2.3. The velocity of a machine element over a 10 second period is:

$$v = 2.5t \text{ m/s} \qquad 0 < t < 4 \text{ s}$$

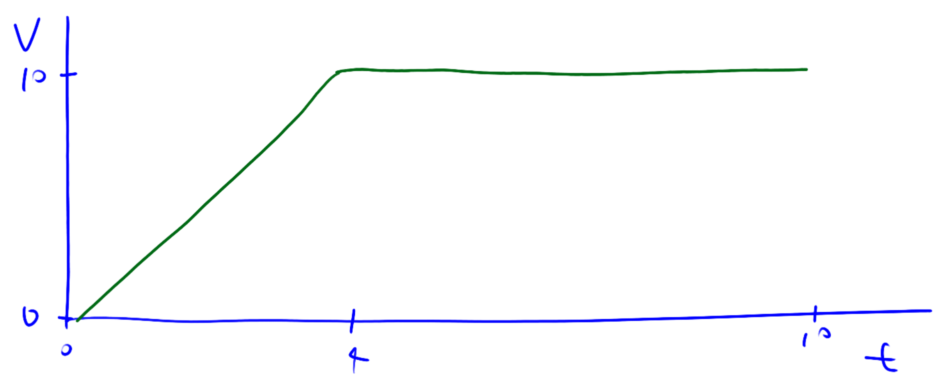
$$v = 10 \text{ m/s} \qquad 4 \leq t < 10 \text{ s}$$

(a) If the element is an ideal damper with $B = 10$ N-s/m, determine the power absorbed as a function of time, and the total energy dissipated over the 10 s period.

(b) If the element represents aerodynamic drag, approximated by the characteristic $F = Cv^2$, determine the power absorbed as a function of time, and the total energy dissipated if $C = 1.0$ N-s^2/m^2.

(c) In the time period $t < 4$ s, how does the power absorbed by the two dampers compare? Which damper dissipates the most energy in the 10 s period?

(d) At a velocity of 20 m/s, which damper absorbs the most power?



a. $V = BF$ $\qquad P = FV$

$F = \frac{V}{B}$

$$P(t) = \begin{cases} \frac{(2.5t)^2}{10} & 0<t<4 \\ 10 & 4\leq t<10 \end{cases}$$

$P(t)$ when $t<4$

$P(t) = F(t)\, V(t)$

$= \frac{V(t)}{B} V(t)$

$= \frac{(2.5t)^2}{10}$

$P(t)$ when $t>4$

$P(t) = F(t)\, V(t)$

$= \frac{V(t)}{B} V(t)$

$= \frac{10}{10} 10 = 10$

$E = \int_0^{10} P(t)\, dt$

$= \int_0^4 \frac{(2.5t)^2}{10} dt + \int_4^{10} 10\, dt$

$= \frac{2.5^2}{10} \frac{t^3}{3}\Big|_0^4 + 10t\Big|_4^{10}$

$= \frac{2.5^2}{10}\left(\frac{4^3}{3} - 0\right) + 10(10-4)$

$= \frac{2.5^2}{10} \frac{64}{3} + 10(6)$