

KWANTLEN UNIVERSITY COLLEGE
CHEMISTRY 1110 S-10
EXAM No. 2
Thursday March 26, 1998

NAME: _____

Instructions: There are **29** questions on this exam. **Part A** consists of multiple choice questions and **Part B** is a problem solving section. **ALL WORK MUST BE SHOWN IN PART B TO RECEIVE ANY CREDIT.** A periodic chart is included with this exam. Rough Calculations may be done on the back side of a page. Maximum Score: **80** points

PHYSICAL CONSTANTS:

Avogadro's Number (N_0) = 6.022×10^{23}

Speed of light (c) = 2.998×10^8 m/s

Planck's Constant (h) = 6.626×10^{-34} J S

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Part A Multiple Choice Questions 1 - 25 Each count 2 points (Circle your response, if you disagree with all the answers for a given problem, write in your own answer)

- Which of the following combinations of quantum numbers (n, l, m_l, m_s) is **NOT** allowed?
a) 4,3,-2,+1/2 b) 3,0,1,-1/2 c) 3,0,0,+1/2 d) 5,4,-1,-1/2 e) all are allowed
- How many orbitals in an atom can have $n=6$ and $m_l=0$?
a) 5 b) 6 c) 10 d) 12 e) 32
- A possible set of quantum numbers for the last electron added to complete an atom of scandium (Sc) in its ground state is:
a) 4,0,0,+1/2 b) 3,0,1,-1/2 c) 4,1,-1,+1/2 d) 3,2,1,+1/2 e) 4,2,2,-1/2
- What is the ground state electron configuration of germanium (Ge)?
a) $1s^2 2s^2 2p^6 3s^2 3p^4$ b) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^2$ c) $1s^2 2s^2 2p^6 2d^{10} 3s^2 3p^6 4s^2 4p^2$
d) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{12}$ e) $[\text{Ar}]4s^2 4p^2$
- The ground state electron configuration of a Mo (molybdenum) atom is:
a) $[\text{Kr}]5s^2 4d^4$ b) $[\text{Kr}]5s^1 5d^5$ c) $[\text{Kr}]5s^1 4d^5$ d) $[\text{Kr}]4d^6$
e) $[\text{Xe}]5s^2 4d^4$
- An atom of nickel (Ni) has _____ unpaired electrons and is _____.
a) 0, diamagnetic b) 2, diamagnetic c) 2, paramagnetic d) 4, paramagnetic
e) 8, paramagnetic
- The electron configuration of Mn^{2+} is:
a) $[\text{Ar}]3d^5$ b) $[\text{Ar}]4s^2 3d^3$ c) $[\text{Ar}]4s^1 3d^4$ d) $[\text{Ar}]4s^2 3d^5$
e) none of these.

8. Which of the following would be the electron configuration of an excited state of an sulfur atom?
- a) $1s^2 2s^2 2p^6 3s^1 3p^5$ b) $1s^2 2s^2 2p^6 3s^2 3p^4$ c) $1s^2 2s^2 2p^6 3s^2 3p^5$
d) $1s^2 2s^2 2p^6 3s^2 3p^6$ e) $1s^2 2s^2 2p^6 3s^1 3p^6$
9. The phosphide ion P^{3-} is isoelectronic with which of the following?
- a) O^{2-} b) F^- c) Na^+ d) Al^{3+} e) K^+
10. What is the ground state electron configuration of the sulfide ion, S^{2-} ?
- a) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^3$ b) $[Ne] 3s^2 3p^4$ c) $1s^2 2s^2 2p^6 3s^2 3p^6$ d) $[Ne] 4s^2 3d^9 3p^3$
e) none of these
11. An element has the electron configuration: $[Xe] 6s^2 4f^3$. The element is a(n)
- a) nonmetal b) transition element c) alkaline earth metal d) lanthanide
e) actinide
12. Which one of the following atoms and ions has the largest radius?
- a) S^{2-} b) Cl^- c) Ar d) K^+ e) Ca^{2+}
13. Which atom will have the smallest radius?
- a) Si b) S c) Ar d) Ga e) Kr
14. Which element will have the greatest first ionization energy?
- a) K b) Ga c) Se d) Te e) Sr
15. Successive ionization energies: IE_1 , IE_2 , IE_3 , etc., provide evidence for the shell structure of the atom. For phosphorus atoms, which ionization energy value show an exceptionally large increase over the preceding ionization energy value?
- a) 2nd b) 3rd c) 4th d) 5th e) 6th

16. Which of the following elements has the most negative value for electron affinity?
a) Mg b) Al c) Si d) Cl e) Ar
17. Which of the following is the most metallic element?
a) Na b) K c) V d) Ni e) Ge
18. Which of the following bonds is the **most** polar (highest percent ionic character)?
a) Cl-Cl b) Al-O c) Al-S d) N-O e) C-O
19. Which element has the greatest electronegativity?
a) Mg b) Ga c) Si d) Ba e) Pb
20. Which of the following compounds is likely to be the most ionic?
a) CO₂ b) NaCl c) KF d) CCl₄ e) P₂O₄
21. Which of the following covalent bonds is the **least** polar (lowest percent ionic character)?
a) Si-O b) Si-N c) Si-P d) Si-S e) Si-Cl
22. Which of the following molecules has an atom (other than H) with an expanded octet?
a) H₂O b) AsCl₅ c) BF₃ d) ICl e) NCl₃
23. Which compound contains both ionic and covalent bonds?
a) NH₃ b) RbI c) Na₂SO₄ d) C₂H₄ e) CuCl₂
24. As the number of bonds between two atoms increases, which of the following decreases?
a) number of electrons between the atoms? b) bond energy
c) bond length d) all of the above
e) none of the above
25. If element A has seven valence electrons and element X has six valence electrons, the expected formula for a compound of A and X is:
a) AX₂ b) AX₃ c) A₂X d) A₃X e) A₃X₃

Part B **Short Answer Section Questions 26 - 29** (SHOW ALL YOUR WORK)

26. The energy required to dissociate H₂ molecules into H atoms is 432 kJ/mol. If the dissociation of an H₂ molecule was accomplished by the absorption of a single photon with exactly the energy required, what would be its wavelength (in nanometers)? (4)

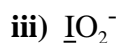
27. The energy levels in any one-electron species are given by the expression:

$$E_n = - 2.18 \times 10^{-18} \text{ J } \left(\frac{Z^2}{n^2} \right)$$

The transition of an electron in a He⁺ ion from the n=5 level to a lower energy level produced a photon having a wavelength of 1.01 x 10⁻⁶ m. Determine the value of "n" for this lower level. (5)

28. For each of the following species: (12)

- a) draw **one** acceptable Lewis diagram (or structure). The underlined atom is the central atom. Show all non-bonding electrons.
- b) predict, redraw, and name the molecular or ionic geometry using VSEPR.
- c) indicate whether the predicted species is polar or non-polar.



29. a) Draw Lewis structures for the three major resonance contributors of the $\text{N}\underline{\text{C}}\text{O}^-$ ion. Include **all non-bonding electrons** and **formal charges**. (9)

29. (Continued)

- b) Which resonance structure(s) would contribute most to the actual structure of NCO^- ? Which would contribute the least? **Briefly explain why. (2)**
- c) Which bonds are likely to be the longest in the ion? **Briefly explain why. (2)**
- d) Which bond(s) is(are) likely to be the weakest in the ion? **Briefly explain why. (2)**
- e) Which bond is the most polar? **Briefly explain why. (2)**