

1 M02T.3

1.1 a

The residual entropy violates 3rd law of thermodynamics, one could measure this residual entropy by Bragg scattering, nonzero entropy means a random disorder which will produce diffuse scattering as well as Bragg peaks. Presence of diffuse scattering at zero temperature indicates nonzero residual entropy.

1.2 b

Each molecule has four bonds and each bond connects two molecules, so we can uniquely assign two bonds per each molecule. Since we take all possible configurations, there are $2 \cdot 2 = 4$ different hydrogen configurations per molecule and hence the entropy per molecule in this model is

$$S = k_B \log 4. \quad (1)$$

1.3 c

If we consider each atom independently using Pauling principle, not all of the previous configurations are possible. For each individual configuration of a molecule the chance of not conflicting with other bonds is $\frac{1}{16}$. However, there are 6 different configurations permitted for each molecule. Hence the number in logarithm must be multiplied by $\frac{6}{16}$ thus leading to

$$S = k_B \log \frac{3}{2}. \quad (2)$$