Scalar Potential $\phi(x)$: $\vec{F} = -\nabla \phi(x)$

$$[F] = \frac{m \cdot l}{t^2}$$

$$[\phi] = \frac{m l^2}{t^2}$$

Potential Energy V: $V = m \cdot g \cdot h$

because $V = \int_0^h F_G \, ds = \int_0^h mg \, ds = mgh$

$\boxed{\text{MECHANICS}}$ $$[V] = m \frac{l}{t^2} \cdot l = \underline{\frac{m l^2}{t^2} = [\phi]}$$

$\boxed{\text{ELECTROSTATICS}}$

$\vec{E} = -\nabla \phi$ $\vec{E}$ ... electr. field, <u>not</u> energy

$\vec{F} = q \cdot \vec{E}$ q ... electr. charge

$\vec{F}$ ... force

$\Rightarrow \vec{F} = q \cdot (-\nabla \phi)$

$$V(h) = \int_0^h \vec{F} \, ds = \int_0^h q \vec{E} \, ds = \int_0^h q \cdot (-\nabla \phi) \, ds = -q(\phi(h) - \phi(0))$$

↑ gradient theorem

choose $\phi(0) = 0$

$\Rightarrow V(h) = -q \, \phi(h)$

$\boxed{\text{MECHANICS : fixed}}$ $\vec{F} := -m \nabla \phi(x)$

this makes mechanics potentials consistent with electr. potentials