Kinetic & Total Energy on PE diagrams

Say particle has
$E_{\text{TOT}} = -2J$

$E_{\text{TOT}} = U + K = -5J + 3J = -2J$

$U = -5J \ (at \ x_0)$

$K = 3J \ (at \ x_0)$

If particle is initially at $x_0$, with $v_0 > 0$, it
moves to the right, slowing down (as $U$ becomes
less negative & $K$ becomes less positive, keeping
$E_{\text{TOT}}$ const.) At $x_1$, $E_{\text{TOT}} = U \Rightarrow K = 0 \Rightarrow$ it's
momentarily at rest. At $x_1$, $\frac{dU}{dx} > 0 \Rightarrow F = -\frac{dU}{dx} < 0$

$\Rightarrow$ The force associated with $U$ pushes the
particle to the left. It accelerates to $x_0$, then
continues left & slows down, until it reaches $x_2$,
then reverses direction again.

Since $U_{\text{grav}} = mg$, can think about the graph of
any $U$ as if it's a graph of $h$ -- this is a powerful
guide to intuitive understanding.

Energy & Friction

When I push an object at constant speed
along a horizontal surface with friction,
I do $W_{\text{ext}}$ on it, but $\Delta U = \Delta K = 0$.

Count Rumford 1798: The mechanical work
done by a drill in boring a canon causes
it to heat up.

Named in his honor

James Prescott Joule 1818-1889:

Experiments with paddles sloshing water,
and the resulting temperature increase
of the water ("Mechanical Equivalent
of Heat")

$\Rightarrow W_{\text{ext}} = \Delta K + \Delta U + \Delta U_{\text{int}}$

"internal energy"