Question

Time Dilation: Two observers, A on earth and B in a spacecraft whose speed is $2.00 \times 10^8\, m/s$, both set their watches to the same time when the ship is abreast of the earth. (a) How much time must elapse by A's reckoning before the watches differ by $1.00\, s$? (b) To A, B's watch seems to run slow. To B, does A's watch seem to run fast, run slow, or keep the same time as his own watch?

Solution

a) From A's perspective, time taken for $1s$ to elapse on spacecraft

$$\begin{aligned} t &= \frac{t_0}{\sqrt{1 - v^2/c^2}} \\ &= \frac{1}{\sqrt{1 - (2/3)^2}} \\ &= \frac{1}{\sqrt{5/9}} \\ &= 0.6\sqrt{5} \\ &= 1.34\, s \end{aligned}$$

If n is the number of seconds to elapse by A's reckoning before the watches differ by $1\ s$

$$\begin{aligned} 1(n) &= 1.34(n-1) \\ n &= \frac{1.34}{0.34} \\ &= 3.94\, s \end{aligned}$$

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b) To B, A's watch appears to run slow.
