Group Member Names \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Bonding Properties of Atoms**

**Pre Activity:**

1. When a metal is heated it expands, why does this happen?

**A model of atomic bonding: The symmetric spring potential vs. the real asymmetric potential.**





r0

EN

Distance between atoms r

Potential Energy

P.E. min

**Atomic Bond model**

A

B

C

D

E

P.E. min

r0

EN

Distance between atoms r

Potential Energy

**Spring model**

**Activity I: Understanding the graphs**

1. For points A, C, and D draw pictures representing the two atoms and their atomic separations.

A

C

D

1. For the points A-E which points are allowed when the system has total energy EN? Give an explanation for why points would be allowed or not allowed.
2. What is the average atomic separation in the spring model case? (Greater than, less than, or equal to r0?)

What is the average atomic separation in the "atomic bond" case?(Greater than, less than, or equal to r0?­)

1. What happens to the average separation for the spring model and atomic bond model when the total energy increases?
2. If the total energy of the system is EN, give a simple description of what each of these ΔE energies are.

EN

r

Potential Energy

P.E. min

**Atomic Bond model**

ΔE2

E0

ΔE1

**E0 =** Bond Energy = **ΔE1+ ΔE2**

**ΔE1**

**ΔE2**

**Activity II: Using the Graphs to Explain/Describe Properties of Bonding**

1. When you heat up a material, what happens to the total energy between two adjacent atoms? When you heat up a material, what happens to the average separation between atoms for the spring model and atomic bond model? Why?
2. On the atomic bond potential energy graph, indicate the total energy needed to break the represented atomic bond. (This bond energy is related to the melting temperature of a system. Although due to effects of entropy the two are not proportional to each other.)
3. What is the total energy needed to break the bond in the spring model?

1. If I increase the temperature of the material, what happens to its bond energy and melting temperature? Why?

**Activity III: Draw the Graphs and Explain your Picture.**

1. How would the potential energy curve for a material with a greater bond energy be different? (Either a written explanation or a comparison picture with two labeled curves is sufficient.)

B.E.:

1. What about a material with a higher coefficient of thermal expansion (α ~ ∆r/∆T)? (Either a written explanation or a comparison picture with two labeled curves is sufficient.)

α:

1. What about a material with a higher modulus of elasticity? (Either a written explanation or a comparison picture with two labeled curves is sufficient.) Hint: A stiffer material, higher modulus, is a stiffer spring. P.E.spring = ½\*k\*x2 try graphing a few different k to see what happens.

Modulus:

1. Concept check: For each situation rank (<, >, or =) the two curves A & B by the requested properties.

B.E.: B.E:

Modulus: Modulus:

α: α:

A

B

A

B

**Activity IV: Looking Forward.**

1. Material A is denser than Material B. How does Material A’s melting temperature compare to material B’s? Explain.

**Activity V: Looking Backward.**

1. When a metal is heated it expands, why does this happen? How has your answer to this question changed?