

Physics Cup 2018 - Problem 5. June 6, 2018

Estimate the mean free path of a black sphere of mass m and radius R in vacuum at temperature T . Mean free path here is defined as the travel distance by which the velocity vector of the sphere turns by an angle $\pi/2$. Assume that $kTR \gtrsim hc$, where k and h are the Boltzmann and Planck constants, respectively; c denotes the speed of light. You may find it useful to know that for a random walk when during a time period τ , a step of length a is taken in a random, the average overall displacement during time $t > \tau$ is estimated as $a\sqrt{t/\tau}$.