

Chemistry 221 Sample Exam I Cover Sheet

Fall XXXX

Name: _____

This exam consists of twenty-five (25) multiple-choice questions and four (4) short answer questions with five points of extra credit.

A periodic table and scratch paper are available for you to use on this exam.

Before you start:

- Write your first and last name in the space above
- Sign the integrity statement below. **Failing to sign the integrity statement on this exam imparts an immediate grade of zero.**
- For multiple choice questions: clearly enter your letter answer in the appropriate location. **Circle** the letter which corresponds to your answer.
- For short answer questions: clearly **circle** your final answer, showing all work.

Point values and your exam score will be summarized on the final page.

Integrity statement:

I have neither given nor received aid on this exam.

Your signature

1. At 0 °C, a bottle contains 325 mL of water in its liquid state. What is the volume of the water after it freezes (at 0 °C)? The densities of liquid water and ice at 0 °C are 1.000 g/mL and 0.917 g/mL, respectively.
- a. 27.0 mL
 - b. 298 mL
 - c. 325 mL
 - d. 354 mL
 - e. 391 mL

Letter answer to question #1: _____

2. The radius of a helium atom is 31 pm. What is the radius in nanometers? ($p = 10^{-12}$)
- a. 3.1×10^{-9} nm
 - b. 3.1×10^{-6} nm
 - c. 3.1×10^{-5} nm
 - d. 3.1×10^{-3} nm
 - e. 3.1×10^{-2} nm

Letter answer to question #2: _____

3. The density of liquid mercury is 13.5 g/cm³. What mass of mercury (in kg) is required to fill a hollow cylinder having an inner diameter of 2.00 cm to a height of 25.0 cm? ($V = \pi r^2 h$)
- a. 1.06 kg
 - b. 4.24 kg
 - c. 0.171 kg
 - d. 1.71×10^{-4} kg
 - e. 4.24×10^{-6} kg

Letter answer to question #3: _____

4. The output of a plant is 4335 pounds of ball bearings per work week (five days). If each ball bearing weighs 0.0113 g, how many ball bearings does the plant make in a single day? ($453.6 \text{ g} = 1 \text{ pound}$)
- a. 3.84×10^5
 - b. 7.67×10^4
 - c. 867
 - d. 3.48×10^7
 - e. 2.91×10^6

Letter answer to question #4: _____

5. The density of mercury is 13.6 g/cm³. The density of mercury is _____ kg/m³.
- a. 1.36×10^{-2}
 - b. 1.36×10^4
 - c. 1.36×10^8
 - d. 1.36×10^{-5}
 - e. 1.36×10^{-4}

Letter answer to question #5: _____

6. The dimensions of a rectangular solid are 8.45 cm long, 4.33 cm wide and 2.85 cm high. If the density of the solid is 9.43 g/cm³, what is the mass?
- 1.12 g
 - 11.1 g
 - 154 g
 - 896 g
 - 983 g

Letter answer to question #6: _____

7. How many protons, neutrons, and electrons are in a neutral oxygen-18 atom?
- 6 protons, 8 neutrons, 4 electrons
 - 6 protons, 10 neutrons, 8 electrons
 - 8 protons, 8 neutrons, 8 electrons
 - 8 protons, 10 neutrons, 8 electrons
 - 8 protons, 10 neutrons, 18 electrons

Letter answer to question #7: _____

8. Which of the following atoms contains the largest number of neutrons?

- $^{31}_{15}\text{P}$
- $^{30}_{14}\text{Si}$
- $^{37}_{17}\text{Cl}$
- $^{32}_{16}\text{S}$
- $^{34}_{16}\text{S}$

Letter answer to question #8: _____

9. All of the following statements are true EXCEPT

- for any neutral element, the number of protons and electrons are equal.
- electrons and protons have equal mass, but opposite charges.
- the mass number is the sum of the number of protons and neutrons.
- the atomic number equals the number of protons.
- isotopes of an element have identical atomic numbers.

Letter answer to question #9: _____

10. You have 4.15 g of each of the following elements: Ca, Cu, Ce, Cs, Cf. Which sample contains the largest number of atoms?

- Ca
- Cu
- Ce
- Cs
- Cf

Letter answer to question #10: _____

11. Pennies minted after 1983 are composed of 97% zinc and 3.0% copper and have a mass of 2.46 g. How many moles of copper are in a penny?
- 0.0012 mol
 - 0.014 mol
 - 0.038 mol
 - 0.040 mol
 - 25 mol

Letter answer to question #11: _____

12. What mass of He contains the same number of atoms as 5.0 g Kr?
- 0.24 g
 - 0.80 g
 - 1.2 g
 - 5.0 g
 - 1.0×10^2 g

Letter answer to question #12: _____

13. The molar mass of cesium is 132.9 g/mol. What is the mass of a single Cs atom?
- 2.207×10^{-22} g
 - 1.249×10^{-26} g
 - 2.763×10^{-23} g
 - 4.531×10^{21} g
 - 1.329×10^{-23} g

Letter answer to question #13: _____

14. An argon ion laser emits light at 488 nm. What is the frequency of this radiation?
- $4.07 \times 10^{-19} \text{ s}^{-1}$
 - $1.63 \times 10^{-15} \text{ s}^{-1}$
 - $1.46 \times 10^2 \text{ s}^{-1}$
 - $2.05 \times 10^6 \text{ s}^{-1}$
 - $6.14 \times 10^{14} \text{ s}^{-1}$

Letter answer to question #14: _____

15. A microwave oven emits radiation with an energy of 3.98×10^{-23} J/photon. What is the frequency of this radiation?
- $1.67 \times 10^{-11} \text{ s}^{-1}$
 - $6.67 \times 10^{-7} \text{ s}^{-1}$
 - 2.00 s^{-1}
 - $1.50 \times 10^6 \text{ s}^{-1}$
 - $6.01 \times 10^{10} \text{ s}^{-1}$

Letter answer to question #15: _____

16. What is the energy of a mole of photons of red light with a wavelength of 632 nm?

- a. 189 kJ
- b. 252 kJ
- c. 314 kJ
- d. 515 kJ
- e. 756 kJ

Letter answer to question #16: _____

17. For a neutron (mass = 1.675×10^{-27} kg) moving with a velocity of 5.2×10^3 m/s, what is the de Broglie wavelength?

- a. 7.6×10^{-11} m
- b. 4.5×10^{-9} m
- c. 2.1×10^{-6} m
- d. 486 m
- e. 1.3×10^{10} m

Letter answer to question #17: _____

18. What type of orbital is designated $n = 3$, $l = 2$, $m_l = -1$ and $m_s = +1/2$?

- a. 3s
- b. 3p
- c. 3d
- d. 2f
- e. 2d

Letter answer to question #18: _____

19. Which of the following is a possible set of quantum numbers for an electron in an atom?

- a. $n = 1$, $l = 1$, $m_l = 1$
- b. $n = 2$, $l = 0$, $m_l = -1$
- c. $n = 0$, $l = 0$, $m_l = 0$
- d. $n = 3$, $l = 1$, $m_l = -1$
- e. $n = 4$, $l = 5$, $m_l = -2$

Letter answer to question #19: _____

20. What is the maximum number of orbitals that can be identified with the following quantum numbers: $n = 3$, $l = 1$, $m_l = 0$?

- a. 0
- b. 1
- c. 3
- d. 5
- e. 7

Letter answer to question #20: _____

21. Which of the following particles would be most paramagnetic?

- a. Se
- b. Cd
- c. Ar
- d. He
- e. Ca

Letter answer to question #21: _____

22. Place the following atoms in order of increasing atomic radii: Se, O, S, and As.

- a. $O < S < Se < As$
- b. $O < S < As > Se$
- c. $As < Se < S < O$
- d. $Se < As < S < O$
- e. $S < As < O < Se$

Letter answer to question #22: _____

23. What is the ground state electron configuration for Cr^{3+} ?

- a. $[Ar]$
- b. $[Ar]3d^34s^2$
- c. $[Ar]3d^44s^1$
- d. $[Ar]3d^3$
- e. $[Ar]3d^74s^2$

Letter answer to question #23: _____

24. What is the correct formula for molybdenum(III) oxide?

- a. MoO
- b. Mo_3O_2
- c. Mo_3O
- d. Mo_2O_3
- e. Mo_2O_2

Letter answer to question #24: _____

25. Which of the following is an incorrect combination of name and formula?

- a. $LiMnO_4$, lithium permanganate
- b. NO_2 , nitrogen dioxide
- c. $NaClO_3$, sodium chlorate
- d. $TiSe_2$, titanium(II) selenide
- e. P_2O_5 , diphosphorus pentaoxide

Letter answer to question #25: _____

Part II: Short Answer / Calculation, 30 points total. *Show all work!*

1. The density of chromium is 7.19 g/cm^3 at room temperature. How many atoms are in a cube of pure chromium that has an edge of 3.47 inches? (1 inch = 2.54 cm, $\text{edge}^3 = \text{Volume}$) (10 points)
2. Silver has two stable isotopes, one (Ag-109) with the exact mass of 108.9047 amu and an abundance of 48.18%. Determine the identity and exact mass of the second isotope. (The atomic mass of silver = 107.87). (10 points)

3. Write the complete nl^x spectroscopic notation ("electron configuration") for bromine and gold. (5 points)

4. Write the correct name for each of the following compounds. (10 points)

Li_2CrO_4	_____
$\text{K}_2\text{C}_2\text{O}_4$	_____
H_3As	_____
NCl_3	_____
NH_4ClO	_____
SBr_4	_____
$\text{Ca}(\text{OH})_2$	_____
H_2O	_____
TiNO_2	_____
SO_3	_____

CH 221 Exam I Point Distribution Sheet

*Avoid a point penalty - do **not** write on this page!*

Multiple choice questions:

 X 4 points per question = points
*number of multiple choice
questions correct*

Short answer questions and extra credit:

 points

Total points on this exam:

 points

<i>Grade</i>	<i>Percentage</i>	<i>Points on This Exam</i>
A	89% - 100%	115 - 130
B	78% - 88%	101 - 114
C	65% - 77%	84 - 100
D	55% - 64%	71 - 83
F	0% - 54%	0 - 70

Part I: Multiple Choice Questions

1. D
2. E
3. A
4. D
5. B
6. E
7. D
8. C
9. B
10. A
11. A
12. A
13. A
14. E
15. E
16. A
17. A
18. C
19. D
20. B
21. A
22. A
23. D
24. D
25. D

Part II: Short Answer / Calculation.

1. 5.70×10^{25} atoms
2. ^{107}Ag
3. Br: $1s^2 2s^2 2p^6 3s^2 3p^4 4s^2 3d^{10} 4p^5$ Au: $1s^2 2s^2 2p^6 3s^2 3p^4 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^9$
4. names:
 - a. lithium chromate
 - b. potassium oxalate
 - c. hydroarsenic acid or trihydrogen monoarsenide
 - d. nitrogen trichloride
 - e. ammonium hypochlorite
 - f. sulfur tetrabromide
 - g. calcium hydroxide
 - h. water or dihydrogen monoxide
 - i. titanium(I) nitrite
 - j. sulfur trioxide