#12 $w'' - 2w' + w = 6t - 2$

$w(-1) = 3$

$w'(-1) = 7$

Let $y(t) = w(t-1)$

$y'(t) = w'(t-1)$

$y''(t) = w''(t-1)$

$$w''(t-1) - 2w'(t-1) + w(t-1) = 6(t-1) - 2$$
$$= 6t - 8$$

So then $\boxed{y''(t) - 2y'(t) + y(t) = 6t - 8}$

$y(0) = 3$

$y'(0) = 7$

$$\left(s^2 Y(s) - 3s - 7\right) - 2\left(sY(s) - 3\right) + Y(s) = \frac{6}{s^2} - \frac{8}{s} = \frac{6 - 8s}{s^2}$$

$$Y(s)\left(s^2 - 2s + 1\right) - 3s - 1 = \frac{6 - 8s}{s^2}$$

$$Y(s)\left(s^2 - 2s + 1\right) = \frac{6 - 8s}{s^2} + \left(3s - 1\right) = \frac{3s^3 - s^2 - 8s + 6}{s^2}$$

$$Y(s) = \frac{3s^3 - s^2 - 8s + 6}{s^2(s-1)^2}$$

So now

$$\frac{3s^3 - s^2 - 8s + 6}{s^2(s-1)^2} = \frac{4}{s} + \frac{6}{s^2} + \frac{-1}{s-1} + \frac{8}{(s-1)^2}$$

$$\frac{A}{s} + \frac{B}{s^2} + \frac{C}{s-1} + \frac{D}{(s-1)^2}$$

Let $s = 2$ $\quad \left(\frac{10}{4} = \frac{A}{2} + \frac{6}{4} + C\right)4$

$10 = 2A + 6 + 4C$

$4 = 2A + 4C$

$A + 2C = 2$

Let $s = -1$ $\quad \left(\frac{10}{4} = -A + 6 - \frac{C}{2}\right)4$

$10 = -4A + 24 - 2C$

$-14 = -4A - 2C$

$2A + C = 7$

$A + 2C = 2$

$2A + C = 7$ $\Big\rangle$ $\quad -2A - 4C = -4$

$2A + C = 7$

$-3C = 3$

$C = -1$

$A - 2 = 2$

$A = 4$

Then $\mathcal{L}^{-1}\left\{\frac{3s^3 - s^2 - 8s + 6}{s^2(s-1)^2}\right\} = 4\mathcal{L}^{-1}\left\{\frac{1}{s}\right\} + 6\mathcal{L}^{-1}\left\{\frac{1}{s^2}\right\} - \mathcal{L}^{-1}\left\{\frac{1}{s-1}\right\}$

$$y(t) = 4 + 6t - e^t$$

So we have $\boxed{y(t) = 4 + 6t - e^{t}}$

and recall $y(t) = w(t-1)$ so $w(t) = y(t+1)$

Then $y(t+1) = w(t) = 4 + 6(t+1) - e^{t+1}$

$$w(t) = 10 + 6t - e^{t+1}$$