

## M09T.3 - 2D and 3D Bosons (J94T.3)

### Problem

Consider a 3-dimensional gas of (spinless, non-relativistic) bosons at pressure  $P$  and temperature  $T$ . The bosons can be absorbed onto a (2-dimensional) surface layer, where they are bound with energy  $-\epsilon_0 < 0$ , but retain their translational degrees of freedom in 2 dimensions. The (ideal) 3D gas is in equilibrium with the (ideal) 2D absorbed gas.

Treating the 3D gas classically, but the 2D gas quantum mechanically, compute the surface density in the layer as a function of  $P$  and  $T$ .

(You may need:  $\int \frac{dx}{ae^x+1} = \ln \frac{e^x}{1+ae^x}$ .)