

$$H = \frac{p^2}{2m} + \frac{1}{2} m \omega^2 x^2$$

$$-\dot{p} = \frac{\partial H}{\partial x} = m \omega^2 x \quad , \quad \frac{\partial H}{\partial p} = \frac{p}{m} = \dot{x}$$

$$y = \begin{pmatrix} x \\ p \end{pmatrix} \quad \rightarrow \quad \begin{pmatrix} \dot{x} \\ \dot{p} \end{pmatrix} = F \begin{pmatrix} x \\ p \end{pmatrix} = \begin{pmatrix} p/m \\ -m\omega^2 x \end{pmatrix}$$

RK4

$$y_1 = y_n$$

$$, y_n = y(t_n) , t_n = n h$$

$$y_2 = y_1 + \frac{h}{2} F(y_1)$$

$$y_3 = y_1 + \frac{h}{2} F(y_2)$$

$$y_4 = y_1 + h F(y_3)$$

$$y_{n+1} = y_n + \frac{h}{6} [F(y_1) + 2F(y_2) + 2F(y_3) + F(y_4)]$$