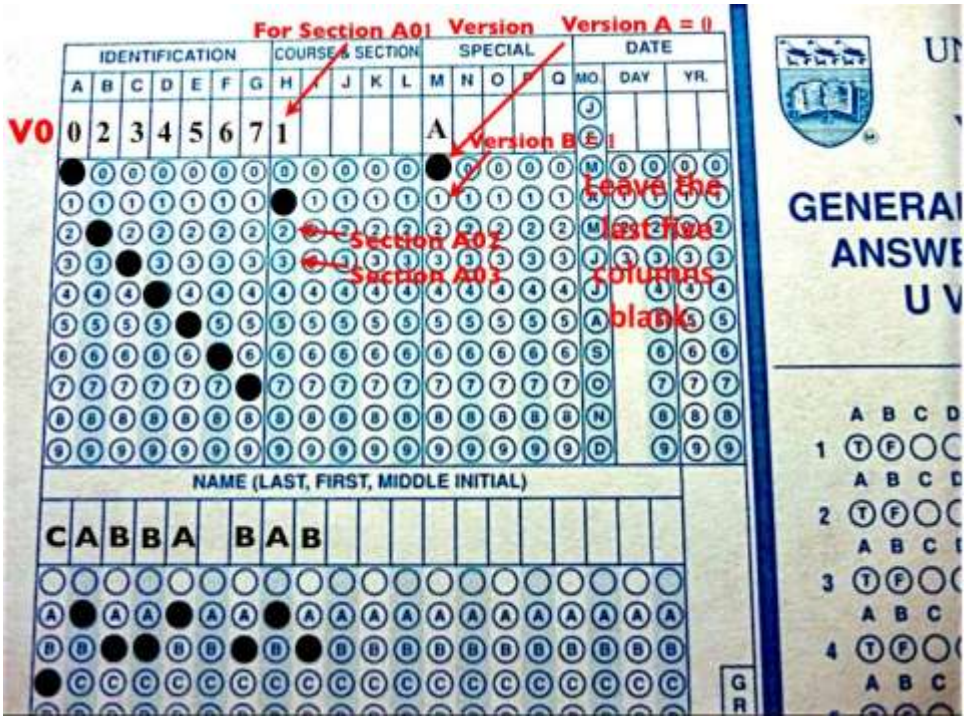
Version A	UNIVERSITY OF VICTORIA CHEMISTRY 101 Midterm Test 1 October 18, 2013 5-6 pm (60 minutes)	Version A

DISPLAY YOUR STUDENT ID CARD ON THE TOP OF YOUR DESK NOW

Answer all multiple choice questions on the bubble sheet provided. Use a soft pencil. The scanner does not read ink. Complete the identification portion of the bubble sheet according to the example shown. (The student's name in the example is Bab Cabba.)



Hand in only the bubble sheet at the end of the test period (60 minutes).

A DATA sheet is included, unstapled, inside the cover page of this test.

This test has 6 pages (not including the DATA sheet). Count the pages before you begin.

The basic Sharp EL510 calculator or the Sharp EL-510 RNB are the only ones approved for use in Chemistry 101.

DO NOT BEGIN UNTIL TOLD TO DO SO BY THE INVIGILATOR

This test consists entirely of multiple choice questions and is worth 50 marks. There are two marks per question. The answers for the 25 questions must be coded on the optical sense form (bubble sheet) using a *SOFT PENCIL*. The scanner does not read ink of any colour.
***Select the* BEST *response for each question below*.**

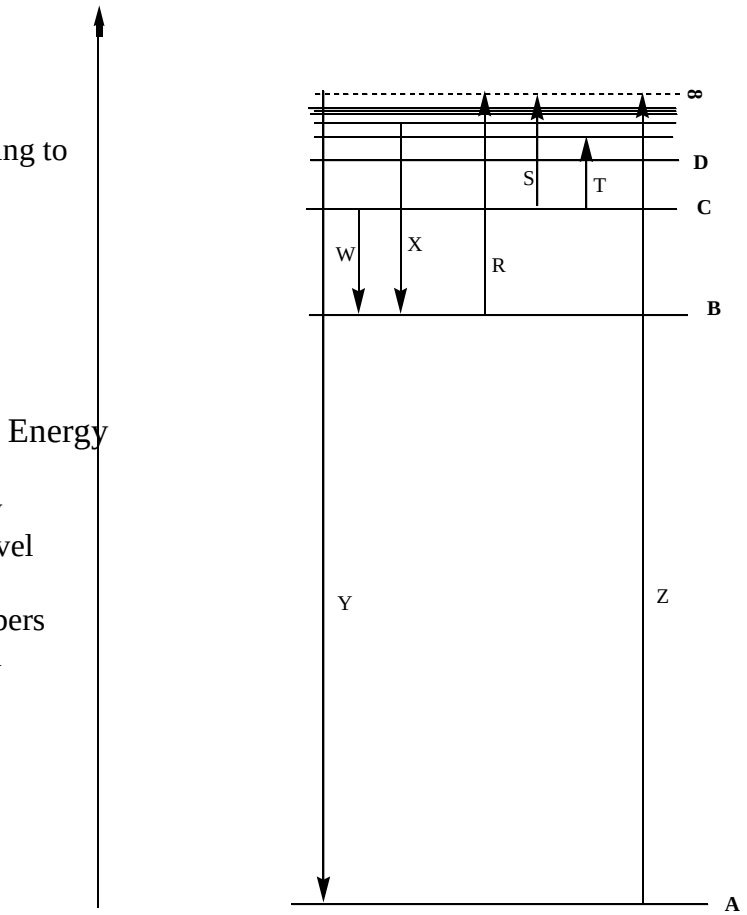
Below is the energy level diagram for the possible energy levels of a hydrogen atom. (not to scale). Answer the following questions 1 to 4 about the hydrogen atom.

1. What is the energy change (ΔE) corresponding to the transition labeled Z?
   A. 6.02×10^{23} J
   B. 3.29×10^{-15} J
   C. 2.18×10^{-18} J
   D. -3.29×10^{-15} J
   E. -2.18×10^{-18} J

2. What is the energy change (ΔE) corresponding to the transition labeled W?
   A. -3.03×10^{-19} J
   B. -1.64×10^{-19} J
   C. 4.57×10^{14} J
   D. -3.63×10^{-19} J
   E. 3.03×10^{-19} J

3. What is the total number of ways that an electron in an H atom could have the energy labeled C? (*i.e.* what is the degeneracy of level C?) This is the same as asking how many different combinations of the quantum numbers would have this energy. Include spin (m_s) in your analysis.
   A. 26
   B. 28
   C. 18
   D. 2
   E. 42

[Energy levels not exactly to scale]

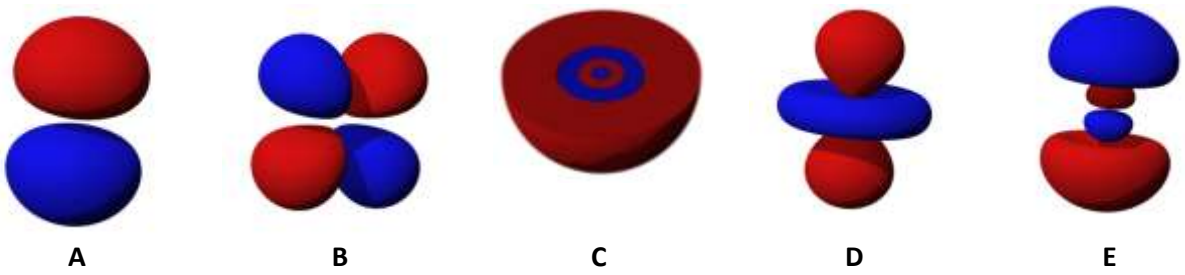


4. Decide whether the following statements are true (T) or false (F) and then select the best response below for indicating the one(s) that is(are) FALSE.

i) Transition W represents an emission. (T)
ii) Transition R represents an ionization. (T)
iii) Transition Y represents an electron affinity. (T)
iv) For the level labeled C the value of n is 3. (T)
v) Level D is the third excited state. (T)
vi) Transition S results in emission of infra-red radiation. (F)

A) iv & vi B) vi only C) v & vi D) iii, iv & vi E) ii & v

Below are some depictions of orbitals. Questions 5 - 7 refer to these pictures.



5. Which of these orbitals has an ℓ value (angular momentum quantum number) of 0?

A. A B. B C. C D. D E. E

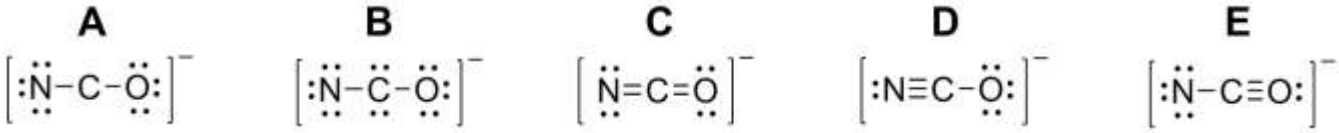
6. Which of these pictures depict(s) a *p* orbital?

A. all of them B. A and E C. A and D D. A, D and E E. C

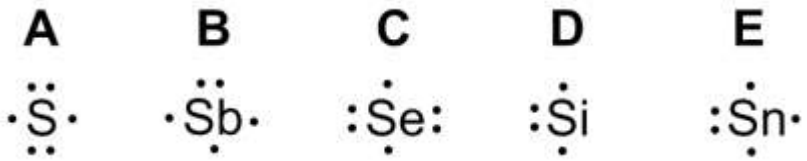
7. Which set of quantum numbers n,ℓ can be valid for the orbital D in the figure above?

A. 2,2 B. 4,3 C. 3,1 D. 3,2 E. 2,3

8. Which of these is the best Lewis structure for $[NCO]^-$? Answer D



9. Which of these neutral atoms has an INCORRECT Lewis symbol? Answer E



10. Which of these elements is the central atom in CHBrClF?

A. C B. H C. Br D. Cl E. F

11. Based on relative electronegativities, which of these is the MOST polar bond?

A. F-F B. F-Cl C. O-F D. S-Cl E. F-I

12. Which of these ionic compounds has the highest lattice energy?

A. KCl B. $CaCl_2$ C. $ScCl_3$ D. CaO E. Sc_2O_3

13. Why does nitrogen have a positive electron affinity? (*i.e.* How do we rationalize the fact that it is energetically unfavorable for an N atom to accept an electron when it is energetically favorable for C and O to do so?)

A. It has a low $Z_{eff.}$
B. It has a high $Z_{eff.}$
C. It has a full shell of valence electrons.
D. Electron-electron repulsion between two electrons in the same 2p orbital is high.
E. Nitrogen has a high electronegativity.

14. Which of these elements has the highest third ionization energy?

A. Mg B. P C. Si D. Al E. S

15. To determine how exothermic the formation of KCl from potassium metal and chlorine gas is, we need to know the heat of atomization of potassium, the heat of atomization of chlorine, the ionization energy of potassium, the electron affinity of chlorine, and what other quantity?

A. The electronegativities of both K and Cl
B. The electrostatic force between K^+ and Cl^-
C. The K-Cl bond enthalpy (*i.e.* bond energy)
D. The lattice energy of KCl
E. The dipole moment of the K-Cl bond

16. How many non-bonding electrons are there in a molecule of $SeCl_2$?

A. 0 B. 12 C. 16 D. 18 E. 20

17. Which of these is NOT a valid reason for a molecule to disobey the octet rule?

A. The central atom is a transition metal.
B. The central atom has more than an octet and is from the third (or higher numbered) row of the periodic table.
C. There are insufficient electrons to provide the central atom with an octet.
D. The molecule has an odd number of electrons.
E. Completing the octet would put a formal positive charge on an electronegative element.

Questions 18 & 19 refer to the molecules in this box. Answer these questions referring to these molecules.

i. SiH_4	ii. BF_3	iii. OF_2	iv. NF_3	v. NO
vi. BrF_5	vii. XeF_4	viii. $OCCl_2$		

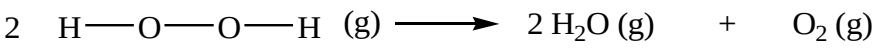
18. Indicate **all** of the molecules in the box above for which the best Lewis structure has an atom that is assigned fewer than eight electrons (*i.e.* an "incomplete octet").

A. i only B. ii & v C. v only D. ii & iv E. vii only

19. Indicate **all** of the molecules in the box above for which the best Lewis structure has an atom that is assigned more than eight electrons (*i.e.* an "extended octet").

A. i & vi B. vi, vii & viii C. v only D. vi & vii E. vii only

20. Using bond energies from the DATA sheet, calculate (estimate) the enthalpy of reaction (heat of reaction, ΔH) in kJ/mol for the decomposition of hydrogen peroxide in the reaction shown below.



A. +203 B. −349 C. +146 D. +349 E. −203

21. For which one of the following molecules do we invoke resonance in describing the bonding?

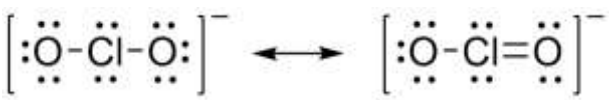
A. SO_3 B. CCl_4 C. N_2 D. PCl_5 E. OF_2

22. Which of the following relationships is/are CORRECT when comparing lattice energies?

i. $CaF_2 > BaF_2$ ii. CsBr > RbBr > NaCl iii. BaO > KF iv. $NaCl > MgCl_2$ v. NaBr > NaCl

A. i & v only B. ii only C. i & iii D. iii only E. i, ii & iii

23. Consider the two resonance structures for ClO_2^- shown below. What is the formal charge on Cl in each of the two resonance structures respectively?



A. +1, 0 B. −1, 0 C. 0, 0 D. 0,+1 E. 0, −1

24. Consider the following electron configuration (written in Aufbau order). What neutral ground state element has this configuration?

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10}$

A. Pb B. Hg C. Tl

D. Cn E. Au

25. The predicted ground state electron configuration for the doubly charged ion of tungsten (W^{2+}) is?

A. [Xe] $4f^{14}\,5d^4\,6s^2$ B. [Xe] $4f^{13}\,5d^5$ C. [Xe] $4f^{12}\,5d^4\,6s^2$

D. [Xe] $4f^{14}\,5d^3\,6s^1$ E. [Xe] $4f^{14}\,5d^4$

END