

### 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  $\tau$ , a step of length  $a$  is taken in a random, the average overall displacement during time  $t > \tau$  is estimated as  $a\sqrt{t/\tau}$ .