2.32) The multiplicity of states for a 2-D gas is obtained in a manner similar to the derivation of (2.40) in the 3D case, except that we make the substitutions

$$V^N \rightarrow A^N \qquad \text{(volume} \rightarrow \text{area)}$$

$$3N \rightarrow 2N$$

This gives us

$$\Omega \approx \frac{1}{N!} \frac{A^N}{h^{2N}} \frac{\pi^N}{N!} (2mU)^N$$

Thus,

$$S = k \ln \Omega \cong k \left\{ -N\ln N + N + N\ln(\pi A) + N\ln(2mU) - 2N\ln h - N\ln N + N \right\}$$

$$= Nk \left\{ -\ln N^2 + 2 + \ln(\pi A) + \ln(2mU) - \ln h^2 \right\}$$

$$= Nk \left\{ \ln\left(\frac{A}{N} \cdot \frac{2m\pi U}{Nh^2} \right) + 2 \right\}$$