

$$2.32) \quad |\psi_1| = A_1 e^{-y^2/4}$$

$$|\psi_2| = A_2 y e^{-y^2/8}$$

$$|\psi_3| = A_3 (e^{-y^2/4} + y e^{-y^2/8})$$

$$\int_{-\infty}^{+\infty} |\psi_1|^2 dy = 1$$

$$\int_{-\infty}^{+\infty} A_1^2 e^{-y^2/2} dy = 1$$

$$A_1^2 \int_{-\infty}^{+\infty} e^{-y^2/2} dy = 1$$

$$A_1^2 (\sqrt{2\pi}) = 1$$

$$\underline{A_1 = \pm (2\pi)^{-1/4}}$$

from
Mathematica

$$\int_{-\infty}^{+\infty} |\psi_2|^2 dy = 1$$

$$\int_{-\infty}^{+\infty} A_2^2 y^2 e^{-y^2/4} dy = 1$$

$$A_2^2 \int_{-\infty}^{+\infty} y^2 e^{-y^2/4} dy = 1$$

$$A_2^2 (4\sqrt{\pi}) = 1$$

$$\underline{A_2 = \pm (16\pi)^{-1/4}}$$

from
Mathematica

$$\int_{-\infty}^{+\infty} |\psi_3|^2 dy = 1$$

$$\int_{-\infty}^{+\infty} A_3^2 (e^{-y^2/4} + y e^{-y^2/8})^2 dy = 1$$

$$A_3^2 (5\sqrt{\pi}) = 1$$

from Mathematica

$$\underline{A_3^2 = \pm (25\pi)^{-1/4}}$$

$$\begin{aligned} P_3 &= \int_0^1 |\psi_3|^2 dy = \int_0^1 (25\pi)^{-1/2} (e^{-y^2/4} + ye^{-y^2/8})^2 dy \\ &= 0.201 \quad \text{from Mathematica} \end{aligned}$$

$$\begin{aligned} P_1 &= \int_0^1 |\psi_1|^2 dy = \int_0^1 (2\pi)^{-1/2} e^{-y^2/2} dy \\ &= 0.341 \quad \text{from Mathematica} \end{aligned}$$

$$\begin{aligned} P_2 &= \int_0^1 |\psi_2|^2 dy = \int_0^1 (16\pi)^{-1/2} y^2 e^{-y^2/4} dy \\ &= 0.041 \end{aligned}$$

$$\boxed{P_3 \neq P_1 + P_2}$$

Use the interval $-1 < y < 1$ in the limits

$$P'_3 = 0.233 \quad P'_1 = 0.683 \quad P'_2 = 0.08$$

$$P'_3 \neq P'_1 + P'_2$$

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$$\text{In}[*]:= \int_{-\infty}^{\infty} e^{-y^2/2} dy$$

$$\text{Out}[*]= \sqrt{2\pi}$$

$$\text{In}[*]:= \int_{-\infty}^{\infty} y^2 * e^{-y^2/4} dy$$

$$\text{Out}[*]= 4\sqrt{\pi}$$

$$\text{In}[*]:= \int_{-\infty}^{\infty} \left(e^{-y^2/2} + y * e^{-y^2/8} \right)^2 dy$$

$$\text{Out}[*]= 5\sqrt{\pi}$$

$$\text{In}[*]:= N\left[\int_0^1 (25 * \pi)^{-1/2} \left(e^{-y^2/2} + y * e^{-y^2/8} \right)^2 dy\right]$$

$$\text{Out}[*]= 0.200618$$

$$\text{In}[*]:= N\left[\int_0^1 (2 * \pi)^{-1/2} * e^{-y^2/2} dy\right]$$

$$\text{Out}[*]= 0.341345$$

$$\text{In}[*]:= N\left[\int_0^1 (16 * \pi)^{-1/2} * y^2 * e^{-y^2/4} dy\right]$$

$$\text{Out}[*]= 0.0405543$$

$$\text{In}[*]:= N\left[\int_{-1}^1 (25 * \pi)^{-1/2} \left(e^{-y^2/2} + y * e^{-y^2/8} \right)^2 dy\right]$$

$$\text{Out}[*]= 0.233427$$

$$\text{In}[*]:= N\left[\int_{-1}^1 (2 * \pi)^{-1/2} * e^{-y^2/2} dy\right]$$

$$\text{Out}[*]= 0.682689$$

$$\text{In}[*]:= N\left[\int_{-1}^1 (16 * \pi)^{-1/2} * y^2 * e^{-y^2/4} dy\right]$$

$$\text{Out}[*]= 0.0811086$$