

3.091 OCW Scholar

Self-Assessment Bonding and Molecules

Supplemental Exam Problems for Study

Problem #1

Answer the following questions about

hydrogen peroxide (H_2O_2).

- (a) Draw the Lewis structure of H_2O_2 . (b) Draw a 3-dimensional representation of the molecular geometry of the molecule.
- (c) Name the geometry of the electron distribution about the oxygen atoms.
- (d) Determine the per cent ionic character of the O–H bond.
- (e) Is the molecule polar or nonpolar? Explain.
- (f) Is it chiral or achiral? Explain.
- (g) Calculate the maximum wavelength of a beam of neutrons capable of breaking the O–H bond in H_2O_2 .

DATA:	Average Bond Energies (kJ/mol)	
	O–O	142
	H–H	432

Problem #2

(a) Draw the Lewis structure of trichloromethane (CHCl_3).

(b) Is CHCl_3 polar or nonpolar? Explain.

(c) Calculate the maximum wavelength of electromagnetic radiation capable of breaking the C–Cl bond in CHCl_3 .

DATA: bond energy (kJ/mol)

$$\text{C–C} = 346$$

$$\text{Cl–Cl} = 240$$

$$\text{H–H} = 432$$

Problem #3

Sketch the relationship between potential energy ($E_{\text{potential}}$) and internuclear distance (r) for the interaction between a bromide ion (Br^-) and an iodide ion (I^-). For reference, the distance $r_0 = r_{\text{Br}^-} + r_{\text{I}^-}$ is shown. No calculations necessary.

Problem #4

(a) For each set of chemical species, rank in order of boiling point from lowest to highest. Justify with reference to the operative chemical bonding.

(i) Ar and HCl and F₂

(ii) CH₄ and CF₄ and HF

Problem #5

(a) Draw a 3-dimensional representation of the molecular geometry around the central atom (not simply the Lewis structure) of BrF₃.

(b) Name the type of hybrid orbitals that the central atom forms.

(c) State whether the molecule is polar or nonpolar. Justify.

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