For N$_2$ gas molecules in a 10 cm cubic box, the rules of QM dictate the discrete allowed values for:

1. Translational K.E. in one dimension: $\{1 \times 10^{-40} \text{ J}, 4 \times 10^{-40} \text{ J}, 9 \times 10^{-40} \text{ J}, \ldots\}$

2. Rotational K.E.: $\{0 \text{ J}, 0.8 \times 10^{-22} \text{ J}, 0.8 \times 10^{-22} \text{ J}, 0.8 \times 10^{-22} \text{ J}, 2.5 \times 10^{-22} \text{ J}, \ldots\}$

3. Vibrational energy: $\{2.3 \times 10^{-20} \text{ J}, 6.9 \times 10^{-20} \text{ J}, 11.5 \times 10^{-20} \text{ J}, \ldots\}$

Sketch a graph of $\frac{dU}{dT}$ of 10^{22} molecules of N$_2$ gas in the temperature range of 70 K (the temperature at which N_2 becomes liquid at 1 atm of pressure) to 5000 K (at which temperature N$_2$ breaks apart).
   (use a logarithmic temperature axis)