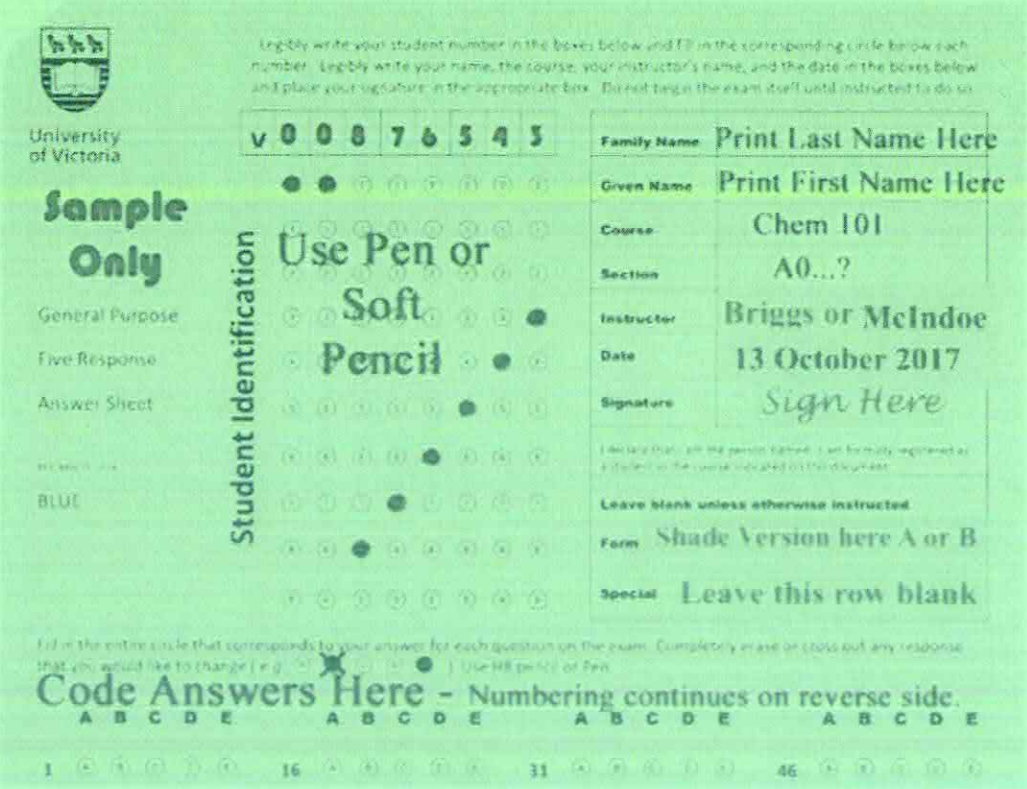
Version B	UNIVERSITY OF VICTORIA CHEMISTRY 101 Midterm Test 1 October 13, 2017 5-6 pm (60 minutes)	Version B

DISPLAY YOUR STUDENT ID CARD 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.

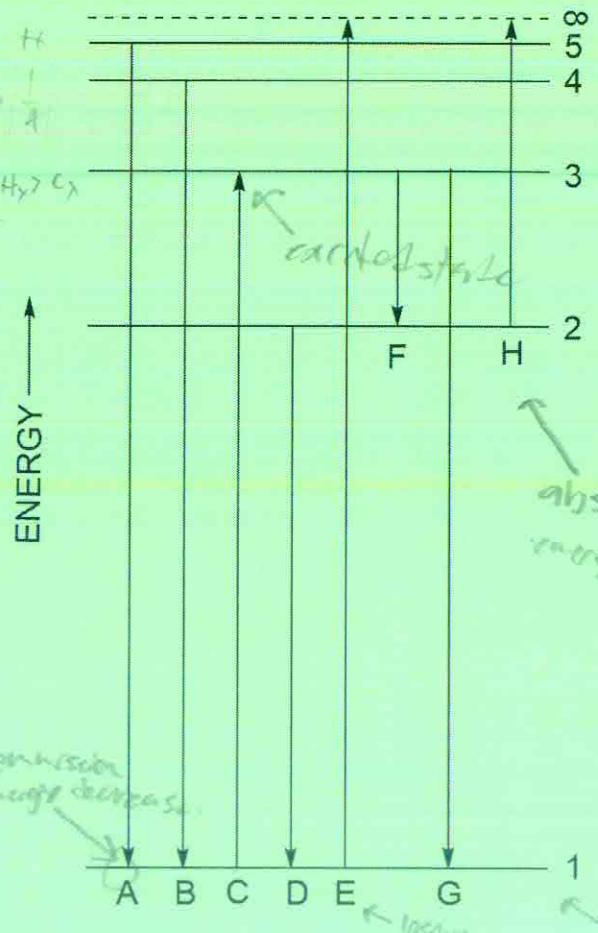
This test has 7 pages (not including the DATA sheet). Count the pages before you begin.

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 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 a soft pencil*.
Select the* BEST *response for each question below.

Use the orbital energy level diagram **for hydrogen** shown at the right to answer questions 1 to 3 below.



1. Which of the following statements is INCORRECT?

A) Transition H represents an absorption.

B) Transition A represents an emission.

C) Transition C represents excitation of a ground state electron to an excited state.

D) The energy corresponding to transition E corresponds to I_1, the first ionization energy.

E) A longer wavelength photon is involved in transition C than transition H.

2. Using a formula from the DATA sheet, calculate the frequency (in s^{-1}) of the photon corresponding to transition E.

A) 3.29×10^{-15} B) 3.29×10^{15} C) 2.73 D) 1.097×10^{7} E) -3.29×10^{15}

3. Using a formula from the DATA sheet, calculate the energy change (in Joules) corresponding to the transition labeled H.

A) 5.45×10^{-19} B) -5.45×10^{-19} C) 2.18×10^{-18} D) 5.45×10^{19} E) 8.72×10^{-18}

4. Which of the following phenomena can be explained by the classical wave theory of light?

A. emission spectra B. the photoelectric effect C. blackbody radiation

D. destructive interference E. none of A, B, C or D.

5. Sodium-vapor streetlamps are efficient because they emit light at a wavelength of 589 nm, near the peak sensitivity of the human eye. A typical streetlamp runs at 100 watts (that is, 100 joules per second). How many photons would such a lamp emit in one second?

A. 2.96×10^{20} B. 5.89×10^{4} C. 3.38×10^{-19} D. 3.38×10^{-17} E. 2.96×10^{18}

6. In an experiment involving the photoelectric effect, an electron is ejected from a metal surface with a velocity of 2.76×10^{6} m s^{-1}. If the uncertainty in the velocity of this electron is 1×10^{4} m s^{-1}, what is the uncertainty in the position of the electron in nanometers (nm)?

A. 5.8×10^{-9} B. 5.8 C. 1.00×10^{-10} D. 73 E. 5.3×10^{-30}

7. How many nodes are there in each of the 5s, 5p, 5d and 5f orbitals?

A. 0, 1, 2, 3 B. 1, 2, 3, 4 C. 3, 2, 1, 0

D. 3, 3, 3, 3 E. 4, 4, 4, 4

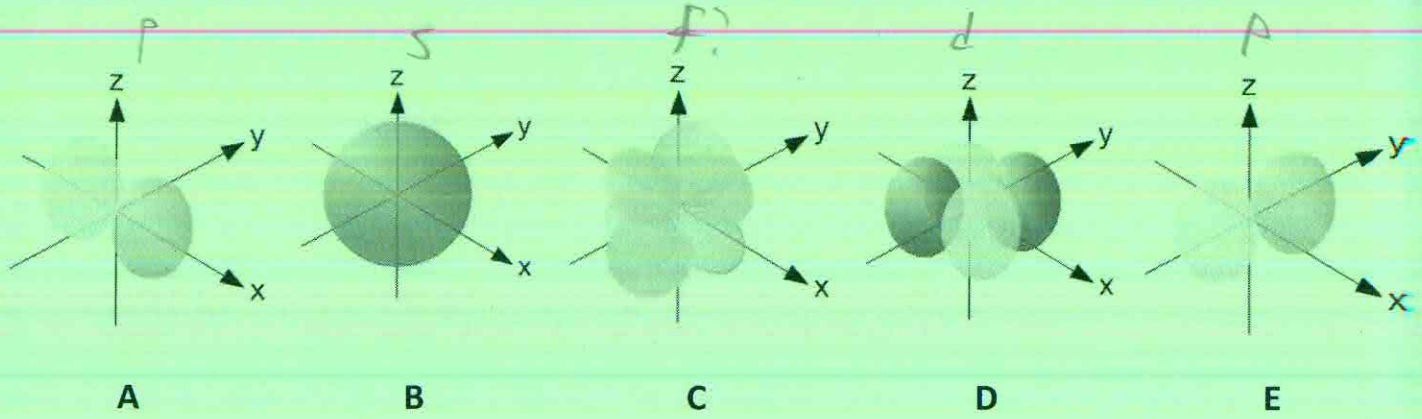
8. Consider the following electron configuration (written in Aufbau order). What neutral ground state element has this configuration?

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

A. Bi B. Sb C. Pb

D. Tl E. Hg

Below are some depictions of orbitals. Questions 9 - 12 refer to these pictures.



9. Which of these orbitals has an ℓ value (angular momentum quantum number) of 2?

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

10. Which of these orbitals is NOT an *s*, *p* or *d* orbital?

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

11. Which set of quantum numbers n, ℓ can be valid for the orbital **A** in the figure above?

A. 3,0 B. 3,1 C. 1,0 D. 4,2 E. 1,1

12. Which set of quantum numbers n, ℓ, m_ℓ, m_s can be valid for an electron in orbital **B** in the figure above?

A. 0,0,0,+½ B. 1,0,1,-½ C. 2,0,0,+½ D. 1,1,0,-½ E. 1,1,1,+½

13. Which of these ions does NOT have the same electronic configuration as a noble gas?

A. Te^{2-} B. Y^{3+} C. Be^{+} D. O^{2-} E. I^-

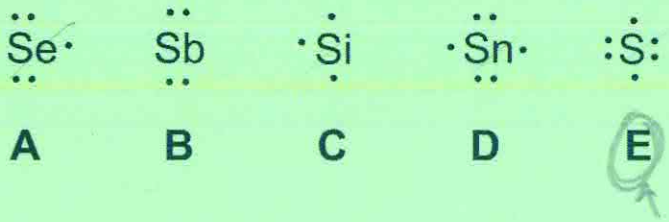
14. What is the correct condensed electron configuration for Tl^{3+}?

A. $[Kr]\ 6s^2\ 4f^{14}\ 5d^{10}$
B. $[Xe]\ 6s^2\ 4f^{14}\ 5d^{10}\ 6p^2$
C. $[Kr]\ 6s^2\ 4f^{14}\ 5d^8$
D. $[Xe]\ 6s^2\ 4f^{14}\ 5d^8$
E. $[Xe]\ 4f^{14}\ 5d^{10}$

15. Which of the following elements is expected to have the largest (*i.e.* most negative, most favorable) electron affinity?

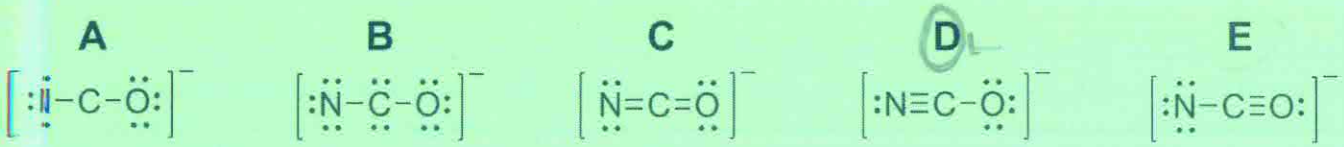
A. Kr B. Ca C. As D. Cl E. K

16. Which of these atoms as shown below has a correct Lewis symbol?



A B C D E

17. Which of these is the best Lewis structure for the isocyanate ion $[NCO]^-$?



A B C D E

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

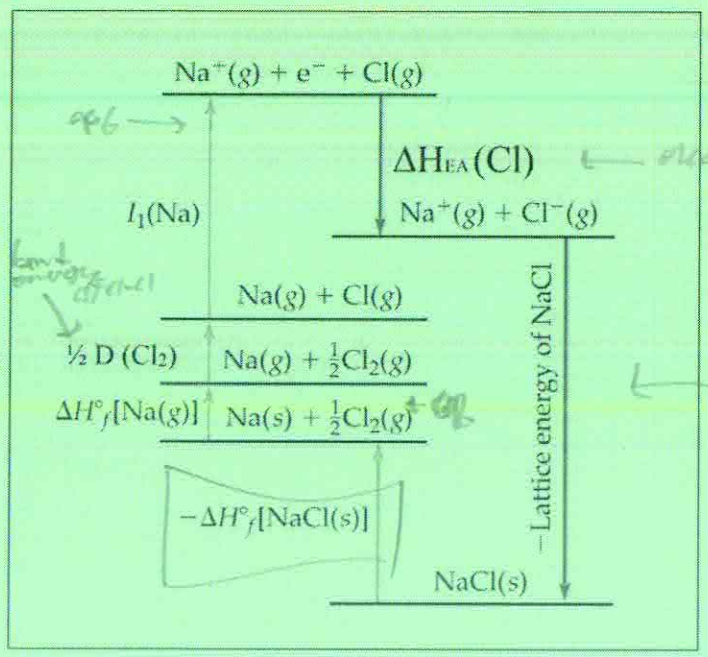
A. O–Cl B. Br–I C. C–Cl D. S–Cl E. C–I

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

A. MgO B. CaO C. MgF_2 D. $CaCl_2$ E. NaBr

20. Elemental sodium and chlorine react vigorously and exothermically in a formation reaction to produce table salt, NaCl.
The following figure is a graph of the Born-Haber cycle for sodium chloride (NaCl). It is not drawn to scale. The energy units are kJ mol^{-1}.
The enthalpy of sublimation (vaporization, atomization) of sodium = ΔH°_{f} [Na(g)] = 98 kJ/mol.

Using this Born-Haber cycle and information from the Data Sheet calculate the enthalpy of formation of NaCl(s) *(i.e.* ΔH°_{f} [NaCl(s)].



A. +303 B. –443 C. –423 D. –303 E. +423

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

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

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

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

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

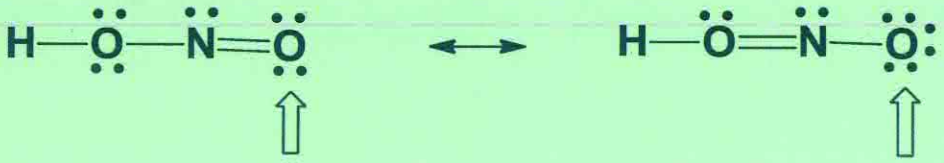
A. N_2 B. CF_4 C. CO_3^{2-} D. PCl_5 E. OF_2

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

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

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

25. Consider the two resonance structures for nitrous acid (HNO_2) shown below. What is the formal charge on the oxygen atom indicated by the arrow in each of the two resonance structures respectively?



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

END