Homework 3

Answers should be submitted, as both a tex file and a pdf file, to both me and the teaching assistants. You may use this file as a template.

Q3.1. The superpotential W of the Minimal Supersymmetric Standard Model is a holomorphic function of Q, u, d, L, e, H_u and H_d that is invariant under the U(1) hypercharge symmetry

$$
\begin{aligned}
Q &\to e^{i\theta}Q \quad, \quad u \to e^{-4i\theta}u \quad, \quad d \to e^{2i\theta}d \quad, \quad L \to e^{-3i\theta}L \\
e &\to e^{6i\theta}e \quad, \quad H_u \to e^{3i\theta}H_u \quad, \quad H_d \to e^{-3i\theta}H_d
\end{aligned}
\tag{Q3.1.1}
$$

and the $\mathbb{Z}_2$ R-parity symmetry

$$
\begin{aligned}
Q &\to -Q \quad, \quad u \to -u \quad, \quad d \to -d \quad, \quad L \to -L \\
e &\to -e \quad, \quad H_u \to H_u \quad, \quad H_d \to H_d
\end{aligned}
\tag{Q3.1.2}
$$

Expand W in a Taylor series and determine the terms up to cubic order.

Q3.2. Calculate

$$
\sum_{n=0}^{\infty} x^n
\tag{Q3.2.1}
$$

for $x = 2$.

Use PGF to draw a diagram illustrating your answer.