



$= s = \frac{1}{2} g t^2 \leftarrow \text{solve for } t$

$\frac{ds}{dt} = v = g t = g \sqrt{\frac{2s}{g}} = v \text{ as func. of } s$

$s = \frac{1}{2} g t^2$

$t = \sqrt{\frac{2s}{g}}$

$t = \pm \sqrt{\frac{2s}{g}}$

$t = \sqrt{\frac{2s}{g}}$

$v = v(t) :$

$s \Big|_{t=T} = \frac{1}{2} g T^2$

$V_{avg} = \frac{1}{T} \int_0^T g t dt = \frac{1}{T} \left( \frac{1}{2} g T^2 \right)$

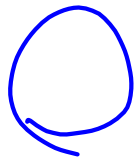
$= \frac{1}{2} g T = \frac{1}{2} V_T$

$V_{avg} = \frac{1}{\frac{1}{2} g T^2} \int_0^{\frac{1}{2} g T^2} \sqrt{2sg} ds$   
as func of s:

$\int_0^{\frac{1}{2} g T^2} \sqrt{2sg} ds$

$= \frac{1}{\frac{1}{2} g T^2} \sqrt{2g} \int_0^{\frac{1}{2} g T^2} \sqrt{s} ds$

$= \frac{2\sqrt{2g}}{g T^2} \left[ \frac{2}{3} s^{\frac{3}{2}} \right]_0^{\frac{1}{2} g T^2}$



$\left( \frac{2\sqrt{2g}}{g T^2} \right) \left( \frac{2}{3} \right) \left( \left( \frac{1}{2} g T^2 \right)^{\frac{3}{2}} \right)$

$= \frac{2\sqrt{2g}}{g T^2} \cdot \frac{2}{3} \cdot \left( \frac{1}{2} \right)^{\frac{3}{2}} (g T^2)^{\frac{3}{2}}$

$= \left( \frac{2\sqrt{2g}}{g T^2} \right) \left( \frac{2}{3} \right) \left( \frac{1}{2\sqrt{2}} \right) (g T^2)^{\frac{1}{2}}$

$= (\sqrt{g}) \left( \frac{2}{3} \right) g^{\frac{1}{2}} T$

$= \frac{2}{3} g T = \frac{2}{3} V_T$