Let us put $J = 1$.
The eigenvalues of the transfer matrix are:

$$\begin{aligned}\tau_+(\beta, B) &= e^{\beta}\left(\sqrt{e^{-4\beta} + \sinh^2(\beta B)} + \cosh(\beta B)\right) \\ \tau_-(\beta, B) &= e^{\beta}\left(\cosh(\beta B) - \sqrt{e^{-4\beta} + \sinh^2(\beta B)}\right)\end{aligned} \tag{1}$$

The partition function reads:

$$Z(N, \beta, B) = \tau_+(\beta, B)^N + \tau_-(\beta, B)^N \tag{2}$$

and the magnetization $M(N, \beta, B) = \frac{1}{\beta}\partial_B \log(Z(B, \beta, B))$ is:

$$-\frac{e^{-\beta N}\sinh(\beta B)\left(\left(e^{\beta}\left(\cosh(\beta B) - \sqrt{e^{-4\beta} + \sinh^2(\beta B)}\right)\right)^N - \left(e^{\beta}\left(\sqrt{e^{-4\beta} + \sinh^2(\beta B)} + \cosh(\beta B)\right)\right)^N\right)}{\sqrt{e^{-4\beta} + \sinh^2(\beta B)}\left(\left(\cosh(\beta B) - \sqrt{e^{-4\beta} + \sinh^2(\beta B)}\right)^N + \left(\sqrt{e^{-4\beta} + \sinh^2(\beta B)} + \cosh(\beta B)\right)^N\right)} \tag{3}$$

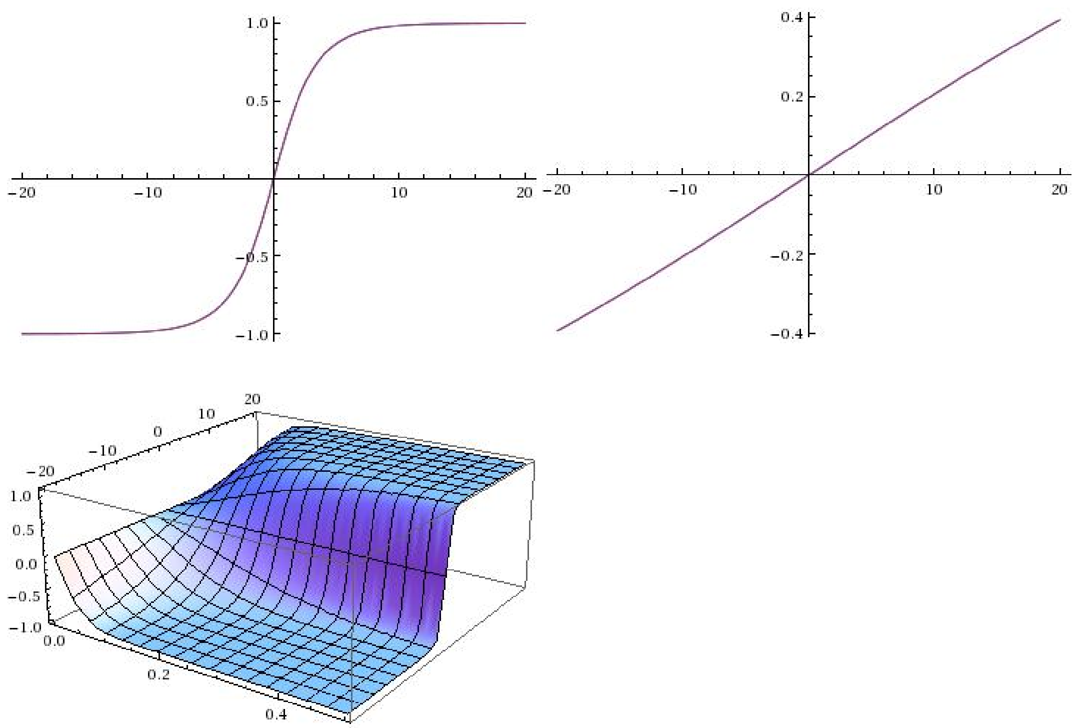

Figure 1: (1): magnetization at $\beta = 0.2$, $N = 10, \infty$ as a function of $B \in (-20, 20)$. (2): magnetization at $\beta = 0.02$, $N = 10, \infty$ as a function of $B \in (-20, 20)$. (3): magnetization as a function of β, B at $N = \infty$