1. Find the derivatives of the following functions:

   a. $v(t) = 2t^2 + 8t + 9$ $\quad \boxed{4t+8}$

   b. $i(t) = \frac{2}{3}e^{-2t}$ $\quad \frac{2}{3}(-2)\,e^{-2t} = \boxed{-\frac{4}{3}e^{-2t}}$

   c. $q(t) = 2k\cos(12t)$ $\quad \boxed{-2k\cdot 12\sin(12t) = -24k\sin(12t)}$

   d. $v(t) = 3e^{-2t}\cos(6t + \frac{\pi}{4})$ $\quad 3\left[e^{-2t}\frac{d}{dt}\{\cos(6t+\pi/4)\} + \frac{d}{dt}\{e^{-2t}\}\cos(6t+\pi/4)\right]$

   $= \boxed{-18e^{-2t}\sin(6t+\pi/4) - 6e^{-2t}\cos(6t+\pi/4)}$

2. Find the integrals of the following functions:

   a. $v(t) = \int_0^2 6\,dt$ $= 6t\Big|_0^2 = \boxed{12}$

   b. $q(t) = \int_0^t 9\tau^2 + \tau\,d\tau$ $= 3\tau^3 + \frac{1}{2}\tau^2\Big|_0^t = \boxed{3t^3 + \frac{1}{2}t^2}$

   c. $i(t) = \int_{-\infty}^2 3e^{4t}\,dt$ $= \frac{3}{4}e^{4t}\Big|_{-\infty}^2 = \frac{3}{4}\left[e^8 - \cancel{e^{-\infty}}^{\,0}\right] = \boxed{\frac{3}{4}e^8} \approx 2236$

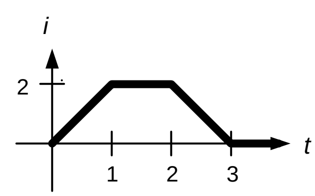
   d. $\omega(t) = \int_t^\infty p(\tau)\,d\tau$ if $p(t) = e^{-2t}$ $= -\frac{1}{2}e^{-2\tau}\Big|_t^\infty = \boxed{\frac{1}{2}e^{-2t}}$

   e. $\omega(t) = \int_{-\infty}^t p(\tau)\,d\tau$ if $p(t) = t$ for $t \geq 0$ and $\omega(0) = 2$. Only solve for $t \geq 0$.

   $= \int_{-\infty}^0 p(\tau)\,d\tau + \int_0^t p(\tau)\,d\tau = w(0) + \int_0^t \tau\,d\tau = 2 + \frac{1}{2}\tau^2\Big|_0^t = \boxed{2 + \frac{1}{2}t^2}$

   f. $q(t) = \int_0^{\pi/4} 3\cos(2t)\,dt$ $= \frac{3}{2}\left[\cancel{\sin\frac{\pi}{2}}^{\,1} - \cancel{\sin 0}^{\,0}\right] = \boxed{\frac{3}{2}}$

3. Find $q(t) = \int_{-\infty}^t i(\tau)d\tau$ for $t \geq 0$ if $q(0) = 2$ and $i(t) =$



t region	$i(t)$	t_0	$q(t_0)$	$\int_{t_0}^t i(\tau)d\tau + q(t_0)$
$0 \leq t < 1$	$2t$	0	2	$\int_0^t 2\tau\,d\tau + 2 = t^2 + 2$
$1 \leq t < 2$	2	1	$1^2+2 = 3$	$\int_1^t 2\,d\tau + 3 = 2t+1$
$2 \leq t < 3$	$-2(t-3)$	2	$2(2)+1 = 5$	$\int_2^t -2(\tau-3)\,d\tau + 5 = -t^2+6t-3$
$t \geq 3$	0	3	$-3^2+6\cdot3-3 = 6$	$\int 0 + 6 = 6$

$$\boxed{q(t) = \begin{cases} t^2+2, & 0 \leq t < 1 \\ 2t+1, & 1 \leq t < 2 \\ -t^2+6t-3, & 2 \leq t < 3 \\ 6, & t \geq 3 \end{cases}}$$