PEU 323 Assignment 3

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1 Problem 1

$$\lambda = \frac{h}{p}$$

$$E_K = \frac{mv^2}{2} = \frac{p^2}{2m}$$

Where E_K is the kinetic energy.

$$p = \sqrt{2mE_K}$$

$$E_K = \frac{f}{2}K_BT$$

Where f is 3 for nitrogen atoms under room temperature (T = 293.15K) and $K_B = 1.380649 \times 10^{-23} J.K^{-1}$ is boltzmann constant.

$$E_K = \frac{3}{2}K_BT$$

$$p = \sqrt{3mK_BT} = \sqrt{3 \times 10^{-18} kg \times 1.380649 \times 10^{-23} J.K^{-1} \times 293.15K}$$

$$= \sqrt{3 \times 10^{-18} \times 1.380649 \times 10^{-23} \times 293.15}\sqrt{kg.J} \approx 10^{-19}\frac{kg.m}{s}$$

$$\lambda = \frac{h}{\sqrt{3mK_BT}}$$

$$h = 6.62607015 \times 10^{-34} J.s$$

$$m = 10^{-18} kg$$

$$kgJ = \frac{kg^2m^2}{s^2}$$

$$\lambda = \frac{6.62607015 \times 10^{-34}}{\sqrt{3 \times 10^{-18} \times 1.380649 \times 10^{-23} \times 293.15}} \frac{J.s}{\sqrt{kgJ}}$$

$$\lambda \approx 6.0 \times 10^{-15} m$$

$$d = 10^{-7} m$$

$$\frac{h}{pd} = \frac{6.62607015 \times 10^{-34}}{10^{-7} \times 10^{-19}} \frac{J.s^2}{kg.m^2} = 6.6 \times 10^{-8}$$

Since the $\Delta p \Delta d >> h$ We don't need to use quantum treatment.

2 Problem 1

References

[1] M.H. El-Deeb. PEU-323 Assignments.