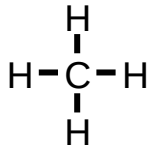
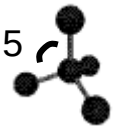
VSEPR Theory: Predicting the 3-D Shapes of molecules

Gather together the following equipment: 6 small white Styrofoam balls, one large coloured ball, and 6 toothpicks. Complete the chart. Note: when building molecules use a large coloured Styrofoam ball as the central atom, small white balls as peripheral atoms, and toothpicks to represent bonds. If the molecule has resonance structures, draw these in the "Lewis structure" box (B), but build only one resonance structure for the "Build molecule" box (C). The bond angle for a tetrahedral molecule is 109.5°. Other bond angles can be calculated by correctly dividing the 360 degrees of a circle (look at your structure).

A. Molecule	B. Lewis structure (use rules for drawing Lewis structures)	C. Build molecule (see pg 247), sketch, & give bond angles	D. Number of peripheral atoms	E. Bond angles (list all)	F. Name (see pg. 247)
1. CH_4		109.5 	4	109.5°	Tetrahedral
2. BeF_2					
3. PCl_5					
4. CCl_4					
5. PF_6^-					
6. SO_3					

Q1. What does VSEPR stand for? Q2. For molecules that have names associated with their shapes, what is the minimum number of atoms a molecule must have? Explain.

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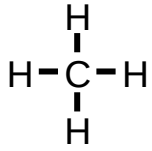
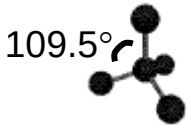
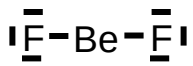
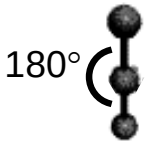
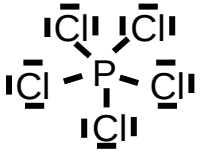
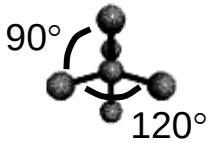
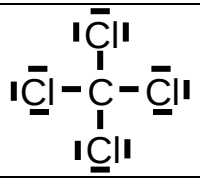
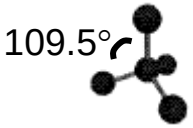
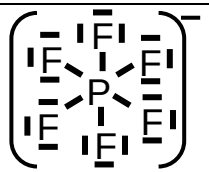
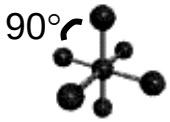
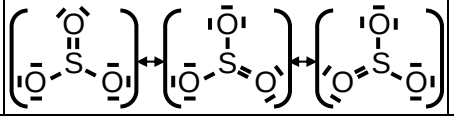
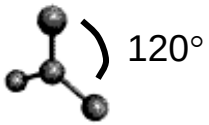
ANSWER KEY

A. Molecule	B. Lewis structure (use rules for drawing Lewis structures)	C. Build molecule (see pg 247), sketch, & give bond angles	D. Number of peripheral atoms	E. Bond angles (list all)	F. Name (see pg. 247)
1. CH_4			4	109.5°	Tetrahedral
2. BeF_2	2 + 7 x 2 = 16, 16 – 4 – 12 = 0 Note: Be is exception to octet rule 		2	180°	Linear
3. PCl_5	5 + 7 x 5 = 40, 40 – 10 – 30 = 0 		5	120°, 90°	Trigonal bipyramidal
4. CCl_4	4 + 7 x 4 = 32, 32 – 8 –24 = 0 		4	109.5°	Tetrahedral
5. PF_6^-	5 + 7 x 6 + 1= 48, 48 – 12 – 36 = 0 		6	90°	Octahedral
6. SO_3	6 + 6 x 3 = 24, 24 – 6 – 18 = 0. S must have octet … resonance possible 		3	120°	Planar triangular

Q1. What does VSEPR stand for? Valence Shell Electron Pair Repulsion.

Q2. For molecules that have names associated with their shapes, what is the minimum number of atoms a molecule must have? Explain

3 (shapes refer to shapes around a central atom. For a "shape" to exist there must be at least 2 peripheral atoms, or 3 total atoms)