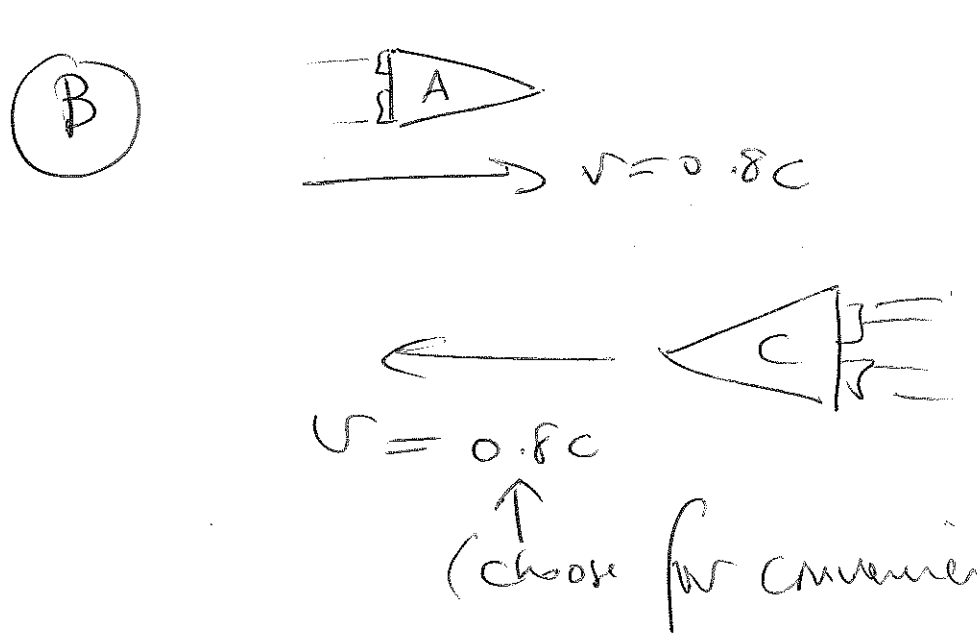
Solutions Sheet 4 — SR



You are C travelling towards B at 0.8c.

In C's frame

(1) B's clocks

For duration of A's journey, time elapsed according to B is 10 years. How long is this according to C's clocks?

C will see B's clocks running slower ∴ More time elapses according to C:

$$T_C = \gamma T_B$$

$$\gamma = \frac{1}{\sqrt{1-0.8^2}} = \frac{1}{0.6} = \frac{5}{4}$$

$$\therefore T_C = \frac{5}{4} \times 10 = 16.6 \text{ years}$$

(2) A's clocks

Now for A's outwards journey we need to work out rel. velocity between A + C

$$v = \frac{0.8c + 0.8c}{1 + 0.8c \times 0.8c/c^2} = \frac{1.6c}{1.64} = \frac{40}{41}c$$

So for A, journey takes 6 years.

During A's 3 years of outward journey, C sees her moving at $\frac{40}{41}c$

$$\therefore T_C = \gamma T_A = \frac{1}{\sqrt{1-\left(\frac{40}{41}\right)^2}} \times 3$$

$$= 4.5 \times 3 = 13.6 \text{ years.}$$

For return journey, A will be at rest rel. to C (both heading towards B at 0.8c)

∴ C will also measure 3 years for A's return journey.

∴ Total time elapsed for C will be

$$13.6 + 3 = 16.6 \text{ years.}$$

So, yes, C agrees that for an elapsed time of 16.6 years, B will age 10 years while A ages just 6 years. ✓