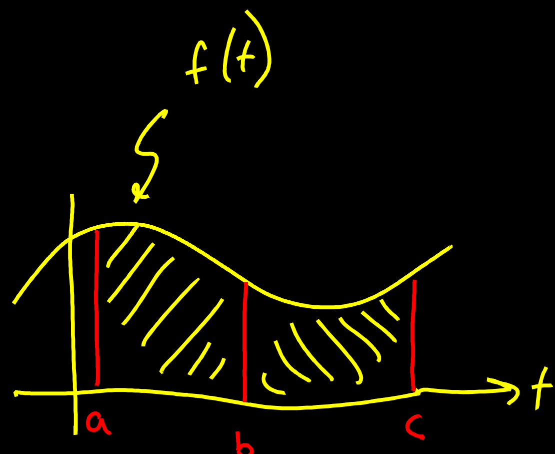
Piecewise Integration



$$\int_a^c f(t)\,dt = \int_a^b f(t)\,dt + \int_b^c f(t)\,dt$$

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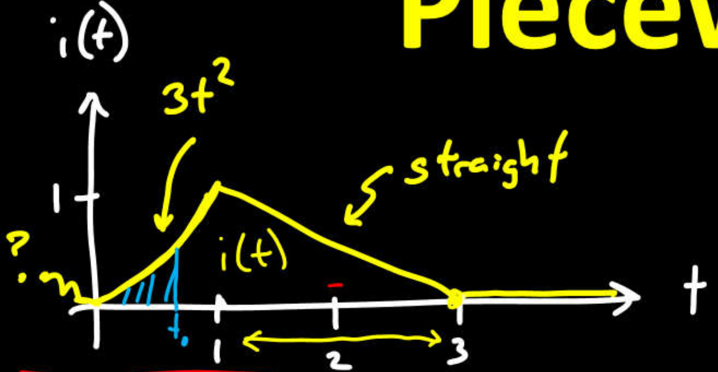

Find $v(t) = \int_{-\infty}^{t} i(\tau)\,d\tau$ for $t \geq 0$ if $v(0) = 2$

$$= \int_{t_0}^{t} i(\tau)\,d\tau + v(t_0)$$

region	$i(t)$	t_0	$v(t_0)$	$v(t) = \int_{t_0}^{t} i(\tau)\,d\tau + v(t_0)$
$0 \leq t < 1$	$3t^2$	0	$v(0) = 2$	$v(t) = \int_0^t 3\tau^2 + 2 = 3 \cdot \frac{1}{3}\tau^3 \Big]_{\tau=0}^{t} + 2 = \tau^3 \Big]_0^t + 2 = \boxed{t^3 + 2}$
$1 \leq t < 3$	$-\frac{1}{2}(t-3)$	1	$v(1) = 1^3 + 2 = 3$	$v(t) = \int_1^t \left(-\frac{1}{2}\tau + \frac{3}{2}\right) d\tau + 3 = -\frac{1}{4}\tau^2 \Big]_1^t + \frac{3}{2}\tau \Big]_{\tau=1}^{t} + 3$ $= -\frac{1}{4}(t^2 - 1) + \frac{3}{2}(t-1) + 3 = -\frac{1}{4}t^2 + \frac{3}{2}t + \frac{1}{4} - \frac{3}{2} + 3$ $= \boxed{-\frac{1}{4}t^2 + \frac{3}{2}t + \frac{7}{4}}$
$t \geq 3$	0	3	$-\frac{9}{4} + \frac{9}{2} + \frac{7}{4} = 4$	$v(t) = \int_3^t 0\,d\tau + 4 = \boxed{4}$

$$\boxed{v(t) = \begin{cases} t^3 + 2, & 0 \leq t < 1 \\ -\frac{1}{4}t^2 + \frac{3}{2}t + \frac{7}{4}, & 1 \leq t < 3 \\ 4, & t \geq 3 \end{cases}}$$