SCH4U TEST – Unit 1: Structures & Properties
Pierre Elliott Trudeau High School

TEACHER: Mr Cheung **NAME:** Uni Lee

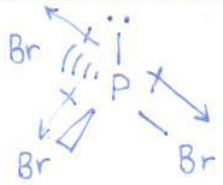
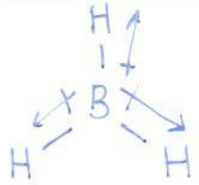
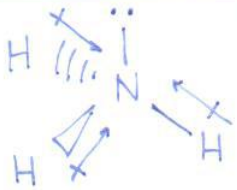
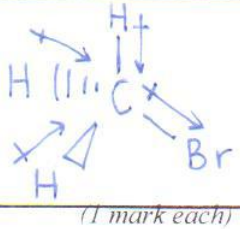
TIME ALLOTED: 75 minutes **DATE:** Oct 1 2014

Knowledge	Thinking/Inquiry	Communication	Application
11 / 14	8.5 /11	9 / 9	8 / 9

THINKING/INQUIRY – *Short Answers & Calculations. Show your work for full marks.* **(11 marks)**

15. For each substance below, draw its 3D Lewis diagram, label its VSEPR shape, identify the strongest type of intermolecular force present, and then rank the melting points of each substance from lowest (1) to highest (4). **(9 marks)**

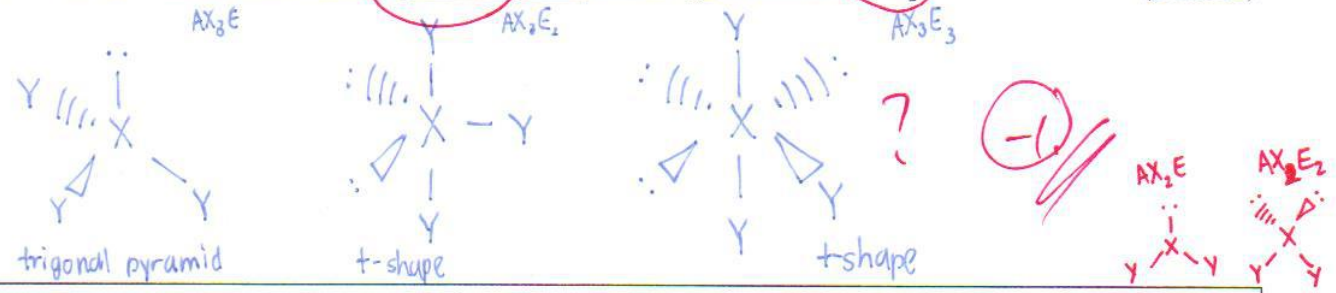
-1 -0.5

	3D Lewis Diagram *Be sure to indicate any...* ❑ *dipole moments that are present* ❑ *lone pair e⁻ around the central atom*	Name of VSEPR shape	Strongest type of intermolecular force present in each substance	Order of increasing melting point *1 = Lowest MP* *4 = Highest MP*
PBr_3 5 7 7 7		trigonal pyramid AX_3E	dispersion Dipole-Dipole	2 x 3
BH_3 3 1 1 1		trigonal planar AX_3	dipole dipole london Dispersion	1
NH_3 5 1 1 1		trigonal pyramid AX_3E	hydrogen bonding	4
CH_3Br 4 1 1 1 7		tetrahedral AX_4	dipole dipole or london dispersion	2 x 3
	(1 mark each)	*(0.5 mark each)*	*(0.5 mark each)*	*(1 mark)*

-1.5 //

16. Draw all VSEPR structures for a polar compound with the general formula XY_2 **(2 marks)**

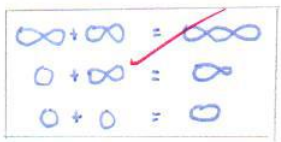
name



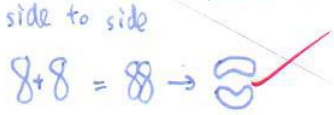
COMMUNICATION – *Short Answers & Diagrams. Answer each question in the space provided.* **(9 marks)**

17. What is the difference between a sigma bond and a pi bond? **(2 marks)**

sigma bonds combine "head on" like:



Whereas pi bonds come together side to side

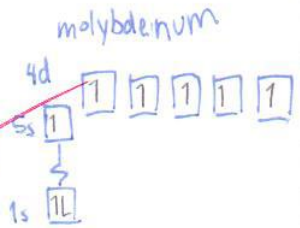


18. Molybdenum has an unusual electron configuration. Using orbital diagrams, explain why it deviates from what is normally expected. **(2 marks)**

molybdenum
Mo^{42}
95.94

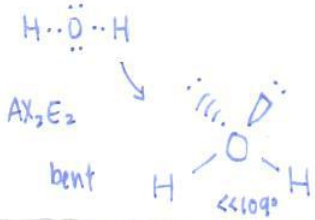
atoms are also stable at half shells. So they will try to get half shell or full shell

because 5s and 4d are close in energy levels. it can excite that e⁻ in the 5s to 4d to make the half shell

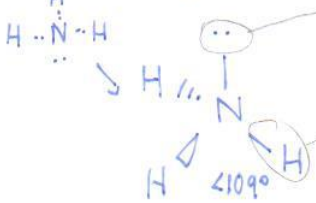


19. Explain why the bond angles in water (H_2O) are less than those of ammonia (NH_3). **(2 marks)**

vsepr of H_2O



VSEPR of NH_3

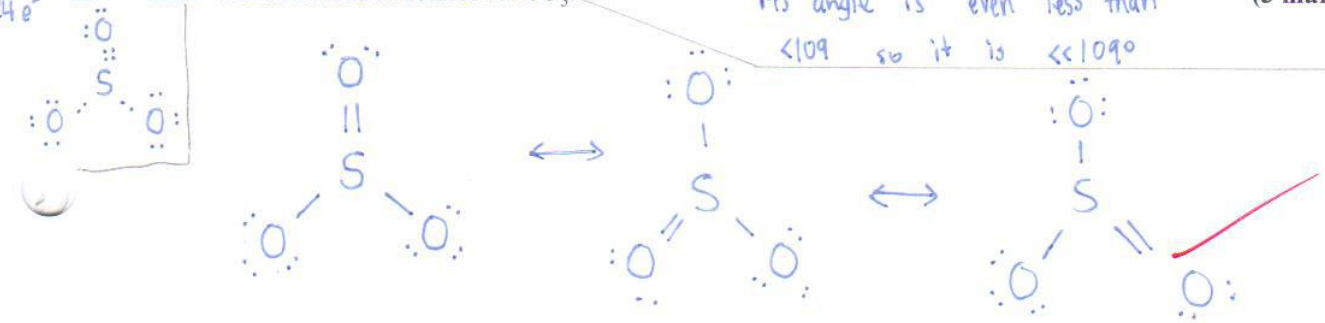


lone pairs repel more than the bonds so it pushes all the others down

H_2O has 2 lone pairs so its angle is even less than <109 so it is <<109°

20. Draw the resonance structures for SO_3. **(3 marks)**

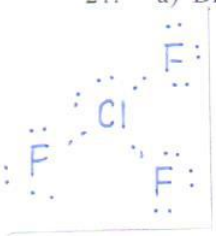
24 e⁻

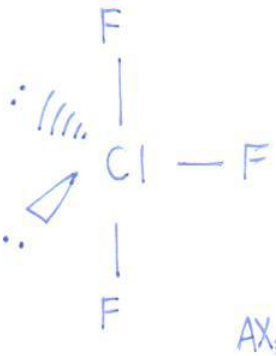


APPLICATION – *Short Answers & Calculations. Show your work for full marks.* **(9 marks)**

7+7+7 = 28

21. a) Draw the 3D Lewis structure of chlorine trifluoride (ClF_3) and identify its VSEPR shape. **(2 marks)**



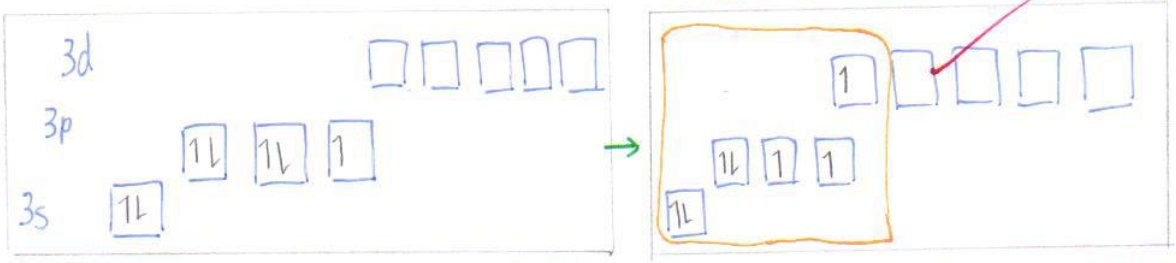


T - shape

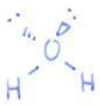
AX_3E_2

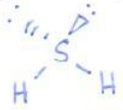
b) What type of hybridization is present in the central atom? **(1 mark)**

$3sp^3d$ orbitals



22. Explain why hydrogen bonding occurs in water (H_2O) but not in hydrogen sulphide (H_2S). **(2 marks)**





$\Delta EN = 1.4$

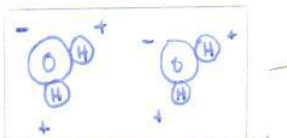
polar covalent range

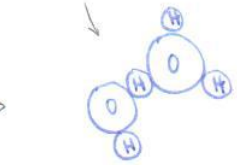
H_2O holds together more. will grab on to other waters and molecules with H because there a polar side to the molecule

$\Delta EN = 0.4$

non polar range

the hydrogen + in one H_2O joined with the other H_2O's partial -

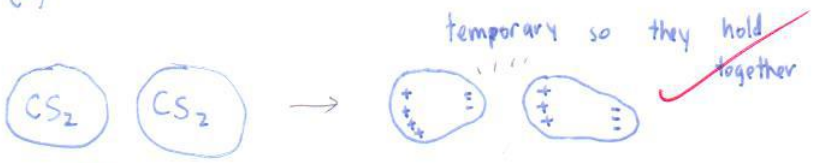




H_2S is low ΔEN so wont grab on to other molecules with H like how water does it

23. a) What are London dispersion forces? **(2 mark)**

compounds such as CS_2 have $\Delta EN = 0$ because 2.5 - 2.5. so its shouldn't stick to other CS_2. However, they do in reality. the molecules make temperary dipoles so the temporary (+) holds on to another's temporary (-)

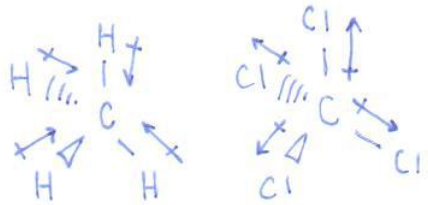


b) The boiling points of CH_4 and CCl_4 are -162°C and 77°C respectively. How can London dispersion forces be used to explain the huge temperature differences between these two compounds? **(2 marks)**

BOIL : -162°C CH_4 gas $\Delta EN = 0.4$ | 77°C CCl_4 solid/liquid $\Delta EN = 0.5$

both are close. both are in the 0.0 - 0.5 non polar range.

- similar geometry and ΔEN
- BP due to London dispersion Forces
- Hydrogen is small atom
∴ unequal distribution of e^- will result in small temporary dipole



dipoles are pointing diff even though both compounds are non polar.

-Chlorine is a bigger atom bc 7 e^- valence
∴ unequal distribution of e^- will result in longer temp dipole → stronger intermolecular force → higher BP

the outside is more positive for CH_4

the inside is more positive for CCl_4

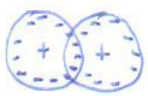
hydrogen on the out side repelling each other

when holding on to other CCl_4, the positive inside attracts other e^- while it's own e^- repels. it'll reach a point where its evenly repel and attract

N.R.

hydrogen repels more. not as tight = low boiling point

not as tight because lots of (+)



held tightly = high melting point

KNOWLEDGE / UNDERSTANDING – *Multiple Choice. Choose the most appropriate answer and shade its corresponding letter on the Scantron sheet provided.* **(15 marks)**

1. The lines in the emission spectrum of an atom results from
   a. energy absorbed by electrons dropping back down to a lower energy level
   b. energy absorbed by electrons jumping to a higher energy level
   c. energy released by electrons jumping to a higher energy level
   d. energy released by electrons dropping back down to a lower energy level
   e. none of the above

2. "A particle of light" is one way of describing
   a. orbital
   b. absorption spectrum
   c. quantum
   d. photon
   e. dipole

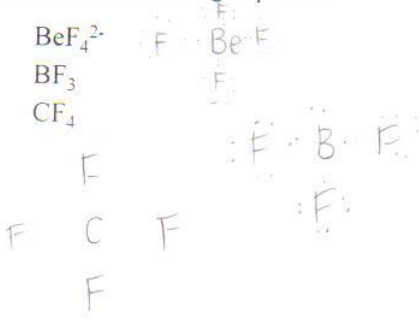
3. Which of the following is the electron configuration for sodium?
   a. $1s^2 2s^3 2p^5 3s^1$
   b. $1s^3 2s^3 2p^3 3s^2$
   c. $1s^2 2s^2 2p^5 3s^2$
   d. $1s^2 2s^2 2p^6 3s^1$
   e. $1s^2 2s^2 2p^7$

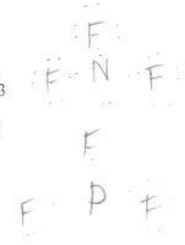
4. What made Rutherford believe that atoms are mostly empty space?
   a. most alpha particles went straight through the gold foil
   b. some alpha particles were deflected by the gold foil
   c. the line spectra of excited atoms
   d. atoms are electrically neutral
   e. none of the above

5. Why is the first ionization energy of arsenic higher than the first ionization energy of selenium?
   a. arsenic wants to be iso-electronic with a noble gas
   b. arsenic is larger than selenium
   c. arsenic's 4p orbitals are half full
   d. selenium needs only two electrons to be iso-electronic with a noble gas
   e. none of the above

6. In which of the following are all the electrons paired up? Assume that all of them are in their lowest energy configuration.
   a. An element with electronic configuration $1s^2 2s^2 2p^4$
   b. Atomic oxygen
   c. A neutral atom with 15 protons
   d. Fe^{3+} ion
   e. N^{3-} ion

7. Which of the following is planar?
   a. BeF_4^{2-}
   b. BF_3
   c. CF_4
   d. NF_3
   e. PF_3





8. What is the basis of metallic bonding?

a. the attraction of metal ions for delocalized electrons
b. the attraction between neutral metal ions
c. the neutralization of protons by electrons
d. the attraction of oppositely charged ions
e. the sharing of two valence electrons between two atoms

9. Four pairs of electrons surrounding a central atom will be arranged

a. pyramidally
b. spherically
c. tetrahedrally
d. linearly
e. trigonally

10. Which of the following is an example of a covalent network solid?

a. Sodium, $Na_{(s)}$
b. Water, $H_2O_{(l)}$
c. Graphite, $C_{(s)}$
d. Magnesium fluoride, $MgF_{2(s)}$
e. Carbon dioxide, $CO_{2(g)}$

11. Intermolecular forces are

a. forces within covalent molecules that hold them together
b. electrostatic forces between ions
c. bonds between hydrogen and oxygen atoms in water molecules
d. attractive forces between separate covalent molecules
e. covalent bonds within a network solid

12. Which of the molecules, CO_2, H_2O, NH_3, and BF_3, will be polar?

ΔEN: 1.0 1.4 0.9 2.1

a. CO_2, NH_3 and BF_3
b. H_2O and NH_3
c. H_2O and BF_3
d. CO_2, H_2O and NH_3
e. CO_2 and BF_3

13. Why does a central atom surrounded by 4 atoms have a tetrahedral shape instead of a square planar shape?

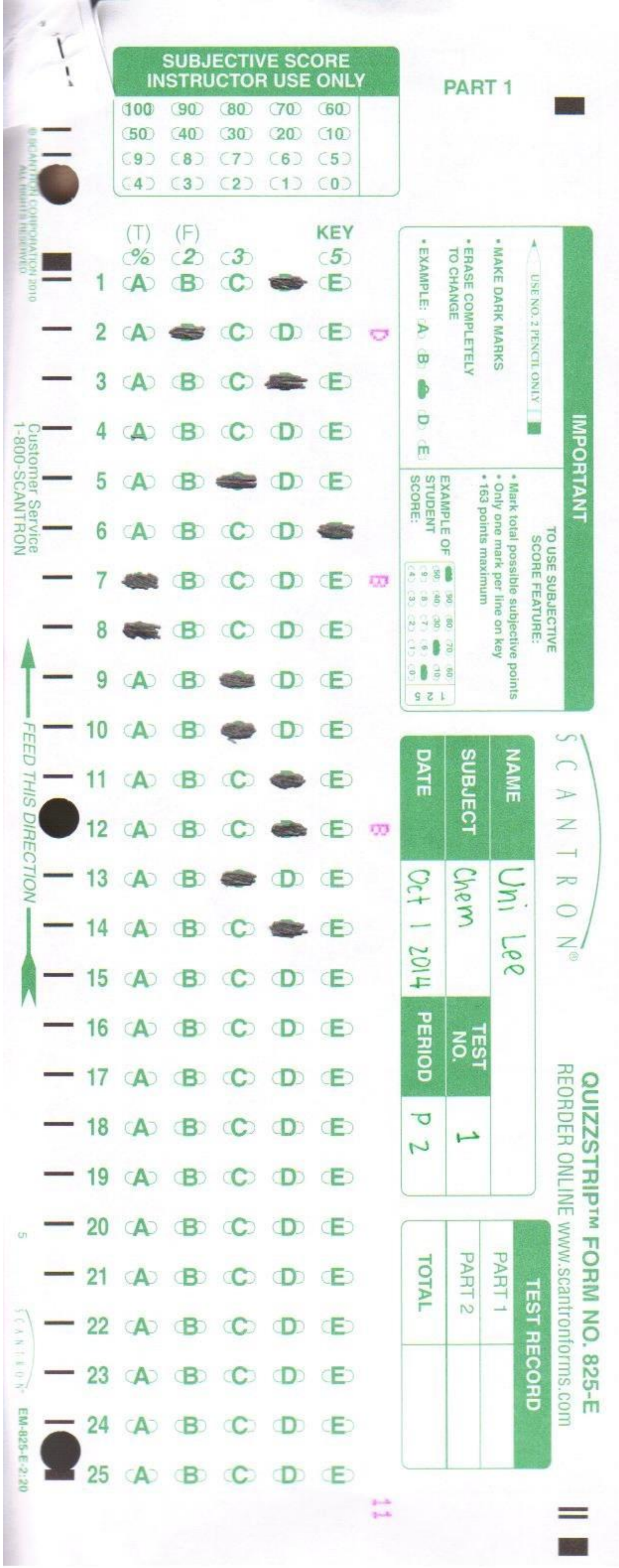
a. orbitals are never at right angles to each other
b. the lone pairs around the central atom push the 4 atoms into this configuration
c. the angle in a tetrahedron is larger than in a square planar arrangement
d. the 4 atoms want to be as close together as possible
e. none of the above

14. Which forces exist between ammonia, NH_3, particles?

0.9

I. Dispersion Forces II. Metallic Bonding III. Hydrogen Bonding IV. Dipole-Dipole

a. I only
b. I and IV only
c. I and II only
d. I, III and IV only
e. I, II and III only



GOOD LUCK GUYS DONT FAIL C: