Solution to Relativity Tutorial Q 11

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11) Define Events as follows

B21

B1

A2

A1

E1: Ends A1 and B1 coincide

E2: Ends A2 and B2 coincide

Va = 0.6c Vb =0.8c γa =5/4 γb =5/3

In the ground frame the lengths would appear to be contracted as

La =l0/ γa  = 4m Lb = l0 / γb = 3m

1. Let time in S frame = t

(0.6c)t + (0.8c)t = La + Lb =7m

**Δ t = 1.67 x 10-8 s**

b) Let A1 and B1 coincide at t=0 in S frame

In t = 1.67 x 10-8 s , end A2 moves by

(0.6c)\* 1.67 x 10-8 s = 3m in + X direction

And end B2 moves by

(0.8c)\* 1.67 x 10-8 s = 4m in – X direction

Therefore Δ x = -1 m

Apply Lorentz Transformation,

Δt'=γ(Δt- Δxv/c2)

Δt'=1.25\*(1.67 x 10-8 – (-1)\*(0.6c)/ c2 )

**Δt'= 2.33 x 10-8 s**

c) Similarly ( as in part b)

Δt''=γ(Δt- Δxv/c2 )

**Δt''= 2.33 x 10-8 s**

d) Least possible time is the proper time

Δτ2 = Δt2  - (Δx2 + Δy2 + Δz2 )/c2

Substitute Δ t = 1.67 x 10-8 s and Δ x = -1 m

**Δτ= 1.63 x 10-8 s**

e) The frame in which the time is the least would have

Δ x''' = γ(Δ x-v Δ t) = 0

Therefore,

v= Δ x/ Δ t = (-1)/1.63 x 10-8 s

**v= -0.2c**