
SECTION: (circle one): A01 MR (Dr. Burford) A02 (Dr. Briggs) A03 MWR (Dr. Burford)

NAME _____ **Student No.** V0 _____
(Please print clearly.)

SIGNATURE _____ (I am the above-named student.)

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

Version B	UNIVERSITY OF VICTORIA CHEMISTRY 101 Midterm Test 2 November 16, 2012 5-6 pm (60 minutes)	Version B
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Answer all multiple choice questions on the bubble sheet provided.

PRINT and shade in only your last name, first name, and the last 7 digits of your student ID number on the bubble sheet. *i.e.* Omit the leading V0.

Do NOT include any info about the course, section or date on the bubble sheet.

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 is the only one 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 except Question 1. The answers for the 26 questions in this part must be coded on the optical sense form (bubble sheet) using a SOFT PENCIL.

Select the **BEST** response for each question below.

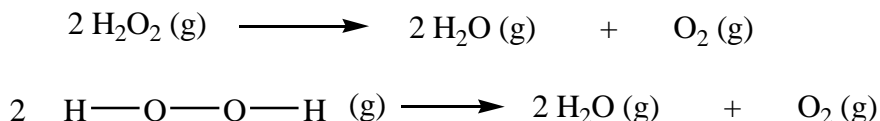
1. This is exam Version B. Mark "B" as the answer to Question 1 on the optical sense form.
2. Choose the **CORRECT** statement about the SO_2 molecule.
- A. The sulfur atom has an unshared (*i.e.* non-bonding) electron pair.
 - B. The S-O bonds are ionic in character.
 - C. The two S-O bonds have different lengths since one is a single bond and the other a double bond.
 - D. The molecule has a linear structure.
 - E. The oxygen atoms have no unshared (*i.e.* non-bonding) electron pairs.

Questions 3-6 refer to the molecules in this box. Answer these questions referring to these answers.

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

3. 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 & iv C. v only D. ii & v E. vii only
4. Indicate **all** of the molecules in the box above that have both an electron domain geometry and a molecular geometry that are trigonal planar.
- A. i & vii B. ii only C. iii only D. ii & viii E. iv only
5. Indicate **all** of the molecules in the box above that have a square pyramidal molecular shape.
- A. vi B. vii C. i D. ii E. iv
6. Indicate **all** of the molecules in the box above that have at least one bond angle of approximately 90° .
- A. ii only B. iv only C. vii only D. vi & vii E. ii & iv
7. Of the following three molecules, which is(are) polar? (That is, which molecules have a non-zero net molecular dipole moment?)
- BF_3 NF_3 CF_4
- A. NF_3 only B. BF_3 only C. CF_4 only D. both BF_3 and NF_3 E. none of them

8. 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 in two formats.



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

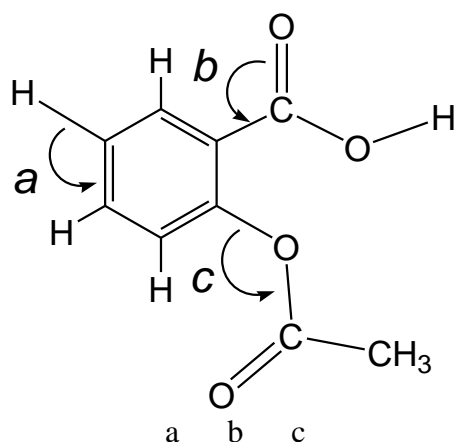
9. Which of the following statements is INCORRECT?

- A. A linear arrangement of electron domains can often be rationalized using sp hybrid orbitals..
 B. When assigning the orbital hybridization, only bonding electrons are considered, since lone pairs do not participate in hybridization.
 C. An octahedral molecular geometry is rationalized by the hybridization of six atomic orbitals.
 D. Double bonds take up more space than single bonds.
 E. The observed bond angles in NF_3 are slightly less than the regular tetrahedral angle of 109.5° .

10. The hybridizations at bromine in BrF_5 and at iodine in ICl_3 are _____ and _____; respectively.

- A. sp^3 , sp^3d B. sp^3 , sp^3d^2 C. sp^3d , sp^3 D. sp^3d^2 , sp^3d E. sp^3d , sp^3d^2

11. A Lewis structure of the aspirin molecule is shown below. What are the approximate bond angles (in degrees, $^\circ$) for the angles labeled "a", "b" and "c" in the drawing?



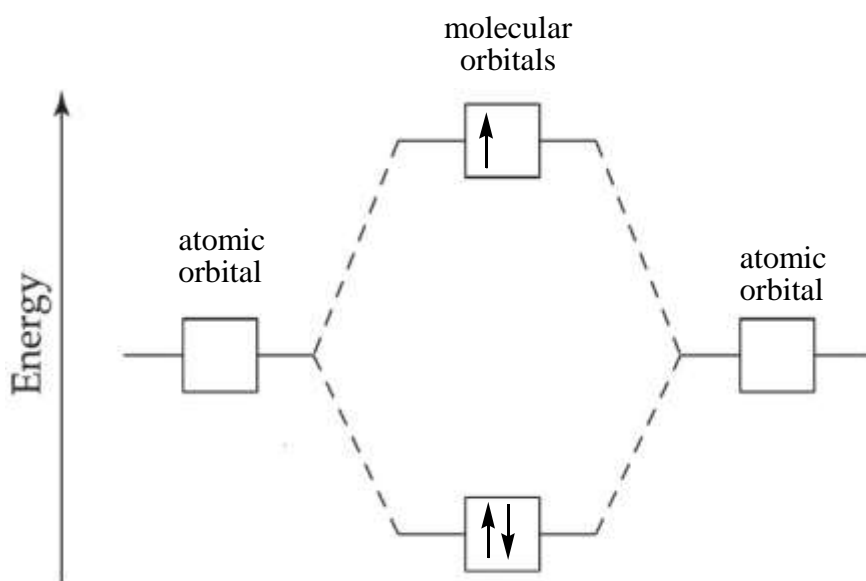
- A. 120, 120, 120
 B. 120, 109, 180
 C. 120, 120, 109
 D. 180, 120, 120
 E. 109, 109, 120

12. Which of the following statements is/are CORRECT?

- i. In metals, bonding electrons are free to move throughout the sample.
- ii. The electron-sea model explains the trends in melting points for the transition metals.
- iii. In an insulator, the energy gap between bonding and antibonding molecular orbitals is large.
- iv. There are no antibonding molecular orbitals in a semiconductor.

- A) i
- B) ii and iii
- C) i and iii
- D) i and ii
- E) ii and iv

13. Consider the following molecular orbital energy diagram, which applies to diatomic species that use only 1s orbitals.



The MO diagram shown above is representative of the electron energy levels for which molecule(s) or ion(s)?

- i. H_2^-
- ii. He_2^+
- iii. He_2^-
- iv. HHe
- v. H_2

- A. i only B. i and ii only C. iv only D. i, ii and iv E. ii, iii and iv

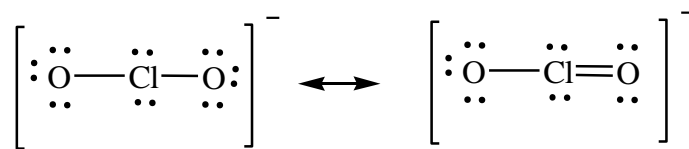
14. For which one of the following molecules do we invoke resonance in describing the bonding?

- A. **SO₃** B. CCl₄ C. N₂ D. PCl₅ E. OF₂

15. Which of the following relationships is/are correct when comparing lattice energies?

- i. CaF₂ > BaF₂ ii. CsBr > RbBr > NaCl iii. BaO > KF iv. NaCl > MgCl₂ v. NaBr > NaCl
 A. i & v only B. ii only C. **i & iii** D. iii only E. i, ii & iii

16. Consider the two resonance structures for ClO₂⁻ shown below. What is the formal charge on Cl in each of the two resonance structures respectively?



- A. 0,+1 B. -1, 0 C. 0, 0 D. **+1,0** E. 0, -1

Note: Some of the molecules listed as possible answers to questions 17 -20 are the same, thus you may be able to use the Lewis structures from a previous question in solving later questions.

17. Of the molecules SO₂, NO₃⁻, and CO₃²⁻, which has/have delocalized pi (π) bonding?

- A. SO₂ and NO₃⁻ B. SO₂ only C. SO₂ and CO₃²⁻
 D. CO₃²⁻ only E. **SO₂, NO₃⁻ and CO₃²⁻**

18. For which of the following pairs of molecules do **both members** have **the same** central atom hybridization?

- A. PF₃ and BF₃ B. **NH₃ and SF₃⁺** C. SO₃²⁻ and SeF₄
 D. IO₂⁻ and HCN E. BrF₅ and PF₅

19. Which **one** of the following molecules would be **non polar**, i.e. exhibit a net molecular dipole moment of zero?

- A. BrF₅ B. **BF₃** C. NH₃ D. HCN E. H₂O

20. Which **one** of the following molecules would **NOT** exhibit an idealized bond angle of 90°?

- A. IF₃ B. BrF₅ C. PF₅ D. **NHCl₂** E. SeF₆

21. Based on MO theory or band theory, which of the following metals would you expect to have the highest melting point?

- A. iron B. nickel C. calcium
D. copper E. chromium

22. Which of the following numbers of electron domains on a central atom can give rise to a linear molecule?

- A. 2 only B. 3 only C. 4 only D. 2 and 5 E. 5 only

23. Consider the intermolecular forces involved in each of the four compounds listed below, and then arrange them in order of increasing boiling point (*i.e.* lowest b.p. first, highest b.p. last).

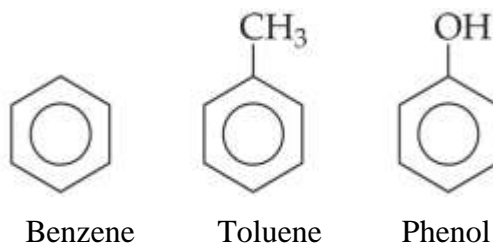


- A. $\text{HOCH}_2\text{CH}_2\text{OH} < \text{CH}_3\text{CH}_2\text{OH} < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 < \text{CF}_4$
B. $\text{CF}_4 < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 < \text{HOCH}_2\text{CH}_2\text{OH} < \text{CH}_3\text{CH}_2\text{OH}$
C. $\text{HOCH}_2\text{CH}_2\text{OH} < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 < \text{CH}_3\text{CH}_2\text{OH} < \text{CF}_4$
D. $\text{CF}_4 < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 < \text{CH}_3\text{CH}_2\text{OH} < \text{HOCH}_2\text{CH}_2\text{OH}$
E. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 < \text{CF}_4 < \text{CH}_3\text{CH}_2\text{OH} < \text{HOCH}_2\text{CH}_2\text{OH}$

24. Which of the following molecules has the highest boiling point? Answer = C

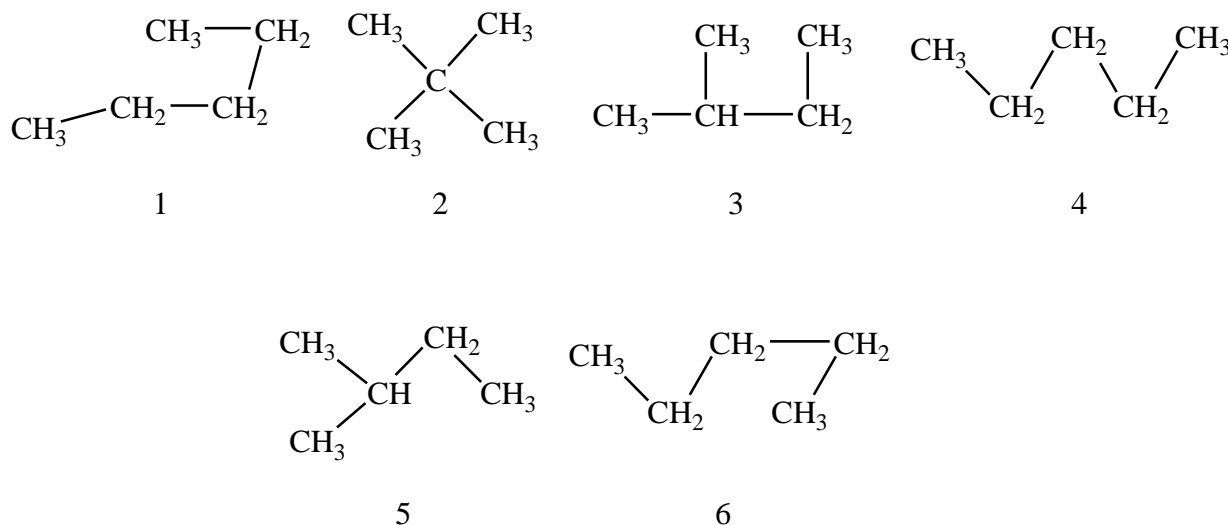
- A. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$ B. $\begin{array}{c} \text{CH}_3\text{CHCH}_3 \\ | \\ \text{CH}_3 \end{array}$ C. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
D. $\begin{array}{c} \text{CH}_3\text{CHCH}_2\text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$ E. $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3\text{CCH}_3 \\ | \\ \text{CH}_3 \end{array}$

25. Benzene, toluene and phenol (shown below) are all solids at $-50\text{ }^{\circ}\text{C}$, the correct order for the melting points from **highest to lowest** is?



- A. benzene > toluene > phenol
- B. **phenol > benzene > toluene**
- C. phenol > toluene > benzene
- D. toluene > phenol > benzene
- E. toluene > benzene > phenol

26. The alkane pentane, C_5H_{12} , has several structural (i.e. constitutional) isomers, all of which are included in the set of molecules shown below.



Which of the following sets of structures represents the isomers of pentane without counting any isomer more than once?

- A. 1, 2, 3 and 4
- B. **2, 3 and 4**
- C. 2, 4, 5 and 6
- D. 2, 3 and 5
- E. 2, 4 and 6

END