

SCH 4U1 Test 1: Atomic Theory and Bonding

ASSESSMENT OF LEARNING

Unit 1: Structure and Properties of Matter

Knowledge: /11
Thinking: /13
Communication: /13

INSTRUCTIONS:

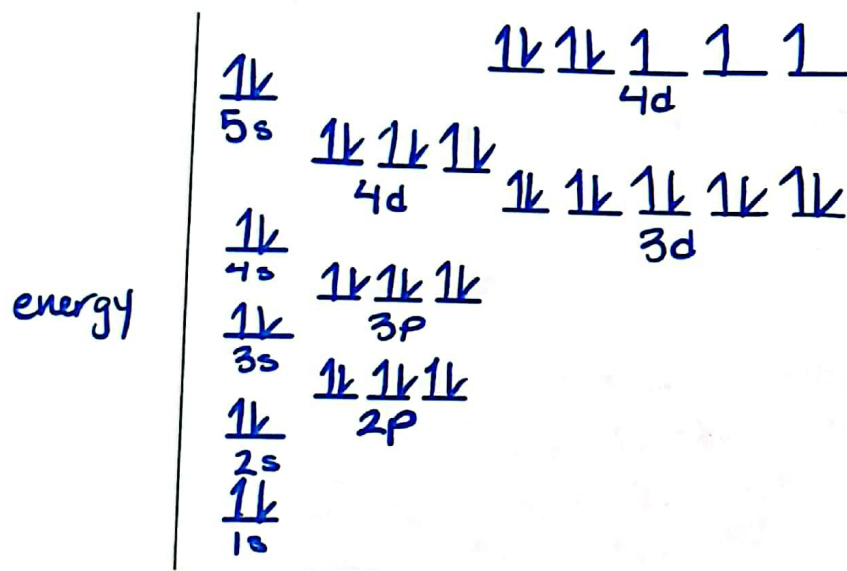
- You have 45 min regular time (up to 75 min extra time) to complete the test
- You may use the data sheet and periodic table provided for all questions
- You may use a model kit if you wish.

1. a) Write the full electron configuration for a rhodium (Rh) atom (1 C)

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 5s^2 4d^7$

- 0.5 if abbreviated

b) Draw an orbital box diagram for a rhodium (Rh) atom. (2 C)



Correct orbital * per sublevel
Correct energy order sublevels
filling correct (arrow 1↑ or 4↓ fine)
ECF from 1a

2. a) Write the abbreviated electron configuration for an iodine (I) atom (1 C)

$[Kr] 5s^2 4d^{10} 5p^5$

- 0.5 if full

b) Write the chemical symbol of the atom that an ion of iodine would be isoelectronic with.

Xe (forms I⁻ ion)

(1T)

c) State the chemical symbols for two ions that will be isoelectronic with an iodine ion, one with the same charge and one with the opposite charge

same charge: Te^{2-} opposite charge: Cs^+, Ba^{2+} (2T)

other correct answers OK
Sb is metal so Sb^{2-} not OK

Totals: /0 K /3 T /4 C

SCH 4U1 Unit 1 Test continued

8. a) Draw a 3-dimensional diagram (VSEPR) diagram of NO_2^- and state its **bond angle(s)**.



Diagram (1 C)

bond angle(s): 117° (1 K)

- b) State the chemical formula for a molecule or ion that has the same molecular shape as NO_2^- but a **different AXE** formula.

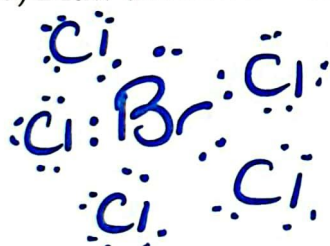
H_2O anything AX_2E_2 (1T)

- c) Explain why the bond angle in the molecule or ion you identified in b) has a **different** bond angle from O_3 .

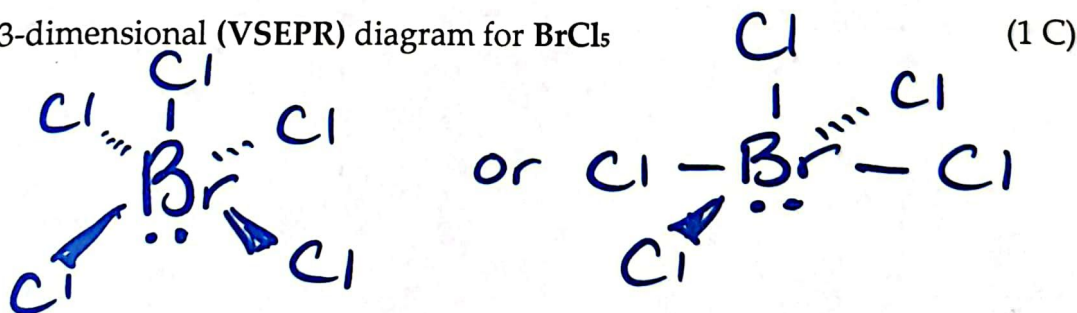
there are more electron domains / 2 lone pairs instead of just one. less space is available for each domain

* NOT lone pairs vs. bonding pairs. (2T)

9. a) Draw the Lewis Dot Diagram (or Lewis Structure) for BrCl_5 (1 C)



- b) Draw the 3-dimensional (VSEPR) diagram for BrCl_5 (1 C)



- c) state the name of the **molecular shape** of BrCl_5 and its **bond angle(s)**

molecular shape: square based pyramidal (1K)

bond angle(s): 88.5° (1 K)

- d) State the **general (AXE)** formula of a molecule with the same electron distribution BUT with one more lone domain and one less bonding domain (*substitute a lone domain for a bonding domain*)

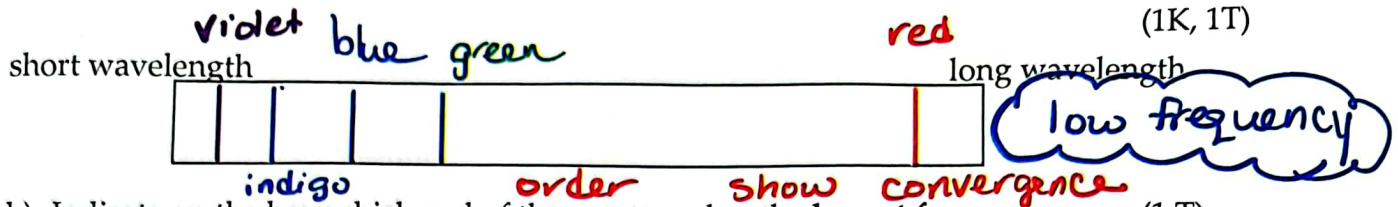
AX_4E_2 (1 T)

Totals: /3K /4T /3C

SCH 4U1 Unit 1 Test continued

6. The emission spectrum for hydrogen has 5 lines in the visible spectrum - red, violet, blue, green and indigo.

a) Using this information, draw an approximation of the **visible line spectrum** for hydrogen on the box below. (exact number values for lines are not required). Be sure to label each colour



b) Indicate on the box which end of the spectrum has the lowest frequency. (1 T)

c) With the help of your diagram above, explain what the **absorption spectrum** for hydrogen would look like. (1 T)

- ✓ - there would be black lines on a coloured spectrum
 - the location / frequency / wavelength would match the locations of the coloured lines
- O.S each

7. a) Draw the VSEPR diagram for nitrogen triiodide and state its AXE formula.

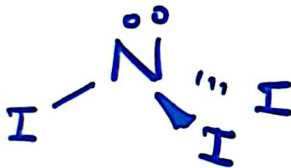


Diagram (1 C)

AXE formula: AX₃E (1 K)

b) State the name of the **electron distribution** for nitrogen triiodide:

tetrahedral (1K)

c) Substituting one lone pair for a bonding domain in this distribution would give a different molecular shape. Identify the **molecular shape** and the **bond angle** in this new molecule.

Molecular shape: bent (1T) Bond angle: 104.5° (1K)

d) Compare the **size of the bond angles** in nitrogen triiodide and the molecular shape you identified in (c). Explain the difference.

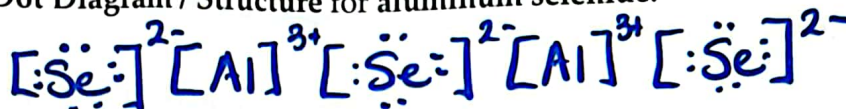
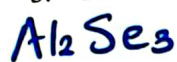
bond angles larger in NI₃ - the extra lone pair of e⁻ repels more than the bonding pair (1K, 1T)

Totals: /5 K /5 T /1 C

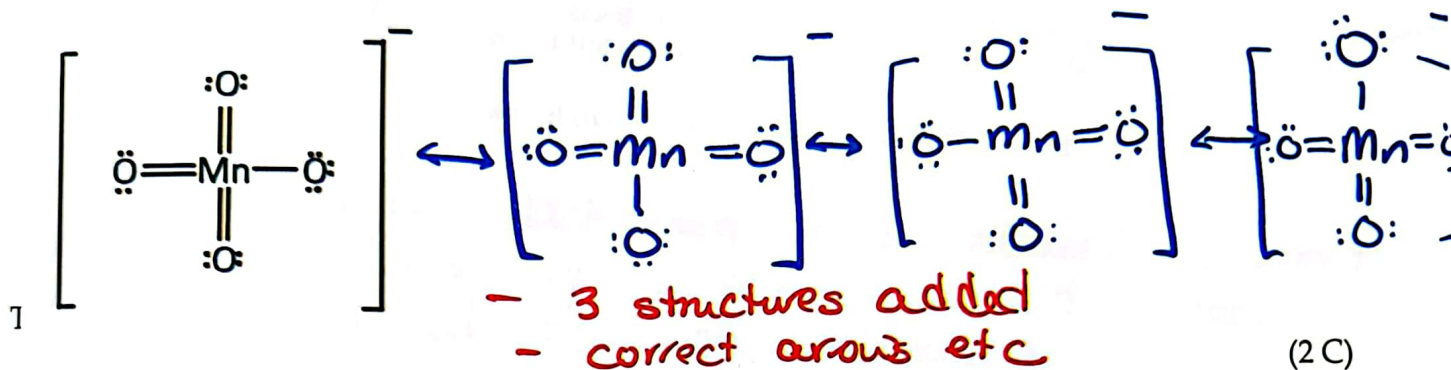
SCH 4U1 Unit 1 Test continued

3. Draw the Lewis Dot Diagram / Structure for aluminum selenide.

(1 C)



4. a) The optimized Lewis structure for MnO_4^- is shown below. Draw the resonance structures for this compound.



b) Name the type of bonds found within the MnO_4^- ion and describe how these bonds are formed.

(polar) Covalent bonds - sharing of a pair (or more) of electrons between 2 nuclei

↳ one pair definition ok
↳ polar not required

(2K)

5 a) Write the quantum numbers associated with the 42nd electron in any atom or ion.

(1 K)

$n=4, l=2, m_l=+1, m_s=+\frac{1}{2}$

b) Use your quantum numbers in (a) to precisely describe the location of this electron (in words).

The first electron in the fourth orbital in the d sublevel of the 4th main energy level

O.S each - specific numbers tell each thing

(2 C)

c) Identify which other electron occupies the same orbital as the 42nd electron.

(1 T)

* 47

Totals: /3 K /1 T /5 C