57. (a) We compute

$$\gamma = \frac{1}{\sqrt{1-(0.9990)^2}} = 22.4$$

Now, the length contraction formula (Eq. 38-13) yields

$$L = \frac{2.50 \text{ m}}{\gamma} = 0.112 \text{ m} .$$

(b) (c) and (d) We assume our spacetime coordinate origins coincide and use the Lorentz transformations (Eq. 38-20, but with primes and non-primes swapped, and $v \to -v$). Lengths are in meters and time is in nanoseconds (so that $c = 0.2998$ in these units).

$$\begin{aligned} x_\alpha &= \gamma\,(4.0 + (0.9990c)(40)) = 357 \\ t_\alpha &= \gamma\left(40 + (0.9990c)(4.0)/c^2\right) = 1193 \\ x_\beta &= \gamma\,(-4.0 + (0.9990c)(80)) = 446 \\ t_\beta &= \gamma\left(80 + (0.9990c)(-4.0)/c^2\right) = 1491 \end{aligned}$$

Thus, our reckoning of the distance between events is $x_\beta - x_\alpha = 89.0$ m. We note that event alpha took place first (smallest value of t) and that the time-separation is $t_\alpha - t_\beta = 298$ ns.