

MSE 2001B Quiz #2, 8-28-2015

Your name (print) _____ Your major _____ Score _____/10

Please **ONLY** use the space of each question to provide your answer. You will have **10 minutes** to work on this quiz. Please sign to confirm that all work on this test is yours and yours only.

Signature _____ KEY _____

1. Explain why it is difficult to find a material with both a high stiffness and a high coefficient of thermal expansion. (5 pts)

- a) Use the **bond energy curve** to explain the macroscopic properties of materials. (1 pt)
- b) For a material with a **high stiffness**, it requires the bond-energy curve with a **smaller radius of curvature** and a **symmetric bond-energy well**. (2 pts)
- c) For a material with a **high coefficient of thermal expansion**, it requires **asymmetric bond-energy well**. (2 pts)

2. During the transformation from a liquid to a solid upon cooling, most substances experience an increase in density. Explain why **water** is an exception – we can observe an anomalous expansion in volume upon freezing. (5 pts)

- a) **Each water molecule (H₂O) has two hydrogen atoms that can bond to an oxygen atom via covalent bonding** (or intra-molecular force). (1 pts)
- b) For solid ice, each water molecule participates **hydrogen bonding** (2 pts). As a result, relatively **open structure** is created, which contributes the **decrease in density** (2 pts) during the transformation from liquid to solid phase.