TEMPERATURE & HEAT ENERGY Unit 19

Dr. John P. Cise, Professor of Physics, Austin Com. College, 1212 Rio Grande St., Austin Tx. 78701 jpcise@austincc.edu
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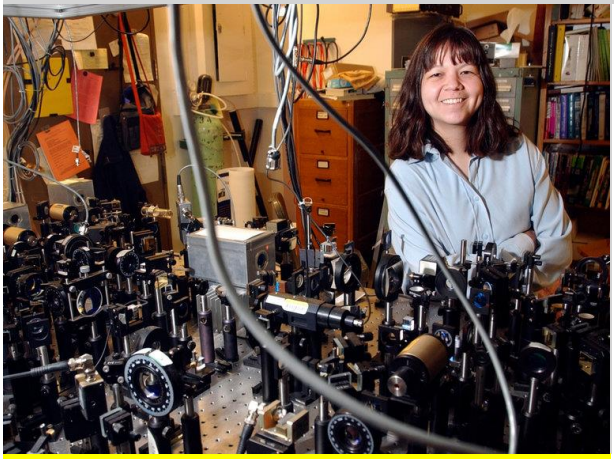
Deborah S. Jin Dies at 47; Physicist Studied Matter in Extreme Cold



Deborah S. Jin, who was mentioned as a potential candidate for a Nobel Prize.

INTRODUCTION: To convert Fahrenheit to Centigrade temperature: $^0C = 5/9\ (^o F - 32)$

To figure the total kinetic energy, you multiply the average kinetic energy KE(ave)/molecule = 3/2 kt (where k = Boltzmann's = 1.3806 X 10^{-23} m^2 kg./$s.^2K$) by number of molecules you have, which is *Nn,* where *n* is the number of moles (N = Avogadro's # = 6.022 X 10^{23} molecules/mole): KE (total) = 3/2 N n k T

Nk equals *R,* the universal gas constant (8.31 J/K^o mole), so this equation becomes the following:

KE(total) = 3/2 n R T

EXAMPLE: If you have 6.0 moles of ideal gas at 27 degrees Celsius, here's how much internal energy is wrapped up in thermal movement (make sure you convert the temperature to kelvin: $K^o = C^o + 273.15$) , thus in this case: K = 27 + 273.15 = 300.15 K^o

Deborah S. Jin, a much-honored physicist who created and **explored matter that exists only at a sliver of a degree above absolute zero — or minus 459.67 degrees Fahrenheit —** died on Sept. 15 in Boulder, Colo. She was 47. The cause was cancer, said JILA, a joint institute of the University of Colorado, Boulder, and the National Institute of Standards and Technology, where Dr. Jin worked for 20 years. (JILA was once an acronym for Joint Institute for Laboratory Astrophysics; the organization dropped the longer name in 1995.) In 2005, Dr. Jin became the second-youngest woman ever elected to the National Academy of Sciences. Her other honors included a 2003 MacArthur fellowship — the so-called genius award, with a no-strings-attached grant of $500,000 — and the 2013 L'Oreal/Unesco For Women in Science award for North America. She was mentioned as a potential candidate for aNobel Prize. Dr. Jin, a daughter of two physicists, had earned her doctorate in physics at the University of Chicago when she moved to Boulder in 1995 to join the laboratory of Eric A. Cornell, a JILA scientist, as a postdoctoral researcher. Dr. Cornell and Carl E. Wieman, then a physics professor at the University of Colorado, **had recently succeeded in cooling a gas of rubidium atoms to less than one-millionth of a degree above absolute zero, at which matter comes to an almost complete stop. The individual atoms melded together, acting as a single coherent particle.**

INTRODUCTION(CONTINUED):Example continued….

KE(total) = 3/2 n R T = 3/2(6.0 moles) (8.31 J/ K^o mole) (300.15 K^o) = 2.24 X 10^4 J

This converts to about 5 kilocalories, or *Calories* (the kind of energy unit you find on food wrappers. 4186 J/ kilocalorie)

QUESTIONS: (a) Convert - 459.67 ^oF (absolute zero on the Fahrenheit scale) to ^oC ? , (b) Assume (as in the example) we have 6 moles of ideal gas but at 2 ^oK(very close to absolute zero). How much energy does that 6 moles have?

HINTS: Given in introductions and example.

ANSWERS: (a) – 273.15 ^oC , (b) 149.58 J