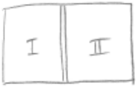
1) Lots of possibilities here ⇒ should include something like properties averaged over space + time, or most microstates, etc.

2) 

$N=8$, # of possible microstates depends if it is distinguishable or indisting. We will assume disting

$n=8$ corresponds to all 8 in LHS → 1 way for that to happen
$n=4$ " " 4 in LHS → 7 ways " " " "

Example

microstate 1 2 3 4 5 6 7 8	n	W(n)	Also valid for
L L L L L L L L	8	1	n = 0
R L L L L L L L L R L L L L L L . . . L L L L L L L R	7	8	n = 1
R R L L L L L L . . . L L L L L L R R	6	28	n = 2
R R R L L L L L . . . L L L L L R R R	5	56	n = 3
R R R R L L L L . . . L L L L R R R R	4	70	

One thing you might notice in enumerating the states is that your are trying to select (for the LHS) "M" objects (where M=n) from N possible objects. Also note that the selection is symmetric.
Examination of the possibilities should lead to: (note: $0! = 1$)

$$W(n) = \frac{N!}{M!\,(N-M)!}$$

(3) $\langle \bar{\varepsilon}_{trans} \rangle = \frac{3}{2} k_B T$, $k_B = 1.38 \times 10^{-23} \frac{J}{K}$, $T = 290\ K$, neon

largest quantum number = ?

$$\varepsilon = \left(\frac{h^2}{8m V^{2/3}} \right) (n_x^2 + n_y^2 + n_z^2)$$

$h = 6.63 \times 10^{-34}\ Js$, $m = 3.35 \times 10^{-26}\ kg$

$$\frac{3}{2} k_B T = \frac{3}{2} \left(1.38 \times 10^{-23} \frac{J}{K} \right) (290\ K) = 6.003 \times 10^{-21}\ J$$

$$6 \times 10^{-21}\ J = \left(\frac{(6.63 \times 10^{-34}\ Js)^2}{(8)\, 3.35 \times 10^{-26} kg} \right) \frac{n_x^2 + n_y^2 + n_z^2}{V^{2/3}}$$

$$\frac{n_x^2 + n_y^2 + n_z^2}{V^{2/3}} = 3.66 \times 10^{21}, \quad n_x^2 + n_y^2 + n_z^2 = 3.66 \times 10^{19}$$

if 2 of $n_x, n_y, n_z = 1$, the remaining one $= 6 \times 10^9$!

Very, very large! Is this reasonable? What is behind this?

(4) 

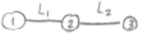
$1.99 \times 10^{-26}\ kg$ Rigid Rotor

$m = 2.66 \times 10^{-26}$ kg

$L = 2.77 \times 10^{-10}\ m = z$

$$\varepsilon = \frac{\hbar^2}{2I} l(l+1), \quad l \geq |m|$$

Find $\underline{\underline{I}}$. For 2-body, $I = \frac{m_1 m_2}{m_1 + m_2} z_0^2$

For 3-body 

$$I = m_1 L_1^2 + m_3 L_2^2 - \frac{(m_3 L_2 - m_1 L_1)^2}{m_1 + m_2 + m_3}$$

4, cont For first 2 energy levels, $l=1$ to $l=2$

and $$\Delta \varepsilon = \frac{\hbar^2}{2I}\left(\underbrace{2(2+1)}_{6} - \underbrace{1(1+1)}_{2} \right) = \frac{4\hbar^2}{2I}$$

$$I = m_o z^2 + m_o z^2 - \frac{(m_o z - m_o z)^2}{m_o + m_c + m_o} = 2 m_o z^2$$

$$\Delta \varepsilon = \frac{\cancel{4}\hbar^2}{\cancel{4} m_o z^2} = \frac{(6.6256\times10^{-34}/2\pi)^2\ J^2\cdot s^2}{(2.66\times10^{-26})(2.77\times10^{-10})^2\ kg\cdot m^2} = J$$

$$\boxed{\Delta \varepsilon = 5.45\times10^{-24}\ J}$$