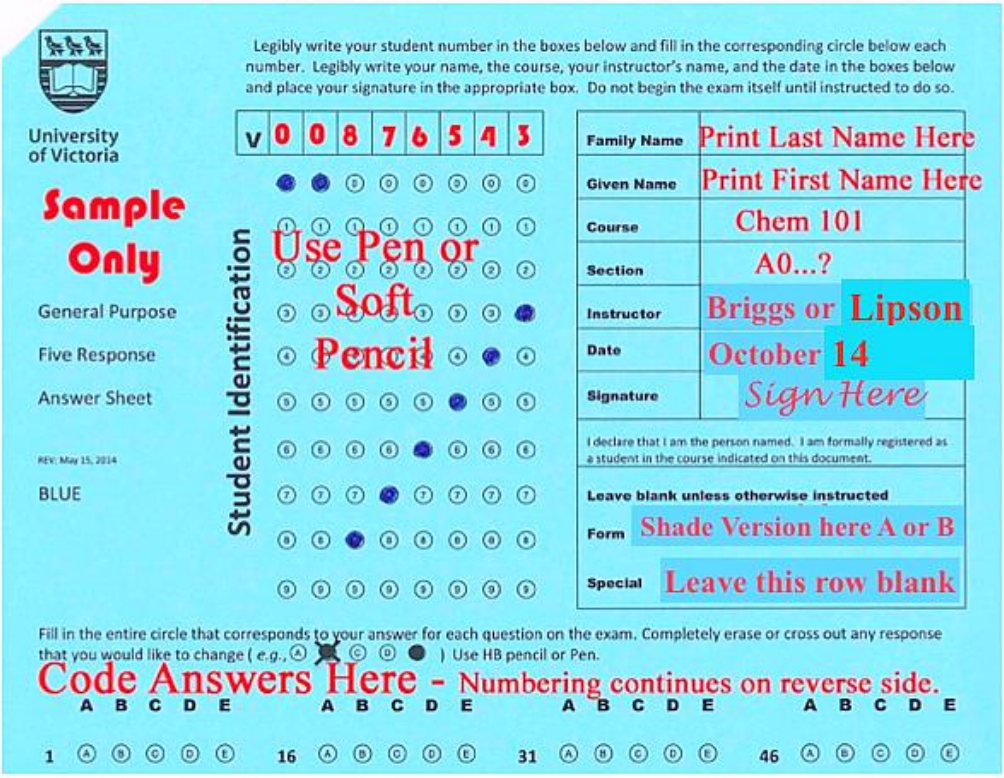
Version B	UNIVERSITY OF VICTORIA CHEMISTRY 101 Midterm Test 1 October 14, 2016 5-6 pm (60 minutes)	Version B

DISPLAY YOUR STUDENT ID CARD (ONEcard) ON THE TOP OF YOUR DESK NOW

Answer all multiple choice questions on the bubble sheet provided. Use a pen (or soft pencil). Complete the identification portion of the bubble sheet according to the example shown, using your own name and student ID number. Indicate your Test Version (A or B) in the line labeled 'Form'.

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 and 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

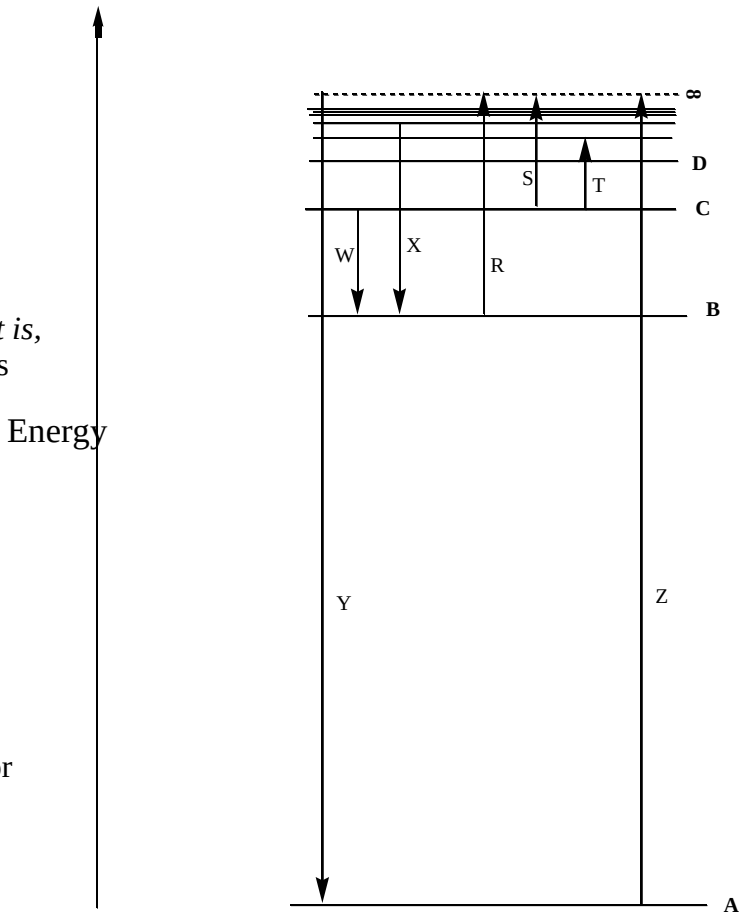
This test consists entirely of multiple choice questions and is worth 25 marks. There is one mark per question. The answers for the 25 questions must be coded on the optical sense form (bubble sheet) using a PEN or *SOFT PENCIL*. *Select the* BEST *response for each question below.*

Below is the energy level diagram for the possible energy levels of a hydrogen atom. (not exactly 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 Y?
   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

[Energy levels not exactly to scale]



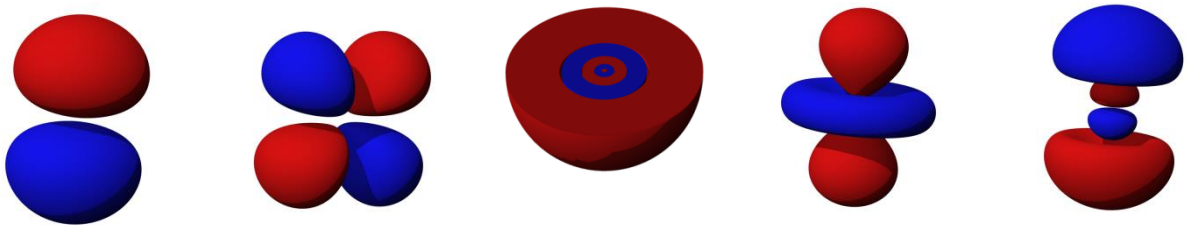
3. What is the total number of ways that an electron in a hydrogen atom could have the energy labeled C? (*That is*, what is the degeneracy of level C?) This is the same as asking how many different combinations of the quantum numbers for hydrogen would have this energy. Include spin (m_s) in your analysis.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

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.
ii) Transition R represents an ionization.
iii) Transition T represents an absorption.
iv) Transition S results in emission of radiation.
v) Level D is the third excited state.
vi) For the level labeled C the value of n is 3.

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

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



A B C D E

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

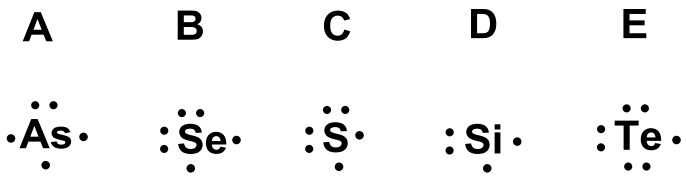
6. Which of these pictures depict(s) a *p* orbital?

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

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 neutral atoms has an INCORRECT Lewis symbol? This question has been dropped from the grading because the wording is ambiguous and was found to be confusing to some students.



9. How many electrons in an antimony (Sb) atom have a principal quantum number of n = 4 and a magnetic quantum number of $m_\ell = 0$?

A. 2 B. 3 C. 6 D. 9 E. 18

10. An electron is travelling with a velocity of 2.42×10^6 m/s. The uncertainty in measuring its velocity is 10.0 m/s. What is the minimum uncertainty in measuring its position (in micrometers, μm).
(1 μm = 10^{-6} m)

A. 5.79 μm B. 2.09 μm C. 423 μm D. 193 μm E. 478 μm

11. Based on electronegativity trends, which of these is the MOST polar bond?

A. Cl-Cl B. F-Cl C. N-O D. Se-Br E. F-Te

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

A. KCl B. $MgCl_2$ C. MgO D. BaO E. $SrCl_2$

13. Why does Beryllium (Be) have a positive electron affinity? (*That is*, how do we rationalize the fact that it is energetically unfavorable for a Be atom to accept an electron when it is energetically favorable for lithium (Li) and boron (B) to do so?)

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

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

A. Cl B. P C. Mg D. Na E. Al

15. What neutral ground state atom has the electronic structure $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}$?

A. Co B. Ni C. Zn D. Cu E. Ga

16. To determine, in a Born-Haber cycle, how exothermic the formation of NaF from sodium metal and fluorine gas is, we need to know the heat of atomization (vaporization) of sodium, the heat of atomization of fluorine (bond energy), the ionization energy of sodium, the electron affinity of fluorine, and what other quantity?

A. The electronegativities of both Na and F
B. The electrostatic force between Na^+ and F^-
C. The Na-F bond length (distance)
D. The lattice energy of NaF
E. The dipole moment of the Na-F bond

17. 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

18. Which of the following is NOT a correct ground state electron configuration?
    A. Ba = [Kr] $5s^2$
    B. Se = [Ar] $4s^2$ $3d^{10}$ $4p^4$
    C. H = $1s^1$
    D. Al = [Ne] $3s^2$ $3p^1$
    E. In = [Kr] $5s^2$ $4d^{10}$ $5p^1$

19. What is the correct electronic configuration for the Zr^{3+} ion (zirconium 3+)?
    A. [Ar] $4d^1$
    B. [Kr] $4d^1$
    C. [Kr] $5s^1$
    D. [Ar] $5s^1$
    E. [Kr] $4d^2$

20. If A > B means the atomic radius of A is greater than that of B, which of these pairs of elements is in the WRONG order with respect to their relative size?

    A: Br > Ca B: Mg > S C: Bi > S
    D: I > Cl E: Zr > Ru

21. Which element from the set below has the largest negative (most favorable) electron affinity?

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

22. Calculate the effective nuclear charge (Z_{eff}) for a valence electron of chlorine (Cl) using the simplest possible model, namely that electrons in the same shell (same n) do not shield (screen) at all, and that all core electrons screen exactly one proton charge each.

    A. Z_{eff} = 6.1 B. Z_{eff} = 5.0 C. Z_{eff} = 7.0 D. Z_{eff} = 6.0 E. Z_{eff} = 5.8

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

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

    A. Pb B. Tl C. Hg

    D. Cn E. Au

24 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] $4f^{14}\,5d^{4}$

25. The hydrogen bromide molecule (H−Br) has a bond length of 141 pm (1.41 Å) and a dipole moment μ = 0.82 Debye units. Calculate the charge on the bromine atom in this molecule in units of the electronic charge e. (1 pm = 10^{-12}m)

A. 1.7×10^{-11} B. 0.24 C. 12 D. 0.12 E. 1.9×10^{-20}

END