

**Version
B**

**UNIVERSITY OF VICTORIA
CHEMISTRY 101
Midterm Test 2
November 17, 2017
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'.

University of Victoria

Sample Only

General Purpose
Five Response
Answer Sheet

NO MARKS
BLUE

Legibly write your student number in the boxes below and fill in the corresponding circle below each number. Legibly write your name, the course, your instructor's name, and the date in the boxes below and place your signature in the appropriate box. Do not begin the exam itself until instructed to do so.

Student Identification

Use Pen or Soft Pencil

Family Name: Print Last Name Here
Given Name: Print First Name Here
Course: Chem 101
Section: A0...?
Instructor: Briggs or McIndoe
Date: 17 November 2017
Signature: Sign Here

I declare that I am the person named. I am formally registered as a student in the course indicated on this document.

Leave blank unless otherwise instructed

Form: Shade Version here A or B

Special: Leave this row blank

Fill in the entire circle that corresponds to your answer for each question on the exam. Completely erase or cross out any response that you would like to change (e.g., ☐ ☒ ☐ ☐ ☐). Use HB pencil or Pen.

Code Answers Here - Numbering continues on reverse side.

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

1 2 3 4 5 6 7 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

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 and the Sharp EL-510 RNB are the only ones approved for use in Chemistry 101.

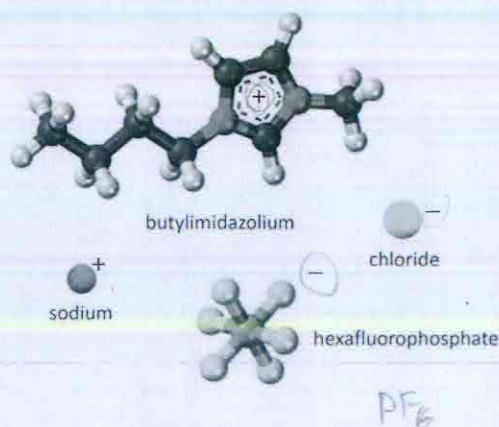
DO NOT BEGIN UNTIL TOLD TO DO SO BY THE INVIGILATOR

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.

1. Which combination of ions is most likely to form a room temperature ionic liquid?

- A. Sodium chloride
- B. Sodium hexafluorophosphate
- C. Butylimidazolium chloride
- D. Butylimidazolium hexafluorophosphate
- E. None are likely to form a room temperature ionic liquid.

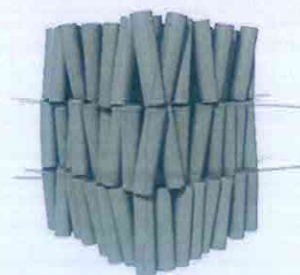
Salt in which ions are poorly coordinated.



2. Which phase best describes the molecules in the image at the right?

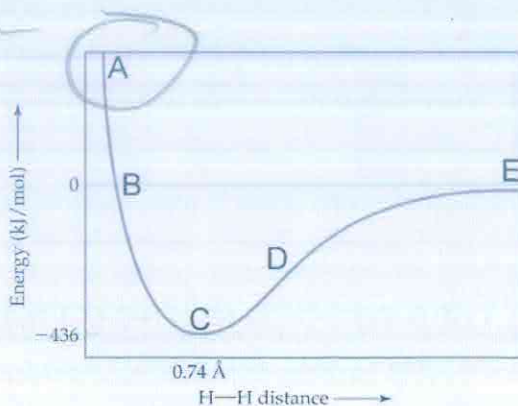
- A. Cholesteric liquid crystal
- B. Solid
- C. Smectic liquid crystal
- D. Liquid
- E. Nematic liquid crystal

Smectic, lined up

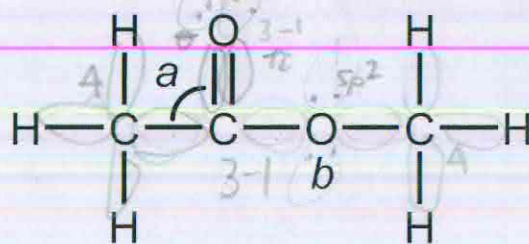


3. A plot of change in potential energy versus distance for two H atoms combining to form H₂ is shown below.

At what point (A, B, C, D or E) is the electrostatic repulsion between nuclei highest?



Questions 4-6 refer to the following molecule. Note that non-bonding electrons are NOT shown.



4. How many sp^2 hybridized atoms are there in the molecule?

- A. 4 B. 3 C. 2 D. 1 E. 5

5. In the actual molecule, what is the bond angle marked 'a'?

- A. slightly under 120° B. 109.5° C. 90° D. 120° E. slightly over 120°

6. In the actual molecule, what is the electron domain arrangement around the oxygen atom labeled 'b'?

- A. linear B. tetrahedral C. trigonal planar D. bent E. acute

7. Which of the following substances exhibits only London dispersion forces?

- A. Potassium chloride (KCl) dissolved in water (H_2O)
 B. Solid iodine (I_2)
 C. Boiling methanol (CH_3OH)
 D. Solid calcium oxide (CaO)
 E. Solid silver (Ag)

Questions 8 to 10 refer to the following reaction



8. Draw the Lewis structure for H_2O and determine the orbital hybridization of the oxygen atom.

- A. sp^3 B. sp^2 C. sp D. unhybridized E. linear

9. Draw the Lewis structure of O_2 . Which feature of the real O_2 molecule can NOT be explained by simple valence bond theory, and requires instead the application of molecular orbital (MO) theory?

- A. That oxygen is non-polar
 B. That it has a sigma (σ) bond and a pi (π) bond
 C. That the oxygen atoms are sp^2 hybridized
 D. That liquid oxygen is attracted to the poles of a strong magnet
 E. That it exhibits an oxygen-oxygen double bond

10. Using average bond energies calculate the enthalpy change ΔH° (i.e. heat change) for the above reaction (kJ). You may assume all reactants and products are gases.

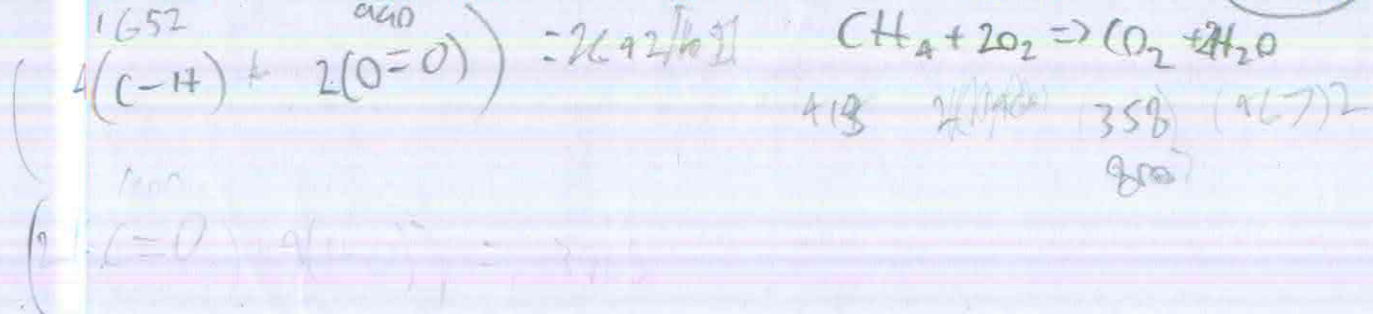
A. -521

B. -1321

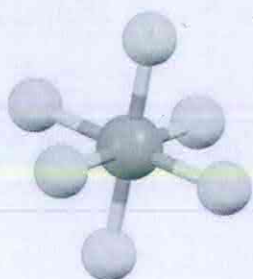
C. -26

D. -48

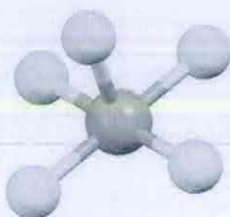
E. -826



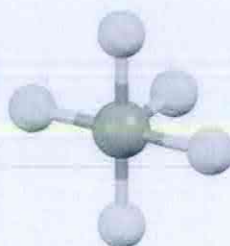
Questions 11 to 13 refer to the following structures.



W.



X.



Y.



Z.

11. Which of the above structures is/are based on an octahedral electron domain geometry (arrangement)?

A. W only B. X only C. W, X & Y only D. Z only E. all of them

12. For the structure labeled **W** above, what atom would be the central atom **A** if the formula of the molecule is AF_6 ?

A. Sn

B. Sb

C. Te

D. I

E. Xe

13. How many lone pairs does the central atom of structure **Z** (above) possess?

A. 2

B. 1

C. 0

D. 4

E. indeterminable

14. Predict which of the following metals will have the highest melting point.

A. Cs

B. Ba

C. Pt

D. Ta

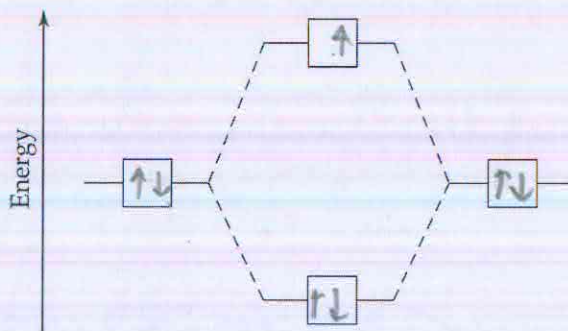
E. Au

15. Which of these molecules is polar (i.e. has a non-zero molecular dipole moment μ)?

A. CCl_4 B. GeF_4 C. $AsCl_5$ D. CS_2 E. PCl_3

16. Use the following molecular orbital energy diagram to determine the bond order in this ion (He_2^+)

- A. 0
 B. 0.5
 C. 1.0
 D. 1.5
 E. 2.0



$$\frac{1}{2}(2-1) = 0.5$$

17. The triiodide ion (I_3^-) is known but the trifluoride ion (F_3^-) is not. Which of the following statements best explains the reason there's no such ion as F_3^- ?

- A. I_2 is known but F_2 is not.
 B. Fluorine is too electronegative to form negative ions.
 C. Iodine has a larger electron affinity than fluorine.
 D. Fluorine can't accommodate three lone pairs and two bonds.
 E. Iodine is more likely to be electron-deficient.

18. The structure shown at the right is a representation of which molecule?

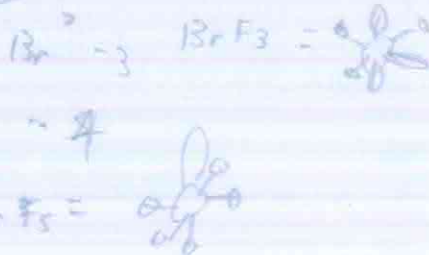
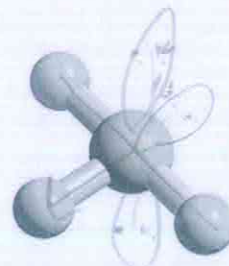
A. GaBr_3

B. PH_3

C. BrF_3

D. AsH_3

E. NCl_3



19. In which of the following compounds does every atom have an octet of electrons (8 electrons) in the Lewis structure?

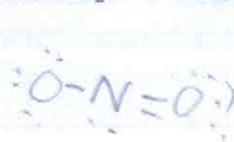
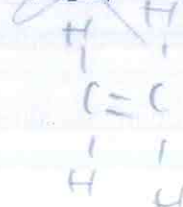
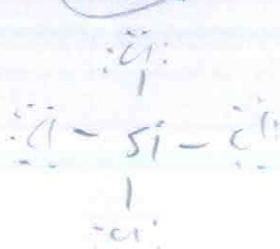
A. SiCl_4

B. C_2H_4

C. IF_5

D. NO_2

E. NaH



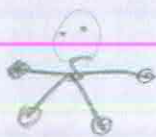
Handwritten Lewis structure for NaH :

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  NaH
  
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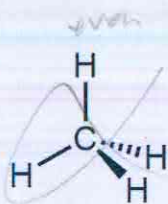
20. What is the molecular geometry of SF_4 ?

← always see-saw example.

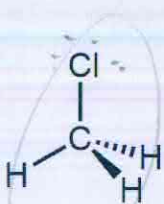


- A. Tetrahedral
- B. Trigonal bipyramidal
- C. Octahedral
- D. Trigonal pyramidal
- E. See-saw

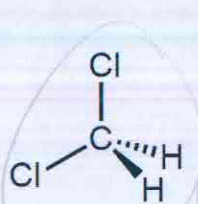
21. How many of the molecules below are polar? (i.e. has/have a non-zero molecular dipole moment μ)?



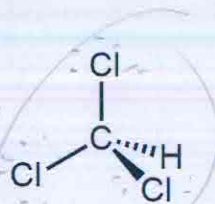
A. 1



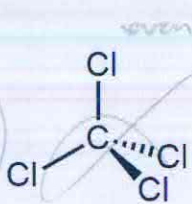
B. 2



C. 3



D. 4



E. 5

22. How many of the molecules SiCl_4 , SeCl_2 , SeCl_4 and ICl have a molecular dipole moment of zero?

A. 0

B. 1

C. 2

D. 3

E. 4

23. The liquid crystal material in an LCD display can be affected by electric fields because of what molecular property?

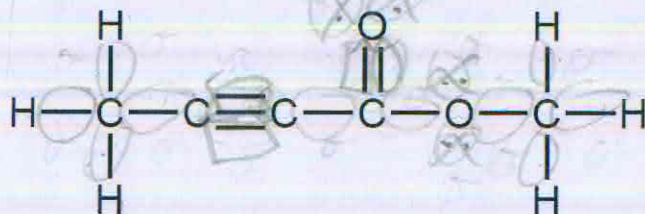
- A. They can form into layers within which the molecules can move around freely.
- B. They have an order somewhere between that of a liquid and a solid.
- C. They have high electron affinity.
- D. They are polar.
- E. They are long and rod-like.

electricity go!

24. Ice is less dense than water. Why?

- A. Dispersion forces are lower in a solid than in a liquid.
- B. When water crystallizes into ice, ion-dipole forces are no longer effective.
- C. Hydrogen bonds are less effective in the solid state than in the liquid state, reducing intermolecular forces and lowering the density.
- D. Hydrogen bonding is optimized in the solid state when each water molecule is involved in a tetrahedral arrangement of hydrogen bonds, creating an open lattice.
- E. More dipole-dipole interactions can be formed for each water molecule in the liquid state.

25. How many sigma (σ) bonds and how many pi (π) bonds are there in the following molecule?



A. 10 σ , 2 π

B. 10 σ , 3 π

C. 10 σ , 5 π

D. 12 σ , 2 π

E. 12 σ , 3 π

END

