

# Chemistry 221 Sample Final Exam Cover Sheet

Fall XXXX

*Name:* \_\_\_\_\_

This portion of the lecture final consists of thirty-two (32) multiple-choice questions and 2 short answer questions.

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.

---

*Integrity statement:*

I have neither given nor received aid on this exam.

---

*Your signature*

1. If a 21.00 gram sample of a Cu-Zn-Ni alloy contains 7.75 g Cu and 10.58 g Ni, what is the percent composition of Zn?
- 36.9%
  - 2.67%
  - 50.4%
  - 20.7%
  - 12.7%

Letter answer to question #1: \_\_\_\_\_

2. What is the atomic symbol for an element with 39 protons and 50 neutrons?

- $^{89}_{11}\text{Na}$
- $^{50}_{39}\text{Y}$
- $^{89}_{39}\text{Y}$
- $^{89}_{50}\text{Sn}$
- $^{227}_{89}\text{Ac}$

Letter answer to question #2: \_\_\_\_\_

3. Rubidium (Rb) has two naturally occurring isotopes. The average mass of Rb is 85.4678 u. If 72.15% of Rb is found as Rb-85 (84.9117 u), what is the mass of the other isotope?
- 0.56 u
  - 85.68 u
  - 86.91 u
  - 86.02 u
  - 83.47 u

Letter answer to question #3: \_\_\_\_\_

4. Which formula represents the compound formed by aluminum and carbonate ions?

- $\text{AlCO}_3$
- $\text{Al}(\text{CO}_3)_2$
- $\text{Al}(\text{CO}_3)_3$
- $\text{Al}_2(\text{CO}_3)_3$
- $\text{Al}_3(\text{CO}_3)_2$

Letter answer to question #4: \_\_\_\_\_

5. What is the correct formula for barium nitrate?

- $\text{Ba}(\text{NO}_3)_2$
- $\text{BNO}_2$
- $\text{Ba}(\text{NO}_2)_2$
- $\text{BaN}$
- $\text{BaNO}_3$

Letter answer to question #5: \_\_\_\_\_

6. What is the correct formula for cobalt(III) oxide?

- a. CoO
- b. Co<sub>3</sub>O
- c. Co<sub>3</sub>O<sub>2</sub>
- d. Co<sub>2</sub>O<sub>3</sub>
- e. CoO<sub>3</sub>

Letter answer to question #6: \_\_\_\_\_

7. Which of the following formulas is not correct?

- a. Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>
- b. NaClO<sub>3</sub>
- c. Ba<sub>2</sub>O<sub>3</sub>
- d. Mg(NO<sub>3</sub>)<sub>2</sub>
- e. KH<sub>2</sub>PO<sub>4</sub>

Letter answer to question #7: \_\_\_\_\_

8. What is the molar mass of cobalt(II) iodide hexahydrate?

- a. 212.8 g/mol
- b. 293.9 g/mol
- c. 312.7 g/mol
- d. 420.8 g/mol
- e. 465.1 g/mol

Letter answer to question #8: \_\_\_\_\_

9. Ammonia is prepared by reacting nitrogen and hydrogen gases at high temperature according to the ***unbalanced*** chemical equation:  $\_\_\text{N}_2(\text{g}) + \_\_\text{H}_2(\text{g}) \rightarrow \_\_\text{NH}_3(\text{g})$  What are the respective coefficients when the equation is balanced with the smallest whole numbers?

- a. 1, 1, 1
- b. 1, 3, 1
- c. 1, 3, 2
- d. 2, 1, 2
- e. 2, 3, 2

Letter answer to question #9: \_\_\_\_\_

10. When methanol undergoes complete combustion, the products are carbon dioxide and water:  $\_\_\text{CH}_3\text{OH}(\text{l}) + \_\_\text{O}_2(\text{g}) \rightarrow \_\_\text{CO}_2(\text{g}) + \_\_\text{H}_2\text{O}(\text{g})$  What are the respective coefficients when the equation is balanced with the smallest whole numbers?

- a. 1, 1, 1, 1
- b. 1, 2, 1, 2
- c. 2, 2, 2, 4
- d. 2, 3, 2, 4
- e. 2, 4, 6, 4

Letter answer to question #10: \_\_\_\_\_

11. What is the net ionic equation for the reaction of aqueous lead(II) nitrate with aqueous sodium bromide?

- a.  $\text{Pb}(\text{NO}_3)_2(\text{aq}) + 2 \text{NaBr}(\text{aq}) \rightarrow \text{PbBr}_2(\text{aq}) + 2 \text{NaNO}_3(\text{s})$
- b.  $\text{Na}^+(\text{aq}) + \text{NO}_3^-(\text{aq}) \rightarrow \text{NaNO}_3(\text{s})$
- c.  $\text{Pb}^{2+}(\text{aq}) + 2 \text{Br}^-(\text{aq}) \rightarrow \text{PbBr}_2(\text{s})$
- d.  $\text{Pb}^{2+}(\text{aq}) + 2 \text{Na}^+(\text{aq}) \rightarrow \text{PbNa}_2(\text{s})$
- e.  $\text{Pb}(\text{NO}_3)_2(\text{aq}) + 2 \text{NaBr}(\text{aq}) \rightarrow \text{PbBr}_2(\text{s}) + 2 \text{NaNO}_3(\text{aq})$

Letter answer to question #11: \_\_\_\_\_

12. Which of the following are oxidation-reduction reactions?

- 1.  $\text{Zn}(\text{s}) + \text{CuSO}_4(\text{aq}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{Cu}(\text{s})$
- 2.  $\text{Pb}(\text{ClO}_4)_2(\text{aq}) + 2 \text{KI}(\text{aq}) \rightarrow \text{PbI}_2(\text{s}) + 2 \text{KClO}_4(\text{aq})$
- 3.  $\text{CaCO}_3(\text{s}) \rightarrow \text{CO}_2(\text{g}) + \text{CaO}(\text{s})$

- a. 1 only
- b. 2 only
- c. 1 and 2
- d. 1 and 3
- e. 2 and 3

Letter answer to question #12: \_\_\_\_\_

13. What is the oxidation number of each atom in potassium nitrate,  $\text{KNO}_3$ ?

- a.  $\text{K} = +1, \text{N} = -3, \text{O} = -2$
- b.  $\text{K} = +1, \text{N} = +5, \text{O} = -2$
- c.  $\text{K} = +1, \text{N} = -3, \text{O} = +2$
- d.  $\text{K} = -1, \text{N} = +3, \text{O} = -2$
- e.  $\text{K} = 0, \text{N} = 0, \text{O} = 0$

Letter answer to question #13: \_\_\_\_\_

14. If 2.891 g  $\text{MgCl}_2$  is dissolved in enough water to make 500.0 mL of solution, what is the molarity of the magnesium chloride solution?

- a.  $5.782 \times 10^{-3} \text{ M}$
- b.  $1.518 \times 10^{-2} \text{ M}$
- c.  $6.073 \times 10^{-2} \text{ M}$
- d. 0.5505 M
- e. 5.782 M

Letter answer to question #14: \_\_\_\_\_

15. How many liters of 0.1107 M  $\text{KCl}(\text{aq})$  contain 15.00 g of  $\text{KCl}$ ?

- a. 0.02227 L
- b. 0.5502 L
- c. 1.661 L
- d. 1.818 L
- e. 123.8 L

Letter answer to question #15: \_\_\_\_\_

16. An argon ion laser emits light at 488 nm. What is the frequency of this radiation?

- a.  $4.07 \times 10^{-19} \text{ s}^{-1}$
- b.  $1.63 \times 10^{-15} \text{ s}^{-1}$
- c.  $1.46 \times 10^2 \text{ s}^{-1}$
- d.  $2.05 \times 10^6 \text{ s}^{-1}$
- e.  $6.14 \times 10^{14} \text{ s}^{-1}$

Letter answer to question #16: \_\_\_\_\_

17. A microwave oven emits radiation with an energy of  $3.98 \times 10^{-23} \text{ J/photon}$ . What is the frequency of this radiation?

- a.  $1.67 \times 10^{-11} \text{ s}^{-1}$
- b.  $6.67 \times 10^{-7} \text{ s}^{-1}$
- c.  $2.00 \text{ s}^{-1}$
- d.  $1.50 \times 10^6 \text{ s}^{-1}$
- e.  $6.01 \times 10^{10} \text{ s}^{-1}$

Letter answer to question #17: \_\_\_\_\_

18. 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 #18: \_\_\_\_\_

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

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

Letter answer to question #19: \_\_\_\_\_

20. 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 #20: \_\_\_\_\_

21. 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 #21: \_\_\_\_\_

22. 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 #22: \_\_\_\_\_

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

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

Letter answer to question #23: \_\_\_\_\_

24. 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 #24: \_\_\_\_\_

25. 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 #25: \_\_\_\_\_

26. How many sigma ( $\sigma$ ) bonds and pi ( $\pi$ ) bonds are in acetylene,  $C_2H_2$ ?

- a. one  $\sigma$ , one  $\pi$
- b. two  $\sigma$ , two  $\pi$
- c. three  $\sigma$ , one  $\pi$
- d. three  $\sigma$ , two  $\pi$
- e. four  $\sigma$ , one  $\pi$

Letter answer to question #26: \_\_\_\_\_

27. One product of the combustion of ethylene,  $C_2H_4$ , is carbon dioxide. What change in hybridization of the carbon occurs in this reaction?

- a.  $sp^3$  to  $sp^2$
- b.  $sp^3$  to  $sp$
- c.  $sp^3$  to  $sp^3d$
- d.  $sp^2$  to  $sp^3d^2$
- e.  $sp^2$  to  $sp$

Letter answer to question #27: \_\_\_\_\_

28. Use molecular orbital theory to predict which ion is paramagnetic.

- a.  $C_2^{2-}$
- b.  $O_2^{2-}$
- c.  $O_2^{2+}$
- d.  $N_2^{2-}$
- e.  $B_2^{2-}$

Letter answer to question #28: \_\_\_\_\_

29. Which of the following species will have a Lewis structure most like that of a sulfate ion,  $SO_4^{2-}$ ? Assume that the Lewis structure has no double bonds.

- f.  $NH_3$
- g.  $CBr_4$
- h.  $SO_3$
- i.  $H_2CO$
- j.  $H_2O$

Letter answer to question #29: \_\_\_\_\_

30. Use Lewis structures to predict the bond order for a nitrogen-oxygen bond in the nitrite ion,  $NO_2^{1-}$ .

- a.  $1/2$
- b. 1
- c.  $4/3$
- d.  $3/2$
- e. 3

Letter answer to question #30: \_\_\_\_\_

31. For  $\text{NH}_4\text{NO}_3(\text{aq})$ , the solvent is

- a.  $\text{NH}_4\text{NO}_3$
- b.  $\text{NH}_4^+$
- c.  $\text{NO}_3^{1-}$
- d. water
- e. Duff beer

Letter answer to question #31: \_\_\_\_\_

32. Determine which of the following species is paramagnetic.

- a.  $\text{NO}^{+1}$
- b.  $\text{CO}$
- c.  $\text{CN}^{-1}$
- d.  $\text{OF}^{-1}$
- e.  $\text{NO}$

Letter answer to question #32: \_\_\_\_\_

**Part II:** Short Answer / Calculation, 20 points total. *Show all work!*

---

1. List the following constants, and include units. (10 points)

speed of light ( $c$ ) =

Planck's constant ( $h$ ) =

Avogadro's number ( $N$ ) =

heat capacity of liquid water =

the molar mass of pure  $^{12}\text{C}$  =

2. Convert the following using correct significant figures: (10 points)

370 mL to L

43 m to cm

150 °C to K

128  $\text{cm}^3$  to mL

150 s to minutes

# CH 221 Final Lecture Exam Point Distribution Sheet

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

*Multiple choice (in class) questions:*

                     X 5 points per question =                      points  
*number of multiple choice  
questions correct*

*Short answer questions:*

                     points

*Total points on this exam:*

                     points

---

| <i><b>Grade</b></i> | <i><b>Percentage</b></i> | <i><b>Points on This Exam</b></i> |
|---------------------|--------------------------|-----------------------------------|
| A                   | 89% - 100%               | 160 - 180                         |
| B                   | 78% - 88%                | 140 - 159                         |
| C                   | 65% - 77%                | 117 - 139                         |
| D                   | 55% - 64%                | 99 - 116                          |
| F                   | 0% - 54%                 | 0 - 98                            |

**Part I:** Multiple Choice Questions

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

**Part II:** Short Answer / Calculation.

1. List the following constants, and include units, to four significant figures. (10 points)

**2.998 x 10<sup>8</sup> m/s**  
**6.626 x 10<sup>-34</sup> J s**  
**6.022 x 10<sup>23</sup> /mol**  
**4.184 J/g\*K**  
**12.00 g/mol**

2. Convert the following using correct significant figures: (10 points)

**0.37 L**  
**4.3 x 10<sup>3</sup> cm**  
**420 K**  
**128 mL**  
**2.5 minutes**