UNIVERSITY OF VICTORIA

CHEMISTRY 101: *From Atoms to Materials*

In-term Test 1 October 13th, 2023
6-7 PM

VERSION B

Display your student ID card on your desk.
Do not begin until instructed by the invigilator.

Print and code your last name, first name, and your student ID number on the blue bubble sheet.

This test has 25 multiple choice questions on 6 pages.
A Data Sheet is provided.

The Sharp EL510 is the only calculator allowed for this test.

Select the best response for each question and record your answer on the blue bubble sheet.
Hand in the blue bubble sheet at the end of the test.

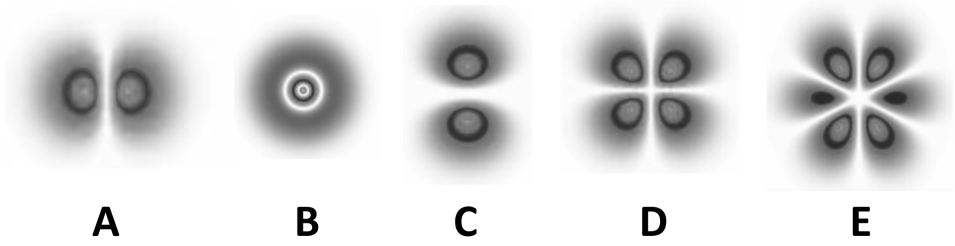
Only answers entered on the bubble sheet by the student by 7 PM will be marked.

1. In an atom, what is the ***maximum number of electrons*** that can have the following set of quantum numbers: n = 3, ℓ = 1, m_s = +½
   A. 0 B. 1 C. 3 D. 5 E. 7

2. An electron with a velocity of 3.270×10^6 m/s has a wavelength in nanometers of:
   A. 4.287 B. 0.2225 C. 0.0129 D. 0.1111 E. 647.2

3. The state of an electron in a molecule or atom is described by a ***wave function***. The squared ***magnitude*** of which tells us:
   A. The de Broglie wavelength of the electron
   B. The energy of the electron at that point in space
   C. The %-wave versus %-particle character of the electron
   D. The probability of the electron being found at that point in space
   E. The electronegativity (electron-attracting power) of that point in space

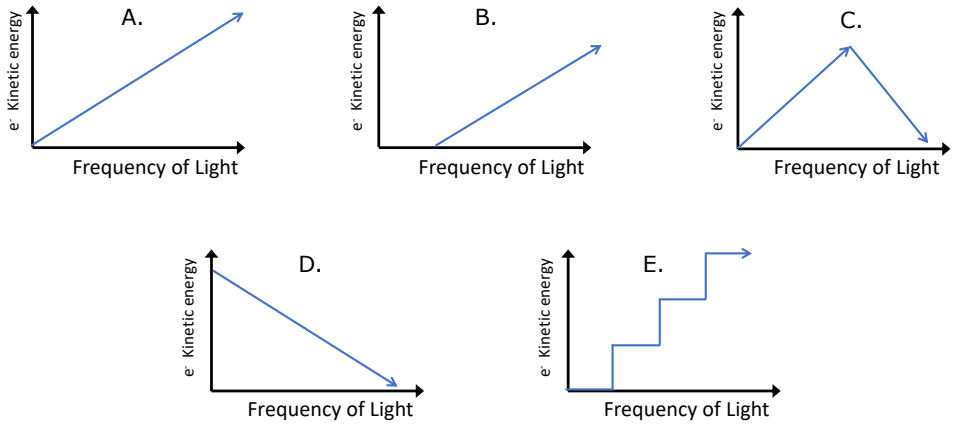
4. Which of the following depicts a ***3d orbital***? D



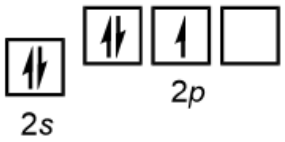
5. Which of the following would be the condensed **electron configuration** for Mo^{3+}?
   A. [Kr] $5s^2 4d^1$ B. [Kr] $5s^1 4d^2$ C. [Kr] $4d^3$ D. [Kr] $4d^5$ E. [Kr] $5s^2 4d^3$

6. Calculate the ***wavelength*** of light that will be emitted from an excited H atom when its electron falls from the *n* = 3 state to the ground state.
   A. 95 nm B. 103 nm C. 416 nm D. 114 nm E. 316 nm

7. Consider the following graphs and select which letter accurately reproduces the ***photoelectric effect*** explained by Einstein: B



8. Inspect the electron configuration of the valence electrons in a nitrogen atom and select the best description of this state.



A. The ground state
B. An excited state
C. A forbidden state
D. An ionized state
E. A state that disobeys the Pauli exclusion principle

9. Which is the ***most electronegative*** atom in this set of atoms: Ge, As, P, Sn, Ga?
A. Ge B. As C. Sn D. P E. Ga

10. Which bond would you expect to be the ***MOST*** polar?
A. H-F B. H-H C. F-F D. H-Cl E. H-I

11. Calculate $\mathbf{Z_{eff}}$ for a valence electron in a phosphorus (P) atom, given that:
i. Core electrons are perfect at screening valence electrons from the nuclear charge
ii. Valence electrons are useless at screening the nuclear charge

A. 4 B. 6 C. 10 D. 15 E. 5

12. It The valence electrons in which of these elements experience the highest effective nuclear charge?
A. Ga B. Rb C. N D. O E. Al

13. Which of the following would you expect to have the ***smallest*** radius?
A. Na^+ B. F^- C. Mg^{2+} D. Ne E. O^{2-}

14. Which of the following sets of atoms is in the correct order of ***first ionization energy***?
A. O < N < P B. Ge < Si < S C. Cl < S < F
D. Li < K < Rb E. Na < Al < Rb

15. Which of the following is expected to be the correct order of ***atomic radii*** from <u>smallest</u> to <u>largest</u>?
A. O < S < F B. Rb < K < Na C. S < Si < Mg D. Cl < S < O
E. Cl < As < P

16. The most stable Lewis structure of $[PO_4]^{n-}$, is the one where *n* is:
A. 4 B. 0 C. 2 D. 1 E. 3

17. Consider the following list of compounds, some of which are ionic and some of which are covalent:

CaO	CO	NCl_3	IBr	KF	Cl_2CO	HI

Select the letter below which corresponds to a list of ***all*** the ionic compounds (the rest being covalent):

A. IBr, CaO B. CaO, KF C. Cl_2CO, HI D. IBr, NCl_3 E. All are covalent

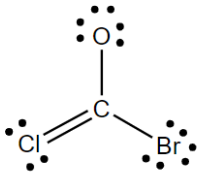
18. Which of the following pairs of Lewis symbols represents the compound SrTe: E

A. [·Sr·][Te] B. [Sr][Te] C. [Sr][Te] D. [Sr][Te] E. [Sr][Te]

19. Which one of the following violates the octet rule?

A. PCl_3 B. CBr_4 C. NF_3 D. OF_2 E. SF_6

20. Consider the following Lewis structure. What are the correct **formal charges** on the Cl and the O, respectively?



A. 0 and 0
B. -1 and +1
C. +1 and -1
D. 0 and -1
E.-1 and 0

21. How many **double bonds** are drawn in the best Lewis structure for the SF_3^+ cation?

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

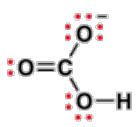
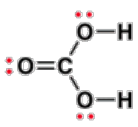
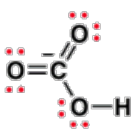
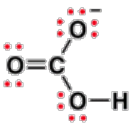
22. The electronic structure of the SO_2 molecule is best represented as a resonance hybrid of _____ equivalent structures (Note: follow the octet rule, do not expand it for this analysis).

A. No resonance occurs here B. 5 C. 4 D. 3 E. 2

23. According to Heisenberg's uncertainty principle, the more accurately we know a subatomic particle's momentum, the less precisely we know its:

A. Location B. Speed C. Mass D. Kinetic Energy E. Spin

24. Select the correct Lewis structure for hydrogen carbonate, HCO_3^-

A.  B.  C.  D. 

E. No stable Lewis structure is possible