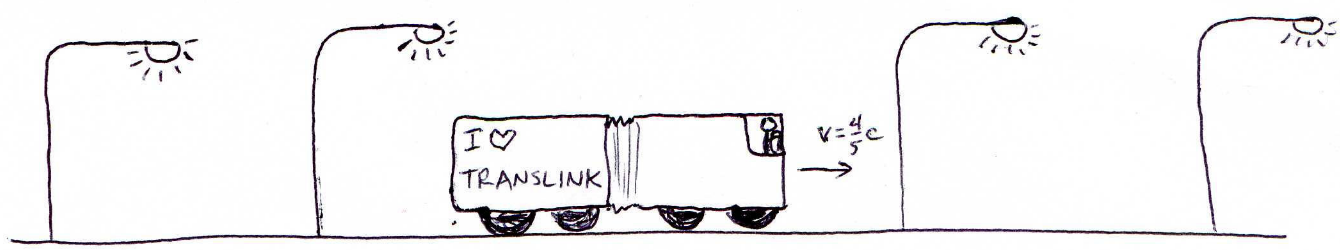


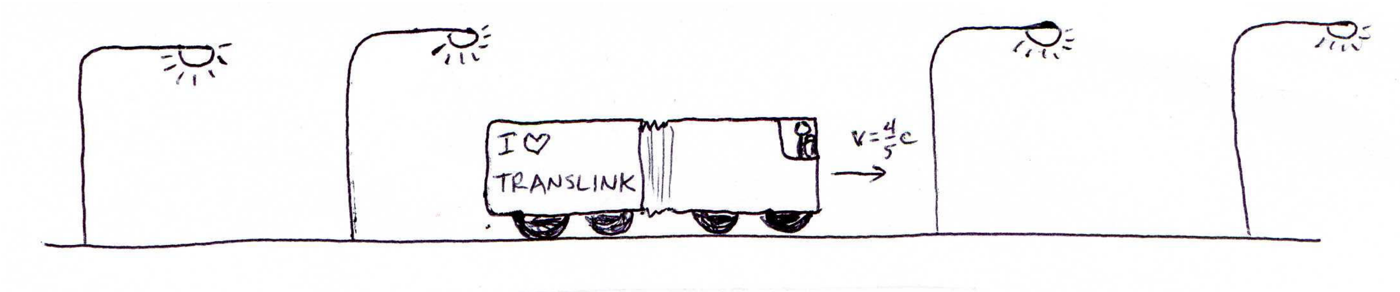
The 99 B-Line bus travels down Broadway Street at speed 4/5c. At 7:00pm, streetlights on Broadway all turn on simultaneously (in the frame of the street). In the reference frame of the bus, the streetlights ahead of the bus turn on:

A) At the same time as the streetlights behind the bus

B) After the streetlights behind the bus

C) Before the streetlights behind the bus

D) There are way too many people on the bus and there is no way to tell which lights come on first since you can't see out any of the windows.



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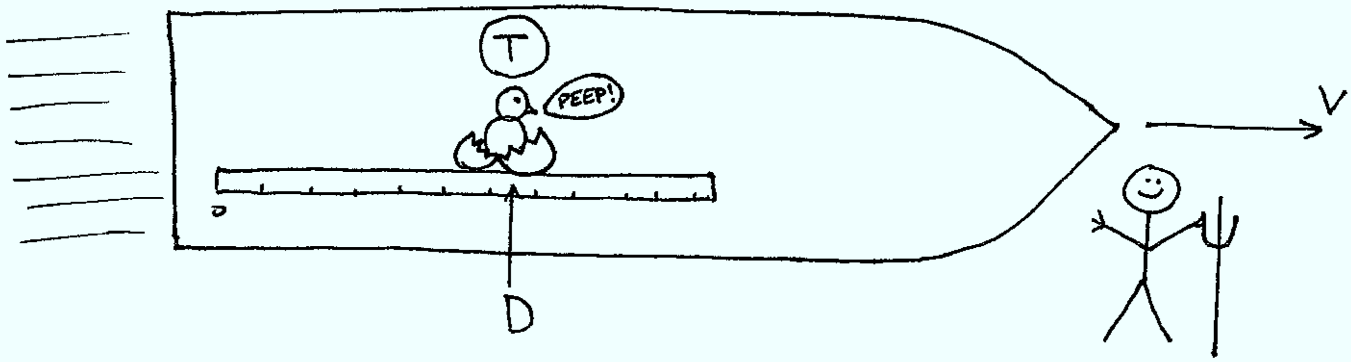
If (x,t) are the coordinates of an event in the frame of the street, the time in the frame of the bus is $t' = \gamma\,(t - v/c^2 x)$. The time t is the same for all the lights turning on, but the position x is larger in front of the bus, so these lights turn on at smaller t' (i.e. before)



At what time does the chicken hatch in the farmer's frame of reference?

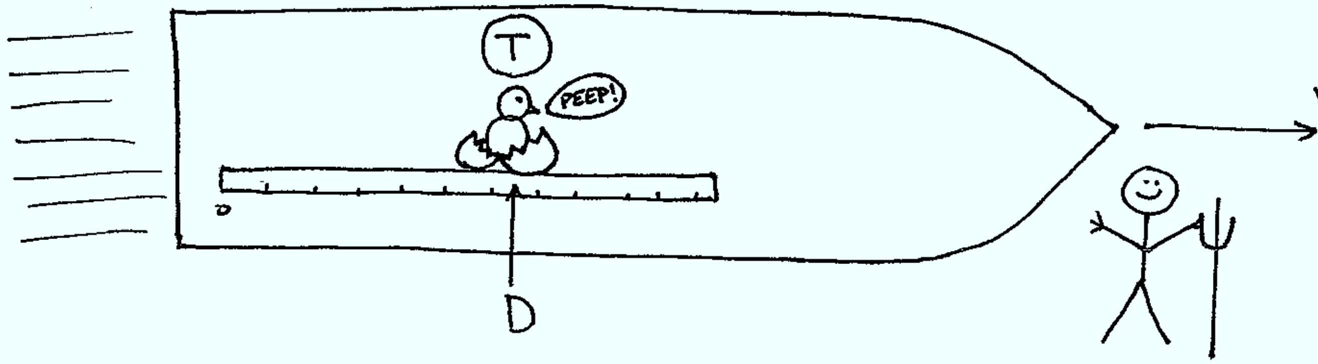
A) T

B) $T \cdot \gamma$

C) T/γ

D) $\gamma\left(T - \frac{v}{c^2} D\right)$

E) $\gamma\left(T + \frac{v}{c^2} D\right)$



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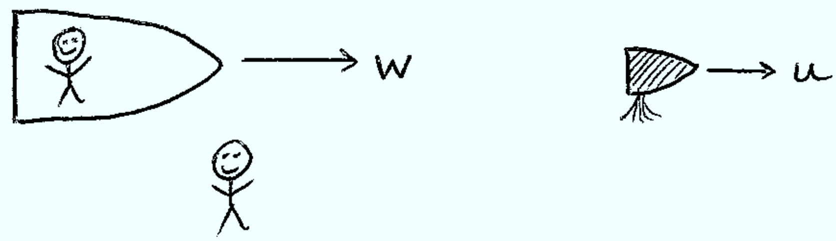
(T, D) coordinates in chicken's frame.

velocity of farmer relative to chicken is

$\underline{\underline{-v}}$

$$\therefore T' = \gamma\left(T - \frac{(-v)}{c^2} D\right)$$
$$= \gamma\left(T + \frac{v}{c^2} D\right)$$

time in farmer's frame



At time T in the frame of the picture, when the small ship is at position X, someone aboard that ship flushes the space-toilet. According to an observer in the frame of the larger ship, when the toilet is flushed, the small ship is at location $x' = \gamma(X - vT)$, where the velocity v is equal to

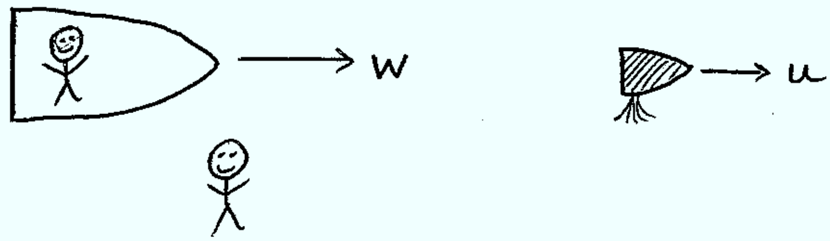
A) w

B) u

C) w - u

D) w + u

E) u - w



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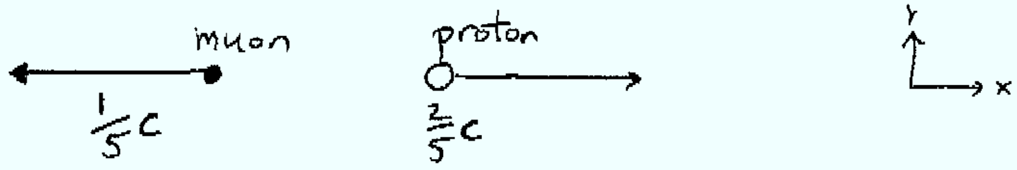
B) u
C) w - u
D) w + u
E) u - w

v in Lorentz tform is ALWAYS the velocity of the S′ frame relative to the S frame.

S′ frame = frame where observers use coords x', t'

S frame = frame where observers use coords. x, t.



What is the velocity of the muon in the proton's frame of reference?

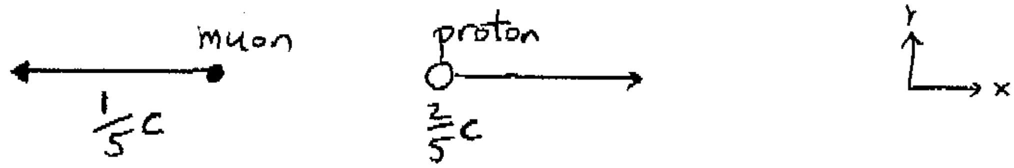
A) $-\frac{15}{23}c$

B) $\frac{5}{23}c$

C) $-\frac{15}{27}c$

D) $-\frac{5}{23}c$

E) $\frac{15}{23}c$



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Have. $u = -\frac{1}{5}c$

$v = \frac{2}{5}c$

$$\therefore\ u' = \frac{u - v}{1 - \frac{uv}{c^2}}$$

$$= \frac{-\frac{1}{5}c - \frac{2}{5}c}{1 + \frac{1}{5}\cdot\frac{2}{5}}$$

$$= -\frac{3}{5}c \times \frac{25}{27}$$

$$= -\frac{15}{27}c$$