, 2:30 PM – 5:20 PM)

☐ 5. (Thursday Lab, 12:30 PM – 3:20 PM)   ☐ 6. (Tuesday Lab, 12:30 PM – 3:20 PM)

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| | | |
|---|---|---|
| **Multiple Choice:** | _____ | / 50 |
| **Q21:** | _____ | / 10 |
| **Q22:** | _____ | / 10 |
| **Q23:** | _____ | / 10 |
| **Q24:** | _____ | / 10 |
| **Q25:** | _____ | / 10 |
| **BONUS:** | _____ | / 3 |
| **TOTAL:** | _____ | / 100 |

Q1.   The chemical formula for the compound formed from the elements calcium and phosphorus is expected to be:
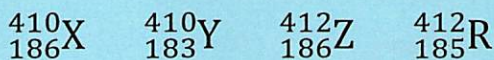
$Ca^{2+}$  $P^{3-}$

A) $Ca_3P$

B) $Ca_2P_3$

C) $CaP_2$
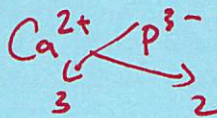
D) $Ca_3P_2$

Q2.   Of the following, _____ is the smallest mass:

A) 0.25 kg      $0.25 \, Kg \times \frac{10^3 g}{Kg} = 250 g$

B) $2.5 \times 10^{-2}$ mg      $2.5 \times 10^{-2} mg \times \frac{10^{-3} g}{mg} = 2.5 \times 10^{-5} g$  * smallest

C) $2.5 \times 10^{15}$ pg      $2.5 \times 10^{15} pg \times \frac{10^{-12} g}{pg} = 2.5 \times 10^3 g$

D) $2.5 \times 10^{10}$ ng      $2.5 \times 10^{10} ng \times \frac{10^{-9} g}{ng} = 2.5 \times 10^1 g$

Q3.   Atoms X, Y, Z, and R have the following nuclide symbols:

$$^{410}_{186}X \qquad ^{410}_{183}Y \qquad ^{412}_{186}Z \qquad ^{412}_{185}R$$

Which two are isotopes?

$\# p^+ / same$, so isotopes !)

A) X & Y

B) X & Z

C) Y & R

D) Z & R

Q4.   Calculate the molar mass of $Ca(BO_2)_2 \cdot 6H_2O$

A) 273.87 g/mol

B) 233.80 g/mol

C) 183.79 g/mol

D) 174.89 g/mol

$1 \times Ca = 1 \times 40.08$
$2 \times B = 2 \times 10.81$
$4 \times O = 4 \times 16.00$
$12 \times H = 12 \times 1.008$
$6 \times O = 6 \times 16.00$
$233.80 g/mol$

—2—

Q5.  Potassium dichromate, $K_2Cr_2O_7$, is used in tanning leather, decorating porcelain, and water proofing fabrics. Calculate the number of chromium atoms in 78.82 g of $K_2Cr_2O_7$.

A) $9.490 \times 10^{23}$ Cr atoms

B) $2.248 \times 10^{24}$ Cr atoms

C) $1.124 \times 10^{24}$ Cr atoms

D) $3.227 \times 10^{23}$ Cr atoms

$2 \times K = 2 \times 39.10$
$2 \times Cr = 2 \times 52.00$
$7 \times O = \underline{7 \times 16.00}$
$294.20 \, g/mol$

$78.82 \, g \; K_2Cr_2O_7 \times \dfrac{1 mol \; K_2Cr_2O_7}{294.20 g \; K_2Cr_2O_7} \times \dfrac{6.022 \times 10^{23} \; K_2Cr_2O_7}{1 mol \; K_2Cr_2O_7} \times \dfrac{2 \, atoms \; Cr}{1 \; K_2Cr_2O_7} =$

$3.227 \times 10^{23} \, atoms$
$Cr.$

Q6.  Which of the following statements about subatomic particles is FALSE?

A) A neutral atom contains the same number of protons as electrons

B) Protons have about the same mass as electrons      $M_p \approx 2000 \times M_e$

C) Neutrons have no charge

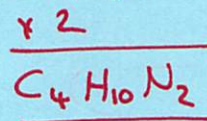D) Protons and electrons have opposite charges, but are equal in magnitude

Q7.  Give a possible molecular formula for the empirical formula of $C_2H_5N$

A) $C_4H_{10}N$

B) $C_5H_{10}N_2$

C) $C_4H_{10}N_2$

D) $C_6H_{15}N$

$\times 2$
$C_4 H_{10} N_2$

Q8.  Calculate the mass percent composition of sulfur in $Al_2(SO_4)_3$

A) 28.12%

B) 9.372%

C) 42.73%

D) 21.38%

$\%S = \dfrac{3 \times 32.07 g/mol}{342.17 g/mol} \times 100 = 28.12\%$

$2 \times Al = 2 \times 26.98$
$3 \times S = 3 \times 32.07$
$12 \times O = \underline{12 \times 16.00}$
$342.17 g/mol$

Q9.  Which response contains an element, compound, and homogenous mixture in that order:

A) silicone, water, vegetable soup

B) beryllium, salt, earl grey tea (hot)

C) sulfate, baking powder, sugar

D) rubidium, flour, baking soda

Q10. The element _____ is the most similar to strontium in chemical and physical properties     group 2A

A) Li

B) At

C) Rb

D) Ba     group 2A

Q11. Aluminum oxide, $Al_2O_3$, is used as a filler for paints and varnishes, as well as in the manufacture of electrical insulators. Calculate the number of moles in 47.51 g of $Al_2O_3$.

A) 2.377 mol

B) 2.146 mol

C) 1.105 mol

D) 0.4660 mol

$47.51g\ Al_2O_3 \times \dfrac{1mol\ Al_2O_3}{101.96g\ Al_2O_3} = 0.4660\ mol\ Al_2O_3$

$2 \times Al = 2 \times 26.98$
$3 \times O = 3 \times 16.00$
$\overline{101.96 g/mol}$

Q12. Which of the following is an example of an intensive property?

A) temperature     independent of amount!

B) volume

C) length

D) mass

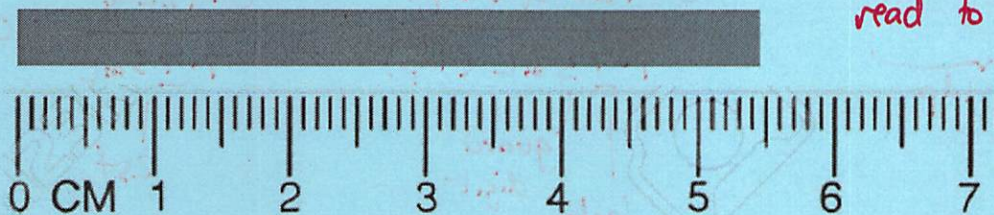Q13. Which of the following contains the **most** atoms?

A) 10.0 g Na

B) 10.0 g Li

C) 10.0 g K

D) 10.0 g Rb

$\# mol = \dfrac{\# g}{molar\ mass}$

− smallest mol mass = largest # mol atoms!

—4—

Q14. Read the following scale to the correct number of significant figures:

*read to $\frac{1}{10}$ division*

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||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||
0 CM 1      2      3      4      5      6      7
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A) 5.4 cm

B) 5.5 cm

C) 5.42 cm ⟵ *(circled)*

D) 5.420 cm

Q15. A piece of metal ore weighs 9.25 g. When a student places it into a graduated cylinder containing water, the liquid level rises from 21.25 mL to 26.47 mL. What is the density of the ore?

$$d = \frac{m}{V} = \frac{9.25g}{26.47mL - 21.25mL} = 1.77 \text{ g/mL}$$

A) 0.340 g/mL

B) 0.564 g/mL

C) 1.77 g/mL ⟵ *(circled)*

D) 2.94 g/mL

Q16. Which of the following numbers has the **greatest** number of significant figures?

A) 0.5070  *4 sf (circled)*

B) 0.201  *3 sf*

C) 418000  *3 sf*

D) $1.06 \times 10^{24}$  *3 sf*

*few!*   *gold foil*  *some*

*α-particles*  *most*
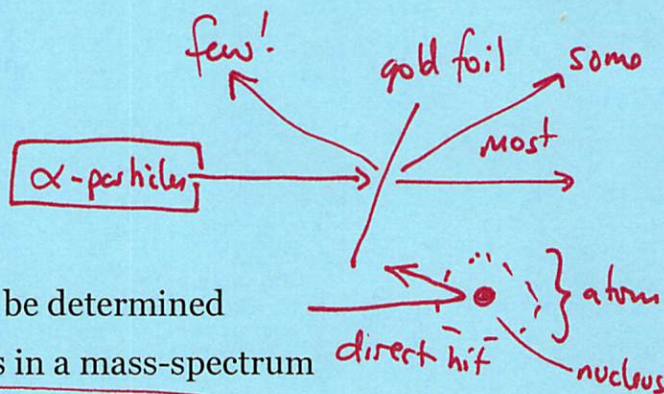
Q17. Rutherford's gold foil experiment showed:

A) The mass to charge ratio of an electron could be determined

B) The existence of isotopes from multiple peaks in a mass-spectrum   *direct hit*

C) The atom contains a tiny nucleus with >99% of the total mass ⟵ *(circled)*   *nucleus*   *atom*

D) Metals can be made into extremely thin sheets limited by the dimensions of the electron cloud

**Q18.** Using the significant-figure/decimal-place rules, evaluate the following expression:

$$\frac{(10.3458\text{ g}-9.4238\text{ g})}{(4.3\text{ mL}+3.43\text{ mL})} = \frac{0.9220\text{ g (4dp)}}{7.73\text{ mL (1dp)}} = \frac{0.9220\text{ g}}{7.73\text{ mL}} = 0.12\underline{9}\frac{\text{g}}{\text{mL}}\text{ (2sf)}$$

(handwritten annotations: 4dp over numerator; 1dp under denominator; 4dp; 4sf; guard digit; last sig fig; 2sf)

A) 0.1 g/mL    1dp

B) 0.12 g/mL   *(circled)*

C) 0.120 g/mL

D) 0.1197 g/mL

**Q19.** Element X consists of two isotopes: X-23, with an abundance of 32.00% and a mass of 23.00 u; and X-25, with an abundance of 68.00% and a mass of 25.00 u. Calculate its atomic mass from this information.

A) 23.32 u

B) 23.68 u

C) 24.00 u

D) 24.36 u   *(circled)*

$$23.00\text{u}\times\left(\frac{32.00}{100}\right) + 25.00\text{u}\times\left(\frac{68.00}{100}\right) = 24.36\text{u}$$

$$\sum \begin{matrix}\text{isotope} \\ \text{mass}\end{matrix} \times \begin{pmatrix}\text{relative} \\ \text{abundance}\end{pmatrix} = \text{atomic mass}$$

**Q20.** Identify the element that is in the 4th period & group 6A of the periodic table.

A) selenium   *(circled)*

B) tellurium

C) lead

D) chromium

(handwritten annotations: row; column (main group); 1A  2A .... 3A  4A  5A  6A ; rows 1 2 3 4 ; Se)

Each problem in this section (short answer) is worth 10 points !

All work must be show in order to receive credit !

You must use the factor–label (conversion–factor) method for all conversions !

Be sure to include units where applicable !

All numeric answers must be rounded to the correct number of significant figures !

Q21.  Place the correct number of the element or ion next to the letter that best matches.
*(use each number only once)*

**9** A.      an alkali metal

**4** B.      an element likely to form a 2– ion

**8** C.      a metalloid

**7** D.      a diatomic element

**10** E.      a polyatomic ion with a charge of 2–

**3** F.      an element in period 4

**6** G.      a polyatomic ion with a charge of 1+

**5** H.      an element with 12 protons

**1** I.      a transition metal element

**2** J.      an inner-transition metal element

1.  gold

2.  uranium

3.  Kr

4.  sulfur

5.  magnesium

6.  ammonium

7.  chlorine

8.  silicon

9.  cesium

10.  sulfite

**Q22.** A compound is analyzed and found to contain (by mass):

**69.94 % iron and 30.06 % oxygen**

(i) Calculate the empirical formula for this compound.
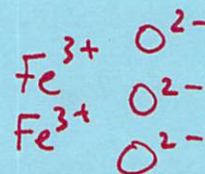
(ii) What is the name of this compound?

Assume 100-g

$69.94g\ Fe \times \dfrac{1\ mol\ Fe}{55.85g\ fe} = 1.252\ mol\ fe$

$30.06g\ O \times \dfrac{1\ mol\ O}{16.00g\ O} = 1.8787\underline{5}\ mol\ O$

$\left. \rule{0pt}{40pt}\right\} \div 1.252\ mol$

$\left\{ \begin{array}{l} 1.000\ Fe \\ 1.501\ O \end{array} \right\} (\times 2)$

$\begin{array}{l} 2.000\ Fe \\ 3.002\ 'O' \end{array}$

So, $2\ Fe : 3\ 'O'$

$\rightarrow$ i) $\boxed{Fe_2O_3}$
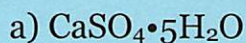
ii) $\boxed{iron(III)\ oxide}$

$Fe^{3+}\quad O^{2-}$
$Fe^{3+}\quad O^{2-}$
$\qquad O^{2-}$

**Q23.** Complete the following table:

| Isotope Symbol ($^A_ZX^{\pm}$) | $^{212}_{82}Pb^{4+}$ | $^{56}_{26}Fe^{3+}$ | $^{81}_{35}Br^-$ | $^{51}_{23}V^{5+}$ |
|---|---|---|---|---|
| Ion Name | lead (IV) | iron(III) | bromide | vanadium (V) |
| Atomic Number | 82 | 26 | 35 | 23 |
| Mass Number | 212 | 56 | 81 | 51 |
| Number of Protons | 82 | 26 | 35 | 23 |
| Number of Neutrons | 130 | 30 | 46 | 28 |
| Number of Electrons | 78 | 23 | 36 | 18 |
| Net charge | 4+ | 3+ | 1− | 5+ |

**Q24.** **Name the following substances:**

a) $CaSO_4 \cdot 5H_2O$    _calcium sulfate pentahydrate_

b) $P_4O_{10}$    _tetraphosphorus decoxide_
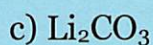
c) $Li_2CO_3$    _lithium carbonate_
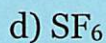
d) $SF_6$    _sulfur hexafluoride_
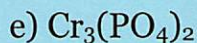
e) $Cr_3(PO_4)_2$    _chromium (II) phosphate_

**Write formulas for the following named substances:**

f) ammonium sulfide    $(NH_4)_2S$
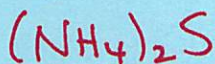
g) iron(III) carbonate    $Fe_2(CO_3)_3$
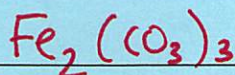
h) trisulfur heptabromide    $S_3Br_7$

i) potassium sulfite    $K_2SO_3$

j) xenon tetroxide    $XeO_4$

**Q25.** Gold has a density of 19.3 g/cm³. The largest nugget of gold ever found had a mass of 159 lbs. What would its volume be in in³?

*Note: 1.00 lb = 454 g, and 1 in = 2.54 cm (exact)*

$$d = m/v \implies V = \frac{m}{d}$$

$$m = 159\,lbs \times \frac{454g}{1\,lb} = 72,186g \implies V = \frac{m}{d} = \frac{72,186g}{19.3g/cm^3} = 3740\,cm^3$$

$$3740\,cm^3 \times \left(\frac{1in}{2.54cm}\right)^3 = 228\,in^3.$$

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## 3 Point Bonus Question

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**Write chemical formulas for the following three acids:**

1) sulfuric acid: ___$H_2SO_4 \, (aq)$___

2) hydrochloric acid: ___$HCl \, (aq)$___

3) nitric acid: ___$HNO_3 \, (aq)$___

# Exam checklist:

**(Check the boxes to certify the following:)**

☐ My full name is written legibly on the front page

☐ My correct lab section has been indicated on the front page

☐ My full name is written legibly on the scantron sheet

☐ My exam version (1A, B, C, or D) is written on the scantron sheet

☐ I have shown work for all problems (where appropriate), paying attention to

    ○ Significant figures / decimal places

    ○ Units

☐ I have used the conversion-factor method for all conversions

☐ If I have torn off the back page (periodic table), I will not turn it in with my exam!

Thank-you from the Chemistry Professors and Good Luck!