

2. The four-point function reads

$$\begin{aligned}
 G_4(x_1, x_2, x_3, x_4) = & \left(\begin{array}{c} \text{Diagram 1} \\ \text{Diagram 2} \\ \text{Diagram 3} \end{array} \right) \\
 - \frac{i\lambda}{2} & \left(\begin{array}{c} \text{Diagram 4} \\ \text{Diagram 5} \\ \text{Diagram 6} \\ \text{Diagram 7} \\ \text{Diagram 8} \\ \text{Diagram 9} \\ \text{Diagram 10} \end{array} \right) \\
 - i\lambda & \left(\begin{array}{c} \text{Diagram 11} \\ \text{Diagram 12} \end{array} \right) + \mathcal{O}(\lambda^2)
 \end{aligned}$$

The diagrams are:

- Diagram 1: Two horizontal lines, top from 1 to 2, bottom from 3 to 4.
- Diagram 2: Two vertical lines, left from 1 to 3, right from 2 to 4.
- Diagram 3: A central vertex with four lines extending to 1, 2, 3, 4.
- Diagram 4: Top line 1-2 with a loop, bottom line 3-4.
- Diagram 5: Top line 1-2, bottom line 3-4 with a loop.
- Diagram 6: Left vertical line 1-3 with a loop, right vertical line 2-4.
- Diagram 7: Left vertical line 1-3, right vertical line 2-4 with a loop.
- Diagram 8: A central vertex with a loop and four lines to 1, 2, 3, 4.
- Diagram 9: A central vertex with a loop and four lines to 1, 2, 3, 4 (rotated).
- Diagram 10: A central vertex with a loop and four lines to 1, 2, 3, 4 (rotated).
- Diagram 11: A central vertex with four lines to 1, 2, 3, 4 (crossing).
- Diagram 12: A central vertex with four lines to 1, 2, 3, 4 (crossing).

What diagrams appear in G_4 at order λ^2 ? Take the symmetry factors into account!

3. Show, at least to order λ , that the functional $W[J] = -i \ln Z[J]$ generates only the connected Feynman diagrams of $G_4(x_1, x_2, x_3, x_4)$,