The following problems from Mandl: 2.2, 2.3, 2.5, 2.6

1) Prove Stirling’s formula

\[ n! \approx \sqrt{2\pi n} \exp(n \log n - n). \]

2) A molecule in a gas moves equal distance \( l \) between collisions. What is the root mean distance \( \overline{R^2} \) after \( N \) collisions.

3) In Russian roulette, one puts a single bullet in one of the chambers of the gun’s cylinder, leaving the other 5 chambers empty, and then spins the cylinder. What is the probability that you will still be alive after 10 games? 100 games?

4) Two very drunk students at Valborg start out together in the middle of Järnbron taking equal random steps along either direction of the bridge. What is the probability that they meet again after \( N \) steps? You may assume that there steps are synchronized (although this would be hard to believe)