

Hamilton's Equations

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$$\dot{q} = \frac{\partial H}{\partial p}$$

$$\dot{p} = - \frac{\partial H}{\partial q}$$

p : momentum

q : position

H : Hamiltonian

$$H = \frac{1}{2}mv^2 + V(q)$$

$$p = mv$$

↑
Potential
energy

$$H = \frac{p^2}{2m} + V(q)$$

$$\dot{q} = \frac{p}{m} = v \quad \checkmark$$

$$ma = m\dot{v} = \dot{p} = - \frac{dV}{dq} = F \quad \checkmark$$

Works in other contexts: special relativity, E&M.

Also extends to QM.