

# MATH327: StatMech and Thermo, Spring 2025

## Extra practice — 2d bosons

Consider a gas of bosons with mass  $m$  confined to a two-dimensional surface of area  $A$ , with temperature  $T = 1/\beta$  and chemical potential  $\mu$ . Its grand-canonical potential is

$$\Phi(T, \mu) = \frac{mAT}{2\pi\hbar^2} \int_0^\infty \log [1 - e^{-\beta(E-\mu)/T}] dE .$$

What is the average particle number  $\langle N \rangle$  in the case of vanishing chemical potential,  $\mu = 0$ ?

**Hint:** Expect something unexpected. (You can find more information in [doi:10.1016/0370-1573\(77\)90052-7](https://doi.org/10.1016/0370-1573(77)90052-7).)