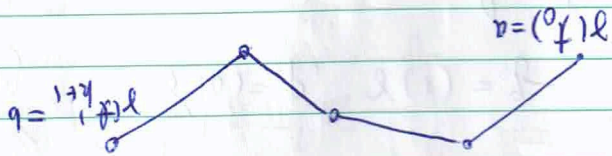


$$= \frac{D}{Dt} \frac{\partial}{\partial s} + R \left(\frac{\partial}{\partial t}, \frac{\partial}{\partial s} \right) \frac{\partial}{\partial t}$$

$$\stackrel{s=0}{=} \frac{D}{Dt} V + R \left(\frac{\partial}{\partial t}, V \right) \frac{\partial}{\partial t}$$

$$4) \sum_k \left\langle \frac{\partial}{\partial s}, \frac{\partial}{\partial s} \right\rangle \Big|_{t_{k+1}}^{t_k} = - \sum_k \left\langle V(t_k), \frac{D}{Dt} (t_k) - \frac{D}{Dt} (t_{k+1}) \right\rangle$$



RR: On each smooth curve, $\mathcal{R}V$: smooth

$$\frac{D}{Dt} \left\langle V, \frac{D}{Dt} \right\rangle = \left\langle V, \frac{D^2}{Dt^2} \right\rangle + \left\langle \frac{D}{Dt}, \frac{D}{Dt} \right\rangle$$

$$\therefore \frac{1}{2} E''(t_0) = - \sum_k \int_{t_{k+1}}^{t_k} \left\langle \frac{D}{Dt} \left\langle V, \frac{D}{Dt} \right\rangle - \left\langle \frac{D}{Dt}, \frac{D}{Dt} \right\rangle + \left\langle V, R \left(\frac{\partial}{\partial t}, \frac{\partial}{\partial s} \right) \right\rangle \right\rangle dt$$

$$- \sum_k \left\langle V(t_k), \frac{D}{Dt} (t_k) - \frac{D}{Dt} (t_{k+1}) \right\rangle$$

$$= \int_a^0 \left\langle V, V' \right\rangle - \left\langle R \left(\frac{\partial}{\partial t}, V \right), \frac{\partial}{\partial t} \right\rangle$$

$$- \left\langle \frac{D}{Dt} \frac{\partial}{\partial s}, \frac{\partial}{\partial s} \right\rangle (0,0) + \left\langle \frac{D}{Dt} \frac{\partial}{\partial s}, \frac{\partial}{\partial s} \right\rangle (0,a)$$

$$= I_a (V, V) - \left\langle \frac{D}{Dt} \frac{\partial}{\partial s}, \frac{\partial}{\partial s} \right\rangle (0,0) + \left\langle \frac{D}{Dt} \frac{\partial}{\partial s}, \frac{\partial}{\partial s} \right\rangle (0,a)$$