AP Questions: Bonding

1975 D

Suppose that a molecule has the formula AB_3. Sketch and name two different shapes that this molecule may have. For each of the two shapes, give an example of a known molecule that has that shape. For one of the molecules you have named, interpret the shape in the context of a modern bonding theory.

1976 D

NF_3 and PF_5 are stable molecules. Write the electron-dot formulas for these molecules. On the basis of structural and bonding considerations, account for the fact that NF_3 and PF_5 are stable molecules but NF_5 does not exist.

1979 D

Draw Lewis structures for CO_2, H_2, SO_3 and SO_3^{2-} and predict the shape of each species.

1982 D

(a) Draw the Lewis electron-dot structures for CO_3^{2-}, CO_2, and CO, including resonance structures where appropriate.

(b) Which of the three species has the shortest C-O bond length? Explain the reason for your answer.

(c) Predict the molecular shapes for the three species. Explain how you arrived at your predictions.

1985 D

Substance	Melting Point, ºC
H_2	-259
C_3H_8	-190
HF	-92
CsI	621
LiF	870
SiC	>2,000

(a) Discuss how the trend in the melting points of the substances tabulated above can be explained in terms of the types of attractive forces and/or bonds in these substances.

(b) For any pairs of substances that have the same kind(s) of attractive forces and/or bonds, discuss the factors that cause variations in the strengths of the forces and/or bonds.

1989 D

CF_4 XeF_4 ClF_3

(a) Draw a Lewis electron-dot structure for each of the molecules above and identify the shape of each.

(b) Use the valence shell electron-pair repulsion (VSEPR) model to explain the geometry of each of these molecules.

1990 D

Use simple structure and bonding models to account for each of the following.

(a) The bond length between the two carbon atoms is shorter in C_2H_4 than in C_2H_6.

(b) The H-N-H bond angle is 107.5º, in NH_3.

(c) The bond lengths in SO_3 are all identical and are shorter than a sulfur-oxygen single bond.

(d) The I_3^- ion is linear.

1992 D

NO_2 NO_2^- NO_2^+

Nitrogen is the central atom in each of the species given above.

(a) Draw the Lewis electron-dot structure for each of the three species.

(b) List the species in order of increasing bond angle. Justify your answer.

(c) Select one of the species and give the hybridization of the nitrogen atom in it.

(d) Identify the only one of the species that dimerizes and explain what causes it to do so.

1994 D

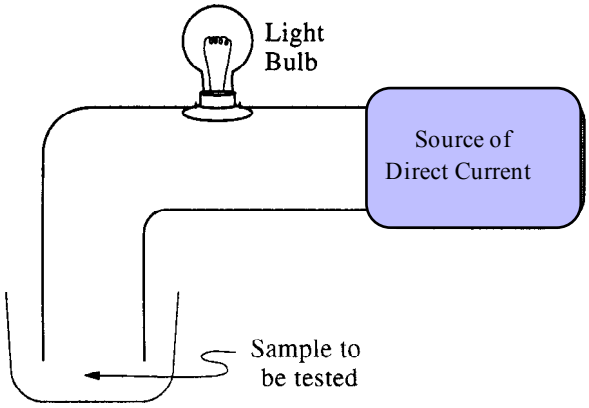
Use principles of atomic structure and/or chemical bonding to answer each of the following.

(b) The lattice energy of $CaO(s)$ is -3,460 kilojoules per mole; the lattice energy for $K_2O(s)$ is -2,240 kilojoules per mole. Account for this difference.

	Ionization Energy (kJ/mol)	
	First	Second
K	419	3,050
Ca	590	1,140

1995 D

The conductivity of several substances was tested using the apparatus represented by the diagram below.



The results of the tests are summarized in the following data table.

	$AgNO_3$	Sucrose	Na	H_2SO_4 (98%)	**Key:**	++ Good conductor
Melting Point (°C)	212°	185°	99°	Liquid at Room Temp.		+ Poor conductor
Liquid (fused)	++	-	++	+		- Nonconductor
Water Solution	++	-	++(1)	++(2)		(1) Dissolves, accompanied by evolution of flammable gas
Solid	-	-	++	Not Tested		(2) Conduction increases as the acid is added slowly and carefully to water

Using models of chemical bonding and atomic or molecular structure, account for the differences in conductivity between the two samples in each of the following pairs.

(a) Sucrose solution and silver nitrate solution.

(b) Solid silver nitrate and solid sodium metal.

(c) Liquid (fused) sucrose and liquid (fused) silver nitrate.

(d) Liquid (concentrated) sulfuric acid and sulfuric acid solution.

1999 D

Answer the following questions using principles of chemical bonding and molecular structure.

(a) Consider the carbon dioxide molecule, CO_2, and the carbonate ion, CO_3^{2-}.

(i) Draw the complete Lewis electron-dot structure for each species.

(ii) Account for the fact at the carbon-oxygen bond length in CO_3^{2-} is greater than the carbon-oxygen bond length in CO_2.