$Q_1 \Rightarrow$

$V_n = \text{Span}\{1, x, x^2\}$

$W = e^{-x}$

$x_1 = 1,\ x_2 = x,\ x_3 = x^2$

$v_1 = x_1 = 1$

- $V_2 = x_2 - \dfrac{\langle x_2, v_2 \rangle}{\|v_1\|^2} \cdot V_1$

$$= x - \int_0^\infty x \cdot e^{-x} dx = x - 1$$

- $V_3 = x_3 - \dfrac{\langle x_3, v_1 \rangle}{\|v_1\|^2} \cdot V_1 - \dfrac{\langle V_3, V_2 \rangle}{\|v_2\|^2} V_2$

$$= x^2 - \frac{\int_0^\infty e^{-x} \cdot x^2 dx}{1} - \frac{\int_0^\infty (x-1)\, e^{-x} \cdot x^2 dx}{1} (x-1)$$

$$= x^2 - 2 - 4x - 4$$

$$= x^2 - 4x - 6$$

$\cancel{\{1, x, 1\}}$

$\{1, x-1, x^2 - 4x - 6\}$ is orthogonal on $[0, \infty]$

$\cancel{f}$

$f(x) = e^x \quad [0,2]$

$P_1(x) = a_0 + a_1 x$

$P_1(f) = \int_0^2 [f(x) - p(x)]^2 dx$

$\Rightarrow \int_0^2 e^x \cdot x\,dx = (x-1)e^x \Big|_0^2 = e^2+1$

$\Rightarrow \int_0^2 e^x dx = e^x \Big|_0^2 = e^2 - 1$

$a_0 = (e^2+1)\frac{3}{2} = \frac{3e^2+3}{2}$

$a_1 = (e^2-1)\frac{1}{2} = \frac{e^2-1}{2}$

$P(x) = \frac{3}{2}(e^2+3) + \frac{e^2-1}{2}x$