General Chemistry 1 *(CHEM 1141)*

Shawnee State University – Autumn 2022

September 22, 2022

Exam # 1 A

Name KEY

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

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

Section #:

- ❒ 1. (Mon Lab, 10:10 AM – 1:00 PM)
- ❒ 2. (Wed Lab, 10:10 AM – 1:00 PM)

} **Fleeman**

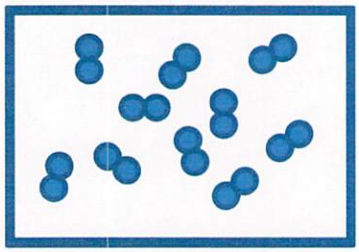
- ❒ 3. (Tue Lab, 11:00 AM – 1:50 PM)
- ❒ 4. (Thu Lab, 11:00 AM – 1:50 PM)

} **Napper**

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

Each problem in this section (multiple choice) is worth 2.5 points!

Q1. Directly underneath is a sketch of a substance that has been drawn as if a sample of the substance were under a microscope so powerful that individual atoms could be seen.



How would you best describe the substance?

(A) Element all composed of same type of atom

B) Compound

C) Homogeneous mixture

D) Heterogeneous mixture

Q2. The SI prefixes μ, m, and M respectively mean:

A) 10^{-3}, 10^{-2}, 10^{9}

(B) 10^{-6}, 10^{-3}, 10^{6}

C) 10^{-3}, 10^{-6}, 10^{6}

D) 10^{-6}, 10^{-3}, 10^{9}

Q3. An example of an intensive property (doesn't depend on amt), and a chemical property respectively would be:

(A) density, flammability

B) concentration, thermal conductivity

C) mass, ability to corrode

D) volume, temperature

Q4. An empty flask had a mass of 34.40 g, and when filled with an unknown liquid, its new mass was 54.30 g. If the total volume of the flask was 10.00 mL, what was the density of the liquid?

$m = 54.30\,g - 34.40\,g = 19.90\,g$ (2dp)

$d = m/V = \frac{19.90\,g}{10.00\,mL} = 1.990\,g/mL$ (4 s.f.)

A) 8.870 g/mL

B) 5.430 g/mL

C) 3.440 g/mL

D) 1.990 g/mL

Q5. Which element would you expect to show similar chemical properties to potassium?

A) sodium — same group (1A or 1)

B) calcium

C) gallium

D) nitrogen

Q6. What is the formula of copper(I) sulfate?

charge

Cu^+ SO_4^{2-}

2 1

so

Cu_2SO_4

A) $CuSO_4$

B) Cu_2S

C) CuS

D) Cu_2SO_4

Q7. A spacecraft sampled mercury isotopes on a comet in the outer Solar System, and determined that it contained:

isotope	mass (amu)	relative abundance
^{202}Hg	201.9	32.1%
^{199}Hg	198.8	67.9%

From this information, calculate the average atomic mass for mercury:

A) 200.5

B) 200.4

C) 199.8

D) 199.7

$\text{avg mass} = \frac{32.1}{100} \times 201.9u + \frac{67.9}{100} \times 198.8u$

$= 199.8u$

Q8. Calculate the mass percent of iron in Fe_2S_3

A) 40.0%

B) 53.7%

C) 63.5%

D) 71.1%

$2 \times Fe = 2 \times 55.85$

$3 \times S = 3 \times 32.07$

207.91

$wt\%\ Fe = \frac{2 \times 55.85}{207.91} \times 100$

$= 53.73\ \%$

Q9. When balancing the following chemical equation using the lowest set of whole number coefficients, what is the coefficient for O_2?

$$\_\_C_4H_8O_2(s) + \underline{5}\ O_2(g) \rightarrow \underline{4}\ CO_2(g) + \underline{4}\ H_2O(g)$$

A) 3

B) 4

C) 5

D) 6

Q10. How many hydrogen atoms are there in a 24.0 g sample of NH_3?

A) 1.41×10^{23}

B) 2.55×10^{24}

C) 8.47×10^{23}

D) 1.90×10^{24}

$24.0\ g\ NH_3 \times \frac{1\ mol\ NH_3}{17.03\ g\ NH_3} \times \frac{3\ mol\ H}{1\ mol\ NH_3} \times \frac{6.022 \times 10^{23}}{1\ mol} = 2.55 \times 10^{24}$ atoms of H

Q11. Two atoms are isotopes if they have

A) different atomic numbers

B) the same mass number, but different atomic numbers

C) the same number of protons and neutrons

D) the same atomic number, but different mass numbers

Q12. The names of the following polyatomic ions in order are: SO_3^{2-}, PO_4^{3-}, NO_2^-.

A) sulfate, phosphate, nitrate

B) sulfite, phosphate, nitrite

C) sulfate, phosphide, nitrate

D) sulfite, phosphide, nitrite

Q13. The molar mass of chromic acetate, $Cr(C_2H_3O_2)_3$ is

A) 198.1 g/mol

B) 111.0 g/mol

C) 229.1 g/mol

D) 178.1 g/mol

$1 \times Cr = 1 \times 52.00$
$6 \times C = 6 \times 12.01$
$9 \times H = 9 \times 1.008$
$6 \times O = 6 \times 16.00$
$229.139\ g/mol$

Q14. Which compound below can be classified as a molecular compound:

A) NBr_3

B) K_2CO_3

C) NH_4Cl

D) $MgSO_4$

ionic

K^+, CO_3^{2-}
NH_4^+, Cl^-
Mg^{2+}, SO_4^{2-}

non-metal + non-metal typically

Q15. In which of the following lists are NOT ALL of the elements listed in the same family (group)?

same vertical column

A) He, Ne, Ar

B) Ni, Pd, Pt

C) B, C, N

D) Li, Na, Rb

2nd period

Q16. Express the number 0.000 044 0 in scientific notation.

3 sig figs

3 5

A) 4.40×10^{-5}

B) 4.4×10^{-5}

C) 4.40×10^{5}

D) 4.4×10^{-4}

Q17. What is the empirical formula of $C_6H_{14}O$?

A) CHO

B) $C_{12}H_{28}O_2$

C) $C_6H_{14}O$ cannot be reduced into anything simpler!

D) C_2H_7O

Q18. Determine the moles of Al in 96.7 g of aluminum?

A) 0.279 mol Al

B) 3.58 mol Al $96.7\,g\ Al \times \frac{1\ mol\ Al}{26.98\,g\ Al} = 3.58\ mol\ Al$

C) 7.43 mol Al

D) 4.21 mol Al

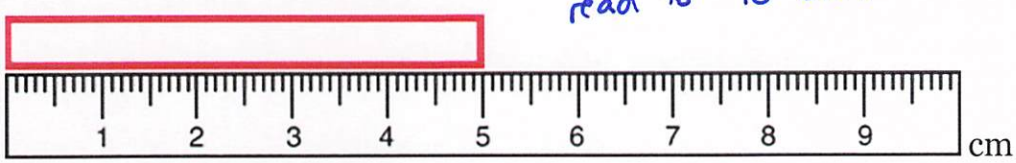
Q19. How close a measurement is to the true value is called

A) precision } how close measurements are to one another

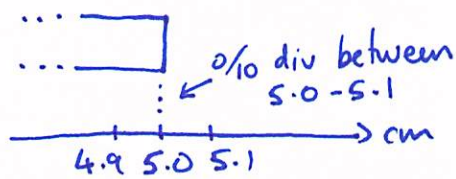
B) significant

C) estimate

D) accuracy



read to 1/10 div.



so 5.00 cm

Q20. Report the length of the bar with correct significant figures and unit.

A) 5 cm

B) 5.0 cm

C) 5.00 cm

D) 4.5 cm

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

All work must be shown 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. (i) Give two examples of elements that occur as diatomic molecules in nature:

H_2 & N_2 also $O_2, F_2, Cl_2, Br_2, I_2$

(ii) Write the chemical formula of cobalt(II) chloride hexahydrate

$CoCl_2 \cdot 6H_2O$ Co^{2+} Cl^- $6\times H_2O$

(iii) Write the chemical formula of trisulfur heptachloride

S_3Cl_7

(iv) Why is the name disodium monoxide incorrect for Na_2O? What should it be?

Na_2O is IONIC, so we do not use prefixes (molecular only)

Sodium oxide.

(v) The most stable form of sulfur is a crown-shaped molecule with the formula S_8.

Student A says that S_8 is a compound because it contains more than one atom per molecule.

Student B says that it can't be a compound because it only contains one type of atom and must be an element.

Who is correct?

Student B.

compounds: 2 or more elements in fixed ratios

elements: composed of same "type" of atom (same Z)

Q22. (i) Circle the two atoms that are isotopes?

same #p⁺ (Z, atomic #)
diff #n° (A, mass # = #p⁺ + #n°)

$^{212}_{83}X$ $^{212}_{82}X$ $^{213}_{84}X$ $^{213}_{82}X$

(ii) How many protons, neutrons, and electrons does the $^{14}_{8}O^{2-}$ ion contain?

protons: 8 neutrons: 6 electrons: 10

14 − 8 = 6

atom: #p⁺ = #e⁻ = 8, ion: 2− gains 2e⁻ so 8 + 2 = 10

(iii) Write out the name of an element in the alkaline earth metals group:

beryllium, (magnesium, calcium, ...)

(iv) What is the name given to the group containing the element bromine?

halogens

(v) Give an example of an element that is a semi-metal, also known as a metalloid:

Silicon, Si (generally elements either side of the metal – non-metal staircase ... although Al is prob a metal!)

(vi) Give an example of an element in the third period of the periodic table:

3rd row

Sodium, Na

(vi) Give an example of an element in group 14 (4A) of the periodic table:

Carbon, C

Q23. Sorbitol is a compound that can be used as a sweetener. An analysis of the compound finds the following percent composition by mass: Carbon: 39.56%; Hydrogen: 7.74%; Oxygen: 52.70%.

i) Calculate the empirical formula of sorbitol.

assume 100-g

$\rightarrow 39.56\text{g C} \times \frac{1\text{ mol C}}{12.01\text{g C}} = 3.294\text{ mol C}$

$7.74\text{g H} \times \frac{1\text{ mol H}}{1.008\text{g H}} = 7.68\text{ mol H}$

$52.70\text{g O} \times \frac{1\text{ mol O}}{16.00\text{g O}} = 3.294\text{ mol O}$

$\div 3.294$ mol

1.000 C, 2.33 H, 1.000 O

$\times 3$

3.000 C, 6.99 H, 3.000 O

so: $C_3H_7O_3$ w/ rounding

ii) What is the molecular formula of sorbitol given that its molar mass is 182.1 g/mol.

$C_3H_7O_3$

$3 \times C = 3 \times 12.01$

$7 \times H = 7 \times 1.008$

$3 \times O = 3 \times 16.00$

91.09 g/mol

$n = \frac{182.1\text{ g/mol}}{91.09\text{ g/mol}} \simeq 2$

So, molecular formula $= (C_3H_7O_3)_2$

$= C_6H_{14}O_6$

Q24. Provide the correct name or formula for the following compounds.

i) Cr_3N_2 chromium (II) nitride

ii) tribromine octoxide Br_3O_8

iii) $Na_2CO_3 \cdot 10H_2O$ sodium carbonate decahydrate

iv) disilicon hexachloride Si_2Cl_6

v) ammonium hydrogen carbonate $(NH_4)_2CO_3$
(also known as ammonium bicarbonate)

Q25. i) Find the mass in pounds of 1.00m^3 of corn syrup. Corn syrup has a density of 1.38 g/cm^3. (1 kg = 2.205 lb)

$$1.00\ m^3 \times \left(\frac{100\ cm}{1\ m}\right)^3 \times \frac{1.38\ g}{cm^3} \times \frac{1\ kg}{1000\ g} \times \frac{2.205\ lb}{1\ kg} = 3040\ lb\ (3\ s.f.)$$

ii) Corn syrup has a formula of $C_{16}H_{14}O_7$. How many molecules of corn syrup are contained in 2.149 g of corn syrup?

$C_{16}H_{14}O_7$

$16 \times C = 16 \times 12.01$

$14 \times H = 14 \times 1.008$

$7 \times O = 7 \times 16.00$

$318.27\ g/mol$

$$2.149\ g\ C_6H_{14}O_7 \times \frac{1\ mol\ C_{16}H_{14}O_7}{318.27\ g\ C_6H_{14}O_7} \times \frac{6.022 \times 10^{23}}{1\ mol} = 4.062 \times 10^{21}\ molecules$$

3 Point Bonus Question

Using the significant figure / decimal place rules, compute the answer to the following calculation to the correct number of digits:

3 { $\frac{12.310-1.220}{0.23+43.77}$ = }

1 2

(1) $12.310 - 1.220 = 11.090$ (3dp)

(2) $0.23 + 43.77 = 44.00$ (2d.p.)

(3) $\frac{11.090}{44.00} = 0.2520$ (4s.f.)

~5s.f. 4s.f.

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 (A, 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!