1. Give an example of each of the following.

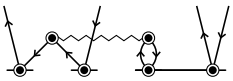
   (a) A closed, connected graph of at least two operators.

   (b) A Hugenholtz path of at least three lines that doesn't qualify as a Goldstone path.

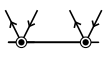
   (c) Non-equivalent, interchangeable subgraphs, where at least one subgraph contains multiple operators.

   (d) A graph that is disconnected and linked.

2. Interpret the following graph algebraically, and then simplify your expression as much as possible.[1]



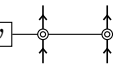
[1]The operators in this graph are defined as follows.

 $\equiv \left(\frac{1}{2!}\right)^2 \sum_{pqrs} \overline{g}^{rs}_{pq} \tilde{a}^{pq}_{rs}$  $\equiv \sum_{ia} c^i_a \tilde{a}^a_i$  $\equiv \left(\frac{1}{2!}\right)^2 \sum_{ijab} c^{ij}_{ab} \tilde{a}^{ab}_{ij}$

3. Write the following algebraic expression as a graph.[2]

$$\sum_{\substack{abcd\\ijkl}} \overline{v}_{ij}^{ab} \overline{w}_{bcd}^{jkl} {:}\, a_{ab^\bullet}^{ij^\circ} a_{j^\circ kl}^{b^\bullet cd} {:}$$

[2]Use the following to denote the operators in your graph.

$\left(\frac{1}{2!}\right)^2 \sum_{pqrs} \overline{v}_{pq}^{rs} \tilde{a}_{rs}^{pq} \equiv$ 

$\left(\frac{1}{3!}\right)^2 \sum_{\substack{pqr\\stu}} \overline{w}_{pqr}^{stu} \tilde{a}_{stu}^{pqr} \equiv$