

Let

$$\Delta = \frac{1}{2}(q_2 - q_1) \wedge (q_3 - q_1) = \sum_{i < j} (q_i \wedge q_j).$$

Then

$$\frac{d^2}{dt^2}(q_i \wedge q_j) = \frac{d^2 q_i}{dt^2} \wedge q_j + q_i \wedge \frac{d^2 q_j}{dt^2} + 2v_i \wedge v_j.$$