

Chemistry 161 Exam III April 17, 2007

Student Name (Print): _____

Student Signature: _____

Recitation Section Number:

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Recitation Instructor: _____

The exam booklet has 25 questions for credit and one additional question to check the color of your exam booklet. Please answer all 26 questions **on the OpScan sheet**. There is no penalty for guessing. Answer each question with the **best** choice from those provided. At the end of the 80-minute exam period, please hand in only *this* top sheet and your OpScan form. Please be sure to sign your name above your printed name on the OpScan form. If you finish early, please do not disturb your fellow students. A proctor will check your picture ID, OpScan form, signature and calculator during the exam. **The use of calculators with permanent memories (graphing calculators), cell phones, pagers, PDAs or other electronic devices other than a basic scientific calculator is expressly forbidden.** The last page of the booklet contains a periodic table along with other useful data. The use of any other notes or information on this test will be considered a violation of the Academic Honesty provisions of the student code. Exam scores will be posted as soon as possible.

ON THE OpScan FORM (Use a #2 pencil or darker)

1. SIGN your name across the top of the form.
2. Code the following information (**blacken** circles)
Your Name (LAST NAME FIRST)
Your RU ID
[Start under Box **A** and continue to Box **I**]
3. Your RECITATION SECTION NUMBER in **K & L**
[Sections 01-08, code a 0 under box **K**]
4. Your EXAM FORM NUMBER under box **P**

BL = Bryan Langowski, RP = Bob Porcja, JW = Judy Waidlich

Periods: 6 = 5:50 -6:45, 8 = 8:45-9:40

Sec	Per.	Instr
01	T6	JW
02	T6	RP
06	Th6	BL
07	Th6	JW
08	Th6	RP
10	T8	JW
11	T8	RP
12	T8	BL
13	Th8	JW
14	Th8	RP
15	Th8	BL

Your EXAM FORM is: ①

BEFORE STARTING THE EXAM PUT YOUR FORM # IN COLUMN P AND YOUR SECTION # IN COLUMN K AND L ON THE SCANTRON. ALSO DARKEN THE CIRCLES PLEASE.

1. When $n = 4$ and $\ell = 2$, and $m_\ell = 0$, what orbital type does this refer to?

- A. 4s
- B. 4p
- C. 4d
- D. 4f
- E. 2d

2. Which is the correct order of increasing electronegativity (lowest to highest)?

- A. $\text{Te} < \text{S} < \text{Cl}$
- B. $\text{S} < \text{Te} < \text{Cl}$
- C. $\text{Cl} < \text{S} < \text{Te}$
- D. $\text{Cl} < \text{Te} < \text{S}$
- E. $\text{Te} < \text{Cl} < \text{S}$

3. Which one of these configurations violates the Pauli's exclusion principle?

- A.

↓↑	↓↑	↑↓		
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- B.

↓↑	↑↓	↑	↓	
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- C.

↑↓	↑↓	↑		↑
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- D.

↑↓	↑↓		↑	↓
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- E.

↑↓	↑↓	↑↑		
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4. Excited hydrogen atoms have many emission lines. One series of lines occurs in a region where an electron changes from higher levels to a level with $n = 5$. What is the wavelength of the lowest energy line of this series?
- A. 6380 nm
 - B. 7470 nm
 - C. 7920 nm
 - D. 8400 nm
 - E. 8950 nm
5. The formal charge of Cl in ClO_3^- where each atom has complete octet is:
- A. 0
 - B. -1
 - C. +1
 - D. +2
 - E. -2
6. How many nodes does a 3s orbital have?
- A. 1
 - B. 2
 - C. 3
 - D. 4
 - E. 0

7. Calculate the wavelength associated with a neutron with a mass of 1.675×10^{-24} g and a kinetic energy of 6.21×10^{-21} J (K.E. = $\frac{1}{2}mv^2$)
- A. 4.34×10^{-10} m
 - B. 3.86×10^{-10} m
 - C. 3.01×10^{-10} m
 - D. 2.55×10^{-10} m
 - E. 1.46×10^{-10} m
8. How many equivalent resonance structures can one write for PO_4^{3-} ion where the formal charge on phosphorus is zero?
- A. 1
 - B. 2
 - C. 3
 - D. 4
 - E. 5
9. Which of the following reactions does not proceed as written?
- A. $\text{Al}_2\text{O}_3(\text{s}) + 6\text{HCl}(\text{aq}) \rightarrow 2\text{AlCl}_3(\text{aq}) + 3\text{H}_2\text{O}(\ell)$
 - B. $\text{Li}_2\text{O}(\text{s}) + \text{SO}_3(\text{g}) \rightarrow \text{Li}_2\text{SO}_4(\text{s})$
 - C. $\text{BaO}(\text{s}) + 2\text{NaOH} + \text{H}_2\text{O} \rightarrow \text{Na}_2[\text{Ba}(\text{OH})_4]$
 - D. $\text{Cl}_2(\text{g}) + 2\text{Br}^-(\text{aq}) \rightarrow 2\text{Cl}^-(\text{aq}) + \text{Br}_2(\ell)$
 - E. $\text{Br}_2(\ell) + 2\text{I}^-(\text{aq}) \rightarrow 2\text{Br}^-(\text{aq}) + \text{I}_2(\text{s})$

10. A line in the Balmer series of emission lines of excited hydrogen atoms has a wavelength of 412.0 nm. The transition is
- A. $6 \rightarrow 2$
 - B. $5 \rightarrow 3$
 - C. $6 \rightarrow 3$
 - D. $4 \rightarrow 2$
 - E. $7 \rightarrow 2$
11. Which one of the following statements is false?
- A. The first electron affinity of Si is more negative than the first electron affinity of Al.
 - B. The second electron affinity of oxygen is positive because work must be done to force the extra electron onto the $O^-(g)$ ion.
 - C. Easy removal of electrons corresponds to large atomic radius and low ionization energy.
 - D. Metallic character increases from top to bottom in a group and decreases from left to right in a period.
 - E. Circle this choice if all the other choices are correct.
12. Which one of the following statements is false?
- A. The effective nuclear charge of Li and Na are basically the same, which is +1.
 - B. The effective nuclear charge decreases across a period.
 - C. Arsenic is bigger than sulfur.
 - D. Fe, Co, and Ni have about the same effective nuclear charge.
 - E. $O^{2-}(g)$ is bigger than $O(g)$ and $Mg^{2+}(g)$ is smaller than $Mg(g)$.

13. How many atoms bear a formal charge in SO_3 where each element has a complete octet?
- A. 0
 - B. 1
 - C. 2
 - D. 3
 - E. 4
14. Suppose you are standing 562 m from a radio station broadcasting at 106.7 MHz on the FM radio band. What is your distance from the radio station in terms of number of wavelengths, λ ?
- A. 100
 - B. 200
 - C. 300
 - D. 400
 - E. 500
15. Which one of the following statements is false?
- A. In the hydrogen atom, all subshells of a principal shell are the same energy level.
 - B. Orbital energies are higher in multielectron atoms than in hydrogen atom.
 - C. Attractive force between the nucleus and an electron in any orbital increases with increasing nuclear charge.
 - D. In a multielectron atom the various subshells of a principal shell are at different energy levels.
 - E. All orbitals within a subshell are at the same energy level – they are degenerate.
16. In which of the following ions/molecule the central atom cannot expand its octet?
- A. ClO_4^-
 - B. ClO_3^-
 - C. SO_2
 - D. Cl_2O
 - E. SO_3

17. The threshold energy (also called work function, homework problem 97 in text) of a photoelectric material, cesium, is 3.42×10^{-19} J. If a light of 325 nm wavelength shines on a piece of cesium, what will be the speed of the electrons emitted from the metal? (mass of electron: 9.1×10^{-31} kg)
- A. No electron will be ejected.
 - B. Electrons will be ejected but with zero speed.
 - C. The energy of the light is not high enough to overcome the threshold energy.
 - D. 7.7×10^5 m/s
 - E. 6.0×10^{11} m/s
18. A cell phone sends signals at about 860 MHz. What is the energy of 1.0 mol of photons with a frequency of 860 MHz?
- A. 0.61 J/mol
 - B. 0.75 J/mol
 - C. 0.92 J/mol
 - D. 0.34 J/mol
 - E. 0.21 J/mol
19. Calculate the ΔH_f° of LiF(s) from the following data:
- The enthalpy of sublimation of Li(s) is 159 kJ/mol
The first ionization energy of Li(g) is 520 kJ/mol
The bond dissociation energy of fluorine (g) is 159 kJ/mol
The electron affinity of fluorine is -328 kJ/mol
The lattice enthalpy of LiF is -1047 kJ/mol
- A. -716 kJ/mol
 - B. -616 kJ/mol
 - C. -561 kJ/mol
 - D. -676 kJ/mol
 - E. -786 kJ/mol

20. Which is the correct order of increasing first ionization energy (lowest to highest)?

- A. As < P < Ge
- B. P < As < Ge
- C. Ge < P < As
- D. Ge < As < P
- E. P < As < Ge

21. Which one of the following species follows the octet rule?

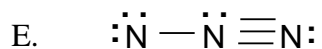
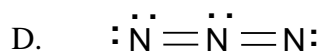
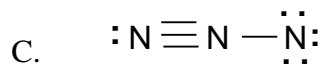
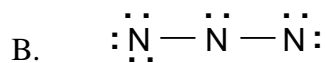
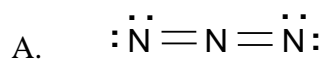
X. NO₂ Y. BH₃ Z. NO₂⁺ W. NO₂⁻

- A. X and Y
- B. Y and Z
- C. Z and W
- D. Z only
- E. W only

22. Which one of the following ions has the most unpaired electrons?

- A. Mn²⁺
- B. Fe²⁺
- C. Cr²⁺
- D. Co³⁺
- E. Eu²⁺

23. What is the best Lewis Structure for N_3^- ion? (formal charges are not indicated)



24. Given:

$$\Delta H_f^\circ (1.0 \text{ M H}_2\text{SO}_4) = -888 \text{ kJ/mol}$$

$$\Delta H_f^\circ (0.25 \text{ M H}_2\text{SO}_4) = -890 \text{ kJ/mol}$$

Which statement below is correct when 1.0 M H_2SO_4 is diluted to 0.25 M?

- A. ΔH of dilution is + 2 kJ and it is exothermic.
- B. ΔH of dilution is - 2 kJ and it is exothermic.
- C. ΔH of dilution is + 2 kJ and it is endothermic.
- D. ΔH of dilution is - 2 kJ and no heat is evolved.
- E. ΔH of dilution is -1778 kJ and it is exothermic.

25. Draw the best Lewis Structure for the anion containing [C, N, O]⁻. The formal charges on C, N and O are, **respectively**
- A. 0, 0, -1
 - B. 0, -1, 0
 - C. -1, 0, 0
 - D. +1, -1, +1
 - E. 0, +1, -2
26. What is the color of your exam?
- A. White
 - B. Yellow
 - C. Pink
 - D. Blue

DATA AND FORMULAS

$$c = \lambda\nu \quad \Delta E_{\text{level}} = h\nu \quad c = 3.00 \times 10^8 \text{ m}\cdot\text{s}^{-1} \quad h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s} \quad 1 \text{ Hz} = 1 \text{ s}^{-1}$$

$$\Delta E = -2.179 \times 10^{-18} \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right) \quad \lambda = \frac{h}{\text{mass} \times \text{velocity}}$$

$$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$$

$$h\nu = h\nu_o + \text{KE}$$

Formal charge = valence electrons – lone pair electrons – 1/2 (bonding electrons)