

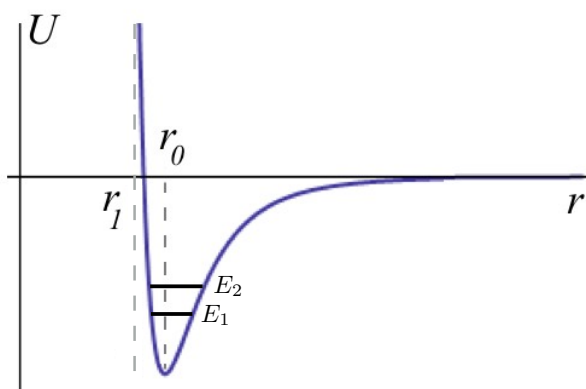
PHYS 234: Recitation 1
(Quiz: Jan 29, 2020)

1. **Estimation:** How many bricks are on Purdue's campus?

Clearly state your assumptions and how you came to the numbers you estimate.

2. **Essay:** State the first law of thermodynamics in words. Then, address the following question: your friend says that friction violates the first law of thermodynamics because it makes an object lose all of its kinetic energy. How would you argue that friction does not actually violate the first law of thermodynamics? Support your answer with an example.

3. The plot shows the potential energy of two atoms in a bound state, separated by a distance r .



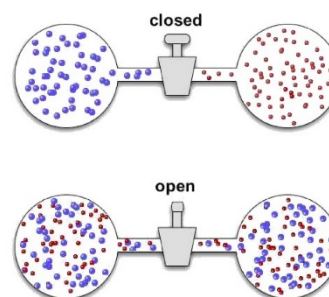
A. At what separation distance(s) is the force between the atoms the largest?

B. At what separation distance(s) is the force between the atoms the smallest?

C. At what separation distance(s) is the force between the atoms attractive?

D. At what separation distance(s) is the force between the atoms repulsive?

4. Consider the mixing scenario shown in the figure. Assume we have N molecules of a weakly interacting gas on the left, and N molecules of a different weakly interacting gas on the right. Both gases have the same temperature T and the system is isolated.



A. Give an expression for the ratio of the total number of microstates after mixing, \mathcal{W}_f , to the total number of microstates before mixing, \mathcal{W}_i .

B. Give an expression for the total entropy change ΔS for the mixing process.

5. A. If you flip a fair coin 6 times, which string of results are you more likely to get, or are they equally likely? Explain. (H = heads, T = tails)

- i) HHHHHH, in this order.
- ii) HTTHHT, in this order.

B. If you flip a fair coin 6 times, which result are you more likely to get, or are they equally likely? Explain.

- i) 6 heads, in any order.
- ii) 3 heads and 3 tails, in any order.

C. Calculate the number of microstates in each of the following macrostates:

- i) 3 heads and 3 tails in any order.
- ii) 4 heads and 2 tails in any order.
- iii) 2 heads and 4 tails in any order.
- iv) n heads and $N - n$ tails in any order.