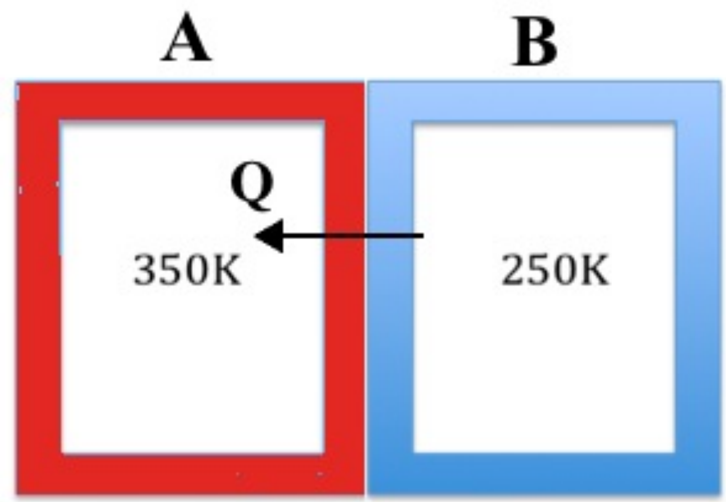
Suppose a small amount of heat Q flows from a system B at low temperature (250K) to a system A at high temperature (350K). Which of the following must be true regarding the entropy of the rest of the universe during this process?

1. It increases by an amount greater than ($|\Delta S_A| - |\Delta S_B|$)
2. It increases by an amount less than ($|\Delta S_A| - |\Delta S_B|$)
3. It decreases
4. It stays the same
5. It cannot be determined from the information given



A block of ice melts at 0^0C. The entropy of the resulting 0^o water is _____ the entropy of the original block of ice.

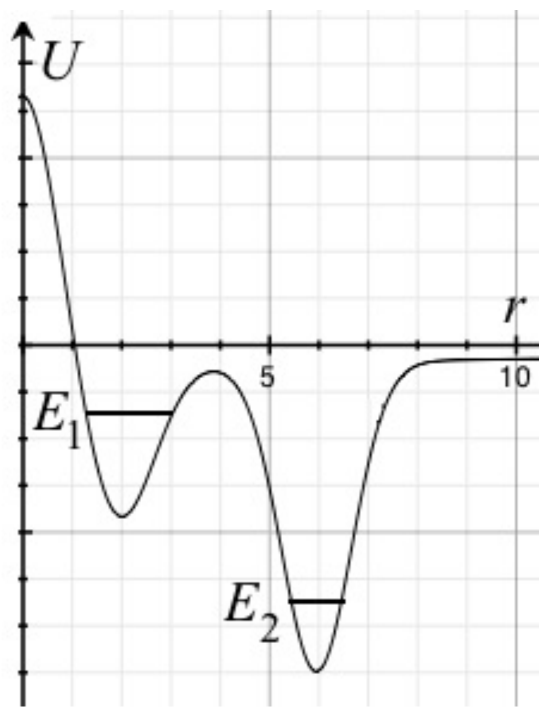
1. Greater than
2. Less than
3. The same as

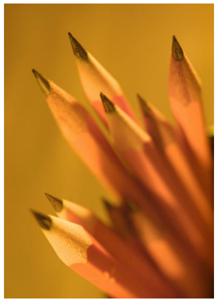
In the Boltzmann factor, $e^{-\frac{\Delta E}{k_B T}}$,
the "*T*" means:

1. Higher-energy states are only possible above a certain temperature
2. Higher-energy states are only possible below a certain temperature
3. Higher-energy states become more probable as the temperature increases
4. Higher-energy states become more probable as the temperature decreases
5. More than one of these
6. None of these

A gas of molecules at room temperature interacts with the potential shown below. Each molecule can be in the state E_1 or E_2. If the gas is at STP and $E_1 - E_2 = 25$ meV, then at equilibrium, the number of molecules found in the state E_1 divided by the number of molecules found in the state E_2 will be

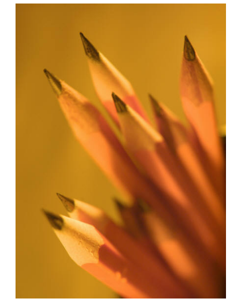
1. About 1
2. About 1/3
3. About 3
4. Much, much larger than 1
5. Much, much smaller than 1
6. Cannot be determined from the information given.



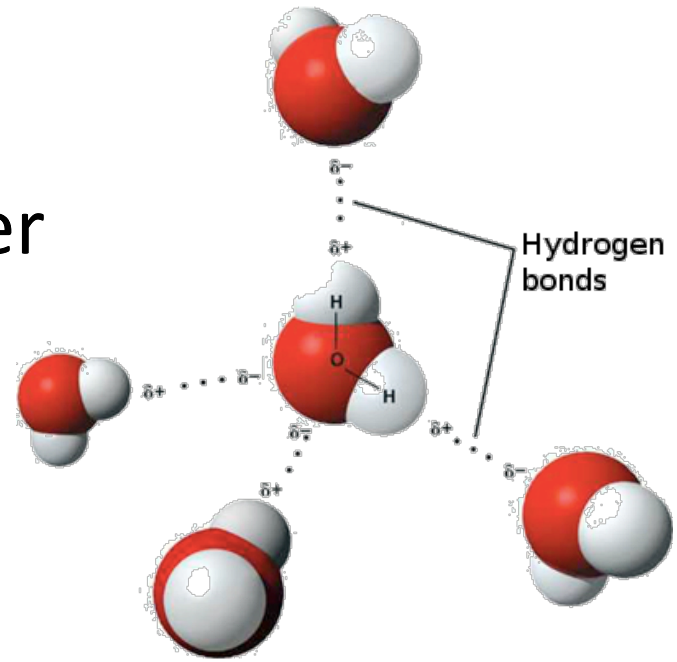


The energy of a C-C single bond is about 350 kJ/mol. What is the probability that thermal motion will result in breaking this bond?

What if it were a double C=C bond? (Energy about 615 kJ/mol)



The molecules in liquid water are connected by hydrogen bonds whose energy is about 23 kJ/mol. (This is what is responsible for the heat of vaporization of water.)



What is the probability that the thermal motion of the water molecules at STP will result in breaking one of those hydrogen bonds?