

CHEMISTRY 102A
Hour Exam II
March 27, 2019
T. Hummel

NAME _____

SIGNATURE _____

SECTION _____

FORM "A"

This exam is made up of an answer sheet, two cover sheets and 6 numbered pages. Below are instructions for coding the answer sheet. The last page of this exam contains some useful equations and constants, plus the periodic table.

On the answer sheet:

1. **Use #2 pencil. Erase cleanly.**
2. Print your **NAME** in the appropriate designated spaces, then blacken in the letter boxes below each printed letter, last name first, then your first name initial.
3. Fill in your university **ID** number under **STUDENT NUMBER**.
4. Under **SECTION** write the five digit number that corresponds to your section designation, and then blacken in the corresponding number of boxes. **For 102A students**, the numbers are:
AQA = 00011, AQB = 00012, AQC = 00013, AQD = 00014, AQE = 00015, AQF = 00016, AQG = 00017, AQH = 00018, AQI = 00019, AQJ = 00020, AQL = 00022, AQM = 00023, AQN = 00024, AQO = 00025.
5. Under **NETWORK ID** print your University Network ID beginning on the left hand side with box #1, and then blacken in the corresponding letters, numbers and/or dashes under each character. Do not fill in a character for any unused boxes.
6. Under **TEST FORM** blacken the letter corresponding to the form designated on the upper left hand corner of the exam booklet.
7. Your TA's name should be printed for **INSTRUCTOR** and write your section number for **SECTION** in the lines provided.
8. **Sign** your name (do not print) on the line provided. Print your name underneath it.
9. **Mark** only one answer per question and do not use the answer sheet for scratch paper or make any stray marks on it. Erase cleanly if you wish to change an answer. The exam itself can be used for scratch paper.

Work carefully and efficiently. If your answer differs from one given in the last proper significant figure, mark that answer as correct and not the response "none of these". All questions are worth the same.

Solubility rules:

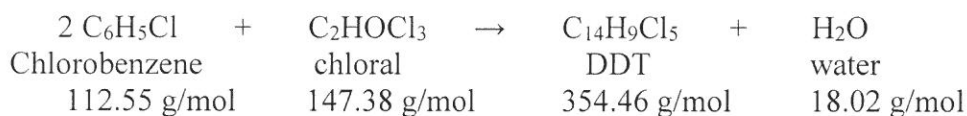
1. Most nitrate salts are soluble.
2. Most salts of alkali metals and ammonium cations are soluble.
3. Most chloride, bromide, and iodide salts are soluble.
Exceptions: salts containing Ag^+ , Pb^{2+} , and Hg_2^{2+} ions are insoluble.
4. Most sulfate salts are soluble.
Exceptions: sulfates containing Ca^{2+} , Ba^{2+} , Pb^{2+} , and Hg_2^{2+} ions are insoluble.
5. Most hydroxide salts are insoluble.
Exceptions: hydroxides containing alkali metals, Ba^{2+} , Sr^{2+} , and Ca^{2+} ions are soluble.
6. Most sulfide, carbonate, chromate, and phosphate salts are insoluble.
Exceptions: salts of alkali metals and ammonium cations are soluble.

1. A hypothetical compound containing carbon, hydrogen, and oxygen consists of 76.33% carbon by mass. A 25.00 g sample of the compound contains 1.595×10^{23} H atoms. What is the empirical formula of this compound?
a) $C_6H_3O_3$ b) CH_2O_2 c) C_3HO d) $C_5H_4O_5$ e) $C_{18}H_3O_4$
2. A 1.00 g-sample of a metal chloride, MCl_2 , is first dissolved in some water and then excess aqueous silver nitrate is added. A precipitate forms having a mass of 1.29 g. Calculate the molar mass of the metal, M. Silver chloride has a molar mass of 143.35 g/mol.
a) 151 g/mol b) 222 g/mol c) 76 g/mol d) 111 g/mol e) 56 g/mol
3. Consider the following four compounds: Br_2 , KCl , Xe , $ClBr$. How many of these four compounds will have a vapor pressure greater than that of ICl at $25^\circ C$?
a) 0 (none) b) 1 c) 2 d) 3
e) 4 (All four of these compounds have a vapor pressure greater than ICl at $25^\circ C$).
4. Consider the following balanced reaction:
$$2 C_2H_6(g) + 7 O_2(g) \rightarrow 6 H_2O(l) + 4 CO_2(g)$$

Which of the following statements (a-d) is/are **true**?
a) If we react equal masses of C_2H_6 and O_2 , then C_2H_6 is limiting.
b) If we react equal moles of C_2H_6 and O_2 , then both reactants run out at the same time.
c) If the mass of C_2H_6 reacted is larger than the mass of O_2 reacted, then O_2 must be limiting.
d) If the mass of O_2 reacted is larger than the mass of C_2H_6 reacted, then C_2H_6 must be limiting.
e) At least two of the above statements (a-d) are true.
5. A compound consists of 49.0% C, 2.74% H, and 48.2% Cl by mass. The gaseous density of the compound at $120.^\circ C$ and 250. torr is 2.25 g/L. What is the molecular formula of the compound?
a) C_3H_2Cl b) $C_{12}H_6Cl_2$ c) $C_9H_6Cl_3$
d) $C_5H_{18}Cl_4$ e) C_6H_3Cl

6. Equal moles of $\text{Cl}_2(\text{g})$ and $\text{N}_2(\text{g})$ are placed in a 4.00 L flexible container. The Cl_2 and N_2 are reacted to form $\text{NCl}_3(\text{g})$ at some constant temperature. After the reaction has gone to completion, determine the final volume of the container. Assume a constant pressure.
- a) 2.00 L b) 2.67 L c) 3.00 L d) 4.00 L e) 6.00 L
7. How many gas particles remain in a 2.0 L flask initially filled with air which is then evacuated to a pressure of 8.0×10^{-7} torr at $20.^\circ\text{C}$?
- a) 2.3×10^{10} particles b) 2.6×10^{13} particles c) 8.8×10^{-11} particles
d) 5.3×10^{13} particles e) 4.6×10^{10} particles
8. Which answer bests completes the following statement. In the van der Waals equation for gases given on the constants page, the symbol labeled "b"
- a) is expected to be a small value for polar gas molecules and a large value for nonpolar gas molecules.
b) depends on the size of the gas molecule.
c) is expected to be large for gases that exactly obey Dalton's Law of Partial Pressures.
d) often has negative values.
e) is always a negative value.

The next two questions refer to the following balanced reaction to produce the toxic insecticide DDT (the molar mass of each compound is below each name):



9. If 100.0 g of chlorobenzene is reacted with 75.0 g of chloral, what mass of DDT would be produced assuming 100% yield?
- a) 134 g b) 145 g c) 157 g d) 175 g e) 180 g
10. If 100.0 g of chlorobenzene is reacted with 75.0 g of chloral, what mass of excess reactant is left over assuming 100% yield?
- a) 9.5 g excess b) 11.4 g excess c) 16.9 g excess
d) 22.0 g excess e) 25.0 g excess

Consider the following information for the next three questions. 100.0 mL of 0.100 *M* iron(II) chloride is added to 100.0 mL of 0.100 *M* sodium hydroxide and a precipitate forms.

11. Which of the following is the correct net ionic equation for the precipitation reaction?

- a) $\text{Fe}^{2+}(\text{aq}) + 2 \text{Cl}^{-}(\text{aq}) \rightarrow \text{FeCl}_2(\text{s})$
- b) $\text{Fe}^{2+}(\text{aq}) + 2 \text{OH}^{-}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_2(\text{s})$
- c) $\text{Na}^{+}(\text{aq}) + \text{Cl}^{-}(\text{aq}) \rightarrow \text{NaCl}(\text{s})$
- d) $\text{Na}^{+}(\text{aq}) + \text{OH}^{-}(\text{aq}) \rightarrow \text{NaOH}(\text{s})$

12. How many moles of precipitate form assuming 100% yield?

- a) 0.0100 mol b) 0.00750 mol c) 0.00667 mol
- d) 0.00500 mol e) 0.00333 mol

13. Calculate the molarity of the Fe^{2+} ions after precipitation is complete.

- a) 0 *M* b) 0.0500 *M* c) 0.0750 *M*
- d) 0.0330 *M* e) 0.0250 *M*

14. Consider four different solutions that are each prepared by adding the same mass of solute dissolved in the same volume of solution. The solutes are LiCl, KCl, KOH, and NaOH. Which solution has the largest molar concentration of solute?

- a) LiCl b) KCl c) KOH d) NaOH
- e) All four of these solutions would have the same concentration of solute.

15. Consider the following four conditions (I-IV) describing 1.0 mol of a gas sample:

- I. small container volume
- II. high container temperature
- III. low container pressure
- IV. slow moving gas particle velocities

How many of these conditions help a “real” gas behave more ideally?

- a) 0 (none) b) 1 c) 2 d) 3
- e) 4; (All of these conditions help a “real” gas behave more ideally.)

16. Consider the following reaction: $3 \text{Fe(s)} + 4 \text{H}_2\text{O(l)} \rightarrow \text{Fe}_3\text{O}_4\text{(s)} + 4 \text{H}_2\text{(g)}$
- 5.00 mol of Fe is reacted with 4.00 mol of H_2O . If the actual yield of Fe_3O_4 is 0.50 mol, what is the percent yield of the reaction?
- a) 10.% b) 13% c) 29% d) 42% e) 50.%
17. Consider the compounds PH_3 , CH_4 , LiH , and NH_3 . Rank these compounds in order of increasing boiling point (from lowest to highest boiling point).
- a) $\text{LiH} < \text{PH}_3 < \text{CH}_4 < \text{NH}_3$ b) $\text{PH}_3 < \text{LiH} < \text{CH}_4 < \text{NH}_3$
c) $\text{NH}_3 < \text{LiH} < \text{PH}_3 < \text{CH}_4$ d) $\text{LiH} < \text{CH}_4 < \text{PH}_3 < \text{NH}_3$
e) $\text{CH}_4 < \text{PH}_3 < \text{NH}_3 < \text{LiH}$
18. A binary compound consisting of an unknown element Z and oxygen contains 43.64% Z by mass. If the formula of the compound is Z_4O_{10} , what is the identity of element Z?
- a) P b) C c) Se d) I e) Ni
19. A balloon contains equal moles of $\text{SO}_2\text{(g)}$ and He(g) . If a small leak in the balloon occurs, which of the following statements (a-d) about gas escaping from this leak is **true**?
- a) $\text{SO}_2\text{(g)}$ leaks four times faster from the balloon as compared to the He(g) .
b) Only helium will escape from the balloon.
c) He(g) leaks 16 times faster from the balloon as compared to the $\text{SO}_2\text{(g)}$.
d) $\text{SO}_2\text{(g)}$ and He(g) leak at the same rate from the balloon.
e) None of the above statements (a-d) are correct.
20. A 70.8 g-sample of $\text{N}_2\text{(g)}$ reacts with excess $\text{O}_2\text{(g)}$ to form a compound N_xO_y . The final product has a mass of 111.2 g. Assuming all of the nitrogen gas has reacted, which of the following could be the compound?
- a) N_2O b) NO c) NO_2 d) N_2O_2 e) N_2O_4
21. What volume of 0.0521 M KOH is required to react completely with 14.20 mL of 0.141 M H_3PO_4 ?
- a) 115 mL b) 19.4 mL c) 57.6 mL d) 25.0 mL e) 38.4 mL

22. Consider the following boiling point data:

Compound	Formula	Boiling Point
methanol	CH ₃ OH	65°C
ethanol	CH ₃ CH ₂ OH	78 °C
propanol	CH ₃ CH ₂ CH ₂ OH	97 °C
butanol	CH ₃ CH ₂ CH ₂ CH ₂ OH	117 °C
pentanol	CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ OH	138 °C

The boiling points of these compounds increase steadily from methanol to pentanol. Which type of intermolecular force is primarily responsible for the steady increase in boiling points from methanol to pentanol?

- a) Ionic forces
b) Hydrogen bonding forces
c) Dipole forces
d) London Dispersion forces
23. Aqueous solutions of (NH₄)₂CO₃, Ag₂SO₄, NaBr, and Ba(NO₃)₂ are mixed together. Several different colored precipitates form. Which of the following compounds did **not** form as a precipitate?
- a) Ag₂CO₃ b) BaBr₂ c) BaCO₃ d) BaSO₄ e) AgBr
24. Which of the following statements is **false**?
- a) For a typical covalent compound, the enthalpy of vaporization should be greater (more positive) than the enthalpy of fusion.
b) The solid phase exhibits the strongest amount of intermolecular forces.
c) As temperature increases, the vapor pressure of a liquid increases.
d) The intermolecular forces between covalent compounds are stronger than the covalent bonds holding the atoms together within the compound.
e) Ideal gases are assumed to exert no intermolecular forces.
25. An organic compound contains only carbon, hydrogen, and oxygen. Combustion of 3.50 g of the compound produced 4.80 g of CO₂ and 1.31 g of H₂O. What is the mass percent of oxygen in the organic compound?
- a) 58.4% O b) 37.4% O c) 4.19% O
d) 2.09% O e) 74.8% O

Consider the following information for the next 2 problems. A 50.0 L rigid container holds a certain mass of $\text{H}_2(\text{g})$ and the same mass of $\text{He}(\text{g})$ (mass of hydrogen gas = mass of helium gas). The total pressure in the container is 3.0 atm at 25°C .

26. What is the partial pressure of $\text{H}_2(\text{g})$ in this container?
- a) 0.50 atm b) 1.0 atm c) 1.3 atm d) 1.7 atm e) 2.0 atm
27. The container is heated to 125°C ? Calculate the total pressure in the container at 125°C ?
- a) 15 atm b) 4.0 atm c) 1.2 atm d) 1.7 atm e) 6.0 atm
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28. Which of the following four (I-IV) statements is/are **not** postulates of the kinetic molecular theory?
- I. The volume of each individual gas particle is assumed to be negligible (zero).
II. Gas particle are assumed to exert no forces on each other; they are assumed to neither attract nor repel each other.
III. The average kinetic energy of a collection of gas particles is assumed to be directly proportional to the Kelvin temperature of the gas.
IV. At a constant temperature, all gas particles are assumed to move at the same average velocity.
- a) II only b) I and II c) IV only d) II and III e) III and IV
29. Which of the following statements about electrolytes is **false**?
- a) Acids dissolved in water are either strong electrolytes or weak electrolytes.
b) Soluble ionic compounds are all strong electrolytes.
c) Covalent compounds are all nonelectrolytes.
d) Weak acids in water are all weak electrolytes.
e) Strong electrolytes are either strong acids or soluble ionic compounds.
30. My answers for this Chemistry 102 exam should be graded with the answer sheet associated with:
- a) Form A b) Form B c) Form C d) Form D e) Form E

†Actinides