Unit Test: Bonding

SCH3UE_2009 -2010_V1

NAME: _____

Multiple Choice (10)

1. Which substance has the lowest electrical conductivity ?

A. $Al_{(s)}$ B. $Al_2O_{3(s)}$ C. $KCl_{(aq)}$ D. $HCl_{(aq)}$

2. Which bond has the lowest polarity?

A. C – H in methane, CH_4 B. C = O in carbon dioxide, CO_2
C. C – C in ethane, C_2H_6 D. C – C in ethanol, C_2H_5OH

3. The boiling points of dimethyl ether (H_3COCH_3) and ethanol (H_3CCH_2OH) are -23ºC and 78ºC, respectively. This difference is best attributed to the presence of:

A. stronger covalent bonds in ethanol.
B. stronger van der Waals' forces in ethanol.
C. a more polar carbon-oxygen bond in ethanol.
D. hydrogen bonding in ethanol.

4. The shape of the triiodide ion, I_3^{-1}, is best described as:

A. bent. B. linear. C. T-shaped. D. triangular.

5. Which intermolecular forces exist in dry ice, $CO_{2\,(s)}$?

A. Covalent bonds B. Dipole-dipole attractions
C. Van der Waals' forces D. Hydrogen bonds

6. The geometry and bond angle of the sulfite ion (SO_3^{-2}) are best described as:

A. pyramidal, 107^0 B. tetrahedral, 109^0
C. bent, 104^0 D. trigonal planar, 120^0

7. The H-N-H bond angle in ammonia (NH_3) is less than the H-C-H angle in methane (CH_4) due to:

a) repulsion between hydrogen atoms in ammonia
b) attractions between hydrogen atoms in ammonia
c) a lone pair of electrons in ammonia
d) the tetrahedral shape of the molecules in ammonia and methane

8. The formation of an ionic compound is to be expected from the reaction between:

a) an element with a low ionization energy and an element with a low electron affinity
b) an element with a low ionization energy and an element with a high electron affinity
c) an element with a high ionization and an element with a low electron affinity
d) an element with a high ionization energy and an element with a high electron affinity

9. In which of the following are the compounds CaF_2 , $CaCl_2$, CsF and LiF arranged in **increasing** order of lattice enthalpy ?

A. $CaCl_2$, CaF_2, CsF, LiF
B. CsF, LiF, $CaCl_2$, CaF_2
C. $CaCl_2$, CaF_2 , LiF, CsF
D. LiF, CaF_2 , CsF, $CaCl_2$

10. The compound $SnC1_4$ is a liquid at room temperature. It boils at $114^{O}C$ and freezes at $-33\ ^{O}C$ to give soft, colourless crystals. The type of crystal formed by $SnC1_4$ is probably:

a) metallic b) ionic c) network solid d) molecular covalent

Multiple Choice Answers (10)

1	2	3	4	5	6	7	8	9	10

Problems (62)

1. a. The two isotopes normally found in a sample of nitrogen are ^{14}N and ^{15}N. Compare these two isotopes in terms of their fundamental particles. State and explain the difference, if any, in the chemical properties of these two isotopes. 3

b. State the block in the Periodic Table to which nitrogen belongs and explain your answer. 2

c. Give the complete electron arrangement of the N^{-3} ion. 1

2. Predict and explain the bond angles in:, NO_2^{-1}, NO_2^{+1} 4

3. Complete the following table: 10

	IF_3	$HCOO^{-1}$	BF_3
Lewis structure including dipoles			
Shape			
Bond angle			
Polar/Non-polar			
IMFA's			

4. There are trends in the properties of the elements, both across periods and down Groups in the Periodic Table.

a. State what is meant by: 3

Period

Group

Periodicity

b. The melting points of some of the halogens are shown in the table below:

Halogen	fluorine	chlorine	bromine	iodine
Melting point (K)	53	172	266	387

i. Describe the structure of, and the bonding, in solid iodine. 2

ii. Explain the trend in the melting points of the halogens shown in the table above. 3

c. The boiling point of some of the hydrogen halides are shown in the table below:

Hydrogen halide	HF	HCl	HBr	HI
Boiling point (K)	293	188	206	238

i. Explain, in terms of intermolecular forces present, why the boiling point of HF is much higher than those of the other hydrogen halides. 3

ii. Explain, in terms of intermolecular forces present, why the boiling points increase from HCl to HI. 3

iii. Draw a diagram to show how two molecules of HF are attracted to each other. Include partial charges and all lone pairs of electrons in your diagram. State the type of intermolecular force responsible for this attraction. 2

d. There are trends in the **melting point** and the **electrical conductivity** of the metals in Period 3. Using Na and Al as your examples, state these trends and explain each trend in terms of the bonding. 6

e. On heating, a mixture of sodium and fluorine react to form sodium fluoride as shown by the equation below:

$$2\ Na + F_2 \longrightarrow 2\ NaF$$

(i) State the type of bonding present, and explain the nature of the attractive forces holding solid sodium fluoride, NaF. 2

ii. Would you expect solid NaF to conduct an electric current, justify your answer. 2

iii. Explain why calcium fluoride, CaF_2, has a greater lattice energy than potassium fluoride, KF. 2

5. Silicon has a melting point of 2950 ^{O}C. Explain, in terms of its structure and bonding, why the melting point of silicon is very high. 4

6. Nitric oxide, NO, reacts instantly with oxygen gas to form nitrogen dioxide, $NO_{2\,(g)}$, a dark brown gas:

$$2\,NO_{(g)} + O_{2(g)} \longrightarrow 2\,NO_{2\,(g)}$$

a. Draw the Lewis structure of $NO_{(g)}$ and $NO_{2\,(g)}$. 2

Lewis structure $NO_{(g)}$ $NO_{2\,(g)}$

b. In one experiment 0.886 mole of NO is mixed with 0.503 mole of $O_{2(g)}$.

(i) Calculate the number of moles of $NO_{2(g)}$ produced. (Show your work) 2

(ii) Calculate the volume of $NO_{2(g)}$ produced at a temperature of 20.0 ^{O}C and a pressure of 98.8 kPa. 3

(iii) $NO_{2(g)}$ exists at room temperature as a mixture of $NO_{2(g)}$ and $N_2O_{4(g)}$:

$$2\,NO_{2(g)} \rightleftharpoons N_2O_{4\,(g)}$$

Draw the Lewis structure of and explain how the bonding in $N_2O_{4\,(g)}$ may arise, [Hint: see 6 (a) above]. 2