

# CHEMISTRY 101 EXAM 2

SECTIONS 572-580

Dr. Joy Heising

## **FORM 2M**

October 25, 2001

### Directions:

1. This examination consists of two parts: **19 multiple choice questions** (6 points each) in **Part 1** and **3 free response questions** (36 points total) in **Part 2**. The total point value for the exam is **150 points**.
2. Fill out your scantron sheet to be used for Part 1.
  - a. Do not forget to include your **SIGNATURE and ID number**.
  - b. Dept = CHEM, Course No. = 101
  - c. If you want your scores posted, mark A under the option column
3. Fill in your **NAME, SIGNATURE and ID number** at the beginning of Part 2 (stapled separately).
4. Use a #1 or #2 pencil for marking the scantron. Fill in the appropriate circles completely. You may write on the multiple choice questions.
5. Read each question **carefully**, then choose the **best answer** for each question. There is no penalty for guessing.
6. Write your answers in Part 2 **clearly** and **neatly**. Show your work for partial credit.
7. DO NOT write on the envelope.
8. The last page of each Part is a sheet of scrap paper. You may tear it off.
9. When finished, put the **SCANTRON SHEET AND PART 2** back in the envelope and turn it in. You may keep Part 1 (this stapled portion).

## PART 1

Multiple Choice (6 points each). Choose the BEST answer.

- How many valence electrons does a silicon atom have?
  - 2
  - 3
  - 4
  - 5
  - 6
- What are the oxidation numbers (oxidation states) of the elements in  $\text{NaClO}_4$ ?
  - $\text{Na} = +1$ ,  $\text{Cl} = +9$ ,  $\text{O} = -2$
  - $\text{Na} = +1$ ,  $\text{Cl} = +7$ ,  $\text{O} = -2$
  - $\text{Na} = +1$ ,  $\text{Cl} = -1$ ,  $\text{O} = 0$
  - $\text{Na} = +2$ ,  $\text{Cl} = +6$ ,  $\text{O} = -2$
  - $\text{Na} = +1$ ,  $\text{Cl} = +5$ ,  $\text{O} = -2$
- Which of the following has a **negative** charge?
  - nucleus
  - neutron
  - proton
  - electron
  - alpha particle
- Which ion has the **largest** radius?
  - $\text{P}^{3-}$
  - $\text{S}^{2-}$
  - $\text{Cl}^-$
  - $\text{N}^{3-}$
  - $\text{F}^-$
- Which of the following matched pairs of name and formula is **INCORRECT**?

<u>Formula</u>	<u>Name</u>
a) $\text{Mn}_2\text{O}_3$	manganese(III) oxide
b) $\text{As}_4\text{O}_6$	tetraarsenic oxide
c) $\text{Cd}(\text{MnO}_4)_2$	cadmium permanganate
d) $\text{SO}_3$	sulfur trioxide
e) $\text{HBrO}$	hypobromous acid

6. Give the number of protons, neutrons, and electrons in the  $^{41}_{21}\text{Sc}^{3+}$  ion.

- a) 21 p, 20 n, 21 e
- b) 21 p, 20 n, 18 e
- c) 21 p, 20 n, 24 e
- d) 20 p, 21 n, 17 e
- e) 21 p, 41 n, 18 e

7. Which comparison of electronegativities is **INCORRECT**?

- a)  $\text{Cl} > \text{S}$
- b)  $\text{Rb} > \text{Ca}$
- c)  $\text{N} > \text{P}$
- d)  $\text{C} > \text{Li}$
- e)  $\text{Br} > \text{Sr}$

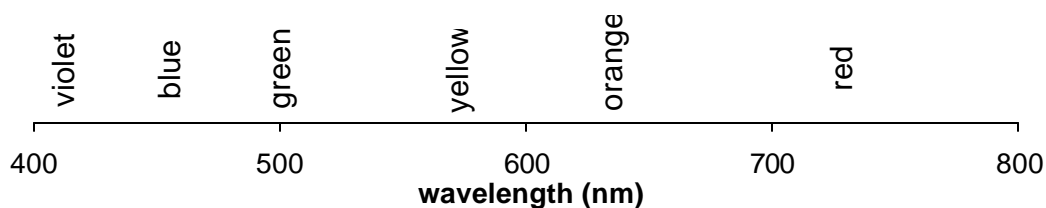
8. If an element consisted of three isotopes in the following relative abundance, what would the atomic weight of the element be? This is a **hypothetical** example.

30.00%	37.00 amu
50.00%	38.00 amu
20.00%	40.00 amu

- a) 38.00 amu
- b) 38.10 amu
- c) 38.20 amu
- d) 39.98 amu
- e) none of these

9. Which of the following pairs of species are isoelectronic?

- a)  $\text{Ne}$ ,  $\text{K}^+$
- b)  $\text{Rb}$ ,  $\text{Cs}$
- c)  $\text{Cl}^-$ ,  $\text{S}^{2-}$
- d)  $\text{Na}$ ,  $\text{Al}^{3+}$
- e)  $\text{S}^{2-}$ ,  $\text{Se}^{2-}$



10. Which of the following colors is the **lowest** energy light? (see Figure.)
- orange
  - yellow
  - green
  - blue
  - they all have the same energy
11. Which of the following statements **DOES NOT** depend upon the quantization of energy?
- Light has the characteristics of both a wave and a particle.
  - The number of electrons ejected from a metal surface irradiated with visible light does not depend on the color of the light as long as the light is above a certain, minimum energy.
  - Electrons in atoms are found in *s*, *p*, *d*, or *f* orbitals.
  - After an electron (in an atom) is excited to a higher energy state, it may move to a lower energy state by emitting radiation of frequency proportional to the energy difference between the two orbits.
  - Each element in the periodic table differs from the preceding element by having one more positive charge in its nucleus.
12. No two electrons in the same atom can have the same set of four quantum numbers is a statement of \_\_\_\_\_.
- the Aufbau Principle
  - the Pauli Exclusion Principle
  - Dalton's Theory
  - Hund's Rule
  - the Heisenberg Uncertainty Principle
13. For a neutral phosphorus atom,  $[\text{Ne}]3s^23p^3$ , a plausible set of quantum numbers for the 'last' electron in the partially filled orbitals could be
- $n = 3, \quad l = 2, \quad m_l = 0, \quad m_s = +1/2$
  - $n = 2, \quad l = 1, \quad m_l = 0, \quad m_s = -1/2$
  - $n = 3, \quad l = 0, \quad m_l = 1, \quad m_s = +1/2$
  - $n = 3, \quad l = 1, \quad m_l = 1, \quad m_s = +1/2$
  - $n = 2, \quad l = 0, \quad m_l = 1, \quad m_s = +1/2$

14. How many resonance structures does the nitrate ion,  $\text{NO}_3^-$ , have?

- a) 1
- b) 2
- c) 3
- d) 4
- e) 0

15. Which one of the following violates the octet rule?

- a)  $\text{PCl}_4^+$
- b)  $\text{ClF}$
- c)  $\text{NF}_3$
- d)  $\text{BCl}_3$
- e)  $\text{AsCl}_3$

16. Which one of the following molecules is **polar**?

- a)  $\text{N}_2$
- b)  $\text{CCl}_4$
- c)  $\text{Cl}_2$
- d)  $\text{CO}_2$
- e)  $\text{H}_2\text{O}$

17. What is the hybridization at antimony in  $\text{SbF}_5$  molecules?

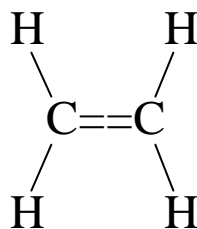
- a)  $sp$
- b)  $sp^2$
- c)  $sp^3$
- d)  $sp^3d$
- e)  $sp^3d^2$

18. Which of the following species has octahedral electronic geometry **and** octahedral molecular geometry?

- a)  $\text{BeCl}_2$
- b)  $\text{CF}_4$
- c)  $\text{BrF}_5$
- d)  $\text{XeF}_4$
- e)  $\text{SeF}_6$

19. How many sigma ( $\sigma$ ) bonds and how many pi ( $\pi$ ) bonds does the ethene molecule contain?

- a) 4  $\sigma$  and 2  $\pi$
- b) 5  $\sigma$  and 2  $\pi$
- c) 5  $\sigma$  and 1  $\pi$
- d) 5  $\sigma$  and 0  $\pi$
- e) 8  $\sigma$  and 2  $\pi$



## **SCRAP PAPER (PART 1)**

## PART 2 FORM 2M

Dr. Heising    CHEM 101    Sections 572-580    EXAM 2    October 25, 2001

**NAME:** \_\_\_\_\_

**SID #:** \_\_\_\_\_

**SIGNATURE:** \_\_\_\_\_

Free Response (36 pts total, see margin for point values). Show all work for partial credit!

20. Electron configurations.

(4 points)      a) Write the electron configuration for polonium (Po). Use noble gas shorthand notation.

(2 points)      b) Determine whether the species is      diamagnetic      paramagnetic      (circle).

(4 points)      c) Draw pictures of the partially occupied orbitals.

(2 points)      d) Now write the electron configuration (noble gas shorthand) for  $\text{Po}^{2+}$ .



21. Cesium (Cs) metal reacts with phosphorus to form the compound cesium phosphide.

(2 points) a) cesium phosphide is an ionic covalent compound (circle).

(2 points) b) write the correct chemical formula for cesium phosphide: \_\_\_\_\_

(3 points) c) write a balanced chemical equation for the reaction.

22. Consider the species  $\text{SbTe}_3^{3-}$ .

(5 points) a) draw the Lewis structure for this ion.

(2 points) b) label the formal charge on each atom (note: double bonds not required).

(2 points) c) the electronic geometry of the species is \_\_\_\_\_.

(2 points) d) the hybridization of the central atom is \_\_\_\_\_.

(2 points) e) the molecular geometry is \_\_\_\_\_.

(4 points) f) Draw a picture of the molecular geometry.

## **SCRAP PAPER (PART 2)**