$$x_{n+1} = x_n + v_n \Delta t + \frac{1}{2} a_n \Delta t^2$$

$$v_{n+1} = v_n + \frac{1}{2}(a_n + a_{n+1})\Delta t$$

$$\frac{\partial x_{n+1}}{\partial x_n} = 1$$

$$\frac{\partial x_{n+1}}{\partial v_n} = \Delta t$$

$$\frac{\partial v_{n+1}}{\partial x_n} = 0$$

$$\frac{\partial v_{n+1}}{\partial v_n} = 1 + \frac{\Delta t}{2} \frac{\partial a_{n+1}}{\partial v_n}$$

$$\frac{\partial a_{n+1}}{\partial v_n} = -\frac{\partial^2 V}{\partial x_{n+1} \partial v_{n+1}}$$

$$J = \frac{\partial x_{n+1}}{\partial x_n} \frac{\partial v_{n+1}}{\partial v_n} - \frac{\partial x_{n+1}}{\partial v_n} \frac{\partial v_{n+1}}{\partial x_n}$$

$$= 1\left(1 + \frac{\Delta t}{2} \frac{\partial a_{n+1}}{\partial v_n}\right) - \Delta(t) \cdot 0$$

$$= 1 - \frac{\Delta t}{2} \frac{\partial^2 V}{\partial x_{n+1} \partial v_{n+1}} = 1$$