

$$\begin{aligned}
 t_f^a t_f^b t_f^a &= \text{Diagram 1} = \text{Diagram 2} - \frac{1}{N} \text{Diagram 3} \\
 &= \text{tr}(t_f^b) \mathbf{1} - \frac{1}{N} t_f^b = -\frac{1}{N} t_f^b.
 \end{aligned}$$

The diagrams are as follows:
 

- Diagram 1:** A horizontal line with three vertices labeled  $a$ ,  $b$ , and  $a$  from left to right. A wavy line connects the first and third vertices above the line. A wavy line connects the middle vertex  $b$  downwards.
- Diagram 2:** A horizontal line with a central vertex. A loop of two straight lines connects the left and right sides of the vertex above the line, with arrows indicating a clockwise direction. A wavy line connects the central vertex downwards.
- Diagram 3:** A horizontal line with a central vertex. A wavy line connects the central vertex downwards.