

QUIZ on Lecture P1_Wk1_L3

1. Listed below are ten common quantities that can be measured for any material. Which of these quantities are useful to know when estimating the electrostatic interaction potential energy between two molecules and/or atoms that comprise a given material.

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|----------------------------------|---------------------------------|
| i. dielectric constant | vi. location in periodic table |
| ii. atomic (or molecular) mass | vii. magnetic dipole moment |
| iii. electrostatic dipole moment | viii. electronic polarizability |
| iv. electron affinity | ix. ionization potential |
| v. specific heat | x. Gibbs free energy |

- a) i, iii, and v
- b) vi, viii, and ix
- c) iii, v and x
- d) i, iii, and viii

2. If electric fields between molecules approach 5×10^9 V/m, what might be the induced dipole moment (in Debye) on an argon atom with an electronic polarizability volume of 1.66×10^{-30} m³ when it experiences these typical intermolecular electric fields?

- a) 0.15 D
- b) 0.28 D
- c) 0.38 D
- d) 0.62 D

3. Calculate the ion-dipole interaction energy (in eV) for a singly charged positive ion and a molecule with a permanent dipole moment $p=1.5$ D if they are separated by 3.5 nm in a material having a dielectric constant of 3. Assume the rotational orientation is such that the dipole is aligned to achieve the most energetically favorable interaction.

- a) +0.008 eV
- b) +0.18 eV
- c) -0.0012 eV
- d) +0.026 eV

4. If the ion and dipole were free to move, would they

- a) attract each other
- b) repel each other
- c) remain at a fixed distance