the general science journal

Clive Tickner BSC, BA.

cliveticker@aol.com

THE LORENTZ TRANSFORMATION QUIZ

ABSTRACT

Lorentz transformations have a number of unintuitive features that do not appear in Galilean transformations. For example, they reflect the fact that observers moving at different velocities may measure different distances, elapsed times, and even different orderings of events, but always such that the speed of light is the same in all inertial reference frames.

This gives rise to many awkward questions- asked here. The final result may not comply with current physics!

KEY WORDS

Lorentz, Galilean transformation, time dilation, length contraction, light clock, light reflection, frames of reference, photons, speed of light, reciprocal events, moving observers, mathematics.

CONTENTS

THE LORENTZ TRANSFORMATION QUIZ

Believing that time that passes between events is dependant on the motion of the observer, Lorentz constructed an equation to facilitate a precise calculation of this difference.

Firstly let's review a current explanation of the application of the Lorentz Transformation;

Issue1) "Your clock and a photon clock run at different rates. It makes sense that a photon takes time to travel between points if it is moving at a finite speed.

The terms "time dilation" and "length contraction" describe the disagreement about the time and distance between events measured by observers moving at different speeds.

Consider a fast rocket travelling at 80 percent the speed of light (v=0.8c) between two stars that are 4 light-years apart.

Watching from the Earth you observe that the trip takes 5 years";

$$\Delta t = \frac{4\ \text{light-years}}{0.8c} = 5\ \text{years}$$

"However, the mathematics of special relativity (Lorentz transformations) tells us that less time will pass on the rocket's clock because it is moving. There is a "time-dilation factor" γ given by";

$$\frac{1}{\gamma} = \sqrt{1 - \frac{v^2}{c^2}} = 0.6$$

"So, according to the rocket pilot, the trip only took";

$$\Delta\tau = \frac{\Delta t}{\gamma} = 3 \text{ years}$$

"The accepted reason for a rocket being able to travel 4 light-years in only 3 years is that the distance between the stars is *not* 4 light-years in the rocket's frame of reference. From the perspective of the rocket pilot, the rocket has been sitting still for 3 years while one star moved towards it and another moved away, both at the speed of **0.8c**. Thus, the separation between the two is just **2.4** light-years in the rocket's frame of reference".

Issue 2) "Let's extrapolate this result to a photon's frame of reference using v=c". "According to an observer on Earth, the photon takes 4 years to travel the 4 light-years between stars. The time dilation factor becomes";

$$\frac{1}{\gamma} = 0$$

"Extrapolating the example of the pilot, the photon sees one star move toward it and another move away from it at light speed for zero seconds* Thus, according to the photon, there is *no separation* between the two points**.
There is no reason for the time on your watch and that on a photon's watch to progress at the same rate.
Thus, the time that passes on the photon's wristwatch is ... *zero*!"

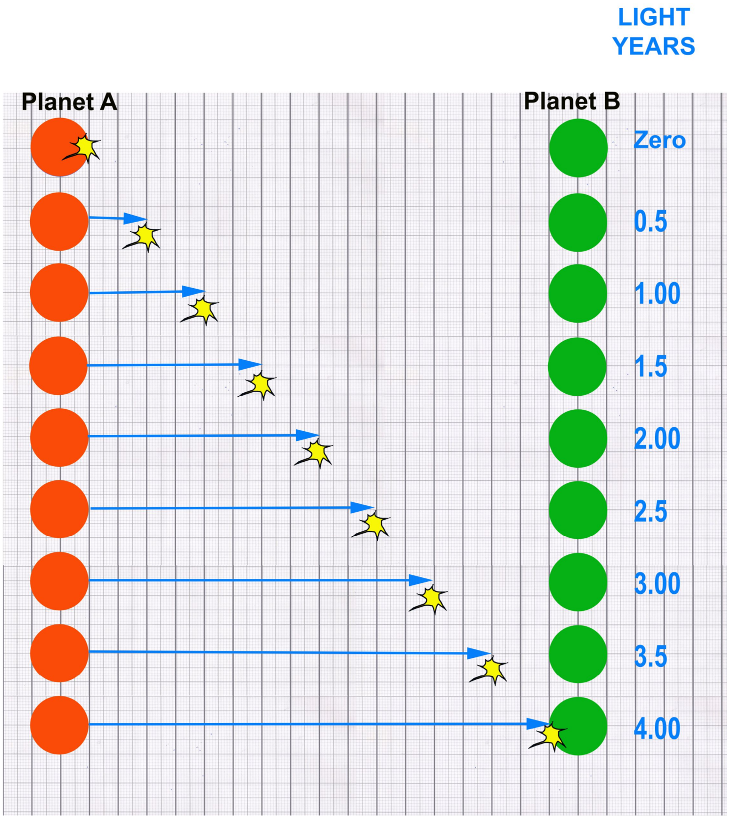
* (the photon 'sees' this implies the impossibility of a photon ever being static)).

**(is the experience of a photon relevant? See question 6)

<u>So that is the given explanation and application of time dilation</u>

Now let us set up matching scenario number 1;

There are two planets, A and B, they are 4 light years apart. Although photons do not 'experience' the passage of time, the chart below is incontestable whilst it demonstrates the time taken for light, emanating from an event on Planet A (a flash for example) to travel towards, and reach, Planet B.



Now let's accept that these two planets are both 4 light years from Earth.
Therefore light from either planet would take 4 years to reach us.

Questions follow where we are marking with an X where we agree with the text

1 Howsoever depicted, the diagram above demonstrates the passage of a flash of light from Planet A to Planet B.

1 Yes , I agree; X	No, it is incorrect;

2 Howsoever the A and B planets may move in the solar system, for this scenario they will maintain a 4 light year physical separation.

2 Yes, ok; X	No, not ok;

Let's populate our scenario with characters and record their interpretation of events.
Person '**a**' lives on planet A and person '**b**' lives on planet B

3 Light from an event on A would be seen by person '**b**' (when received at B) after a period of 4 years.
Light from an event on B would be seen by 'a', (dwelling on A), after 4 years

3 Yes, of course; X	No, it is incorrect;

4 We are on Earth. No matter how far distant we are from these planets, once we see the *initial* event on A occuring, we would expect B to receive that (flash) information after 4 years, *if both planets were equidistant from Earth*.

4 Yes, of course; X	No, it is incorrect

5 So all the characters, so far mentioned, agree that photons, travelling at 'c' would take 4 light years for the light of an event on one planet to reach the other planet.

5 Yes, of course; X	No, it is incorrect

6 Should photons actually be able to wear a wristwatch, the time marked on its dial, having travelled from A to B, (whether 'zero' or 4 light years), is irrelevant to the experience of our characters so far.

6 Yes, of course; X	No, it is incorrect

7 Should there be *any* floating object, mid point between these two planets, vaguely *closing* the distance between B and *increasing* its distance from A, this would not affect the established distance between the two planets

7 Yes, it would;	No, it would not; X

Now we introduce a **rocket** and its **pilot**. He is leaving planet A and his destination is planet B. He travels at 80% the speed of light.

8 This astronaut may consider it to be himself travelling, or he could consider himself to be 'at rest' and the planets A and B to be in relative motion (*along with the rest of the Universe, of course*). Further to that he might agree that it is both the planets *and* his craft, all moving in a relative arrangement.

8 Yes, I accept this circumstance X	No, it is incorrect

9 Now I am sure we all agree that *for us* on Earth, however long it has been since the actual event of the rocket leaving planet A, (due to the time that the information has taken to reach us), the rocket's total journey time, according to Earthly calenders, will be 5 years (at the rocket's agreed speed of 80%c).

9 Yes, of course; X	No, it is incorrect

10 In the reference frame of '**a**', on planet A, he will see a craft take 5 years to reach B from A. (at 80% c)

In the reference frame of **'b'**, on planet B, she will see a craft take 5 years to reach her travelling from A (at 80% c)

10 Yes, of course; X	No, it is incorrect

Now, the theoretical example given at the beginning of this quiz has the rocket taking only 2.4 (or 3) years to reach B, from A, in the reference frame, (and in the opinion and experience of), the pilot.

11 But the conclusion must be for characters 'a', 'b' and 'ourselves on Earth', that we would definitely see the rocket arrive at B after completing a *5 year* journey, (allowing for the transfer time of that information to reach us all).

11 Yes, of course; X	No, it is incorrect

Further open questions;

So, how do we reconcile these time differences and what are the concomitant issues?

12 Will the rocket have used up 2.4 years' worth of fuel or 5 years' worth of fuel?

If objects shrink in the direction of travel at near light speed, will the fuel tanks have burst, given that one cannot compress a liquid?

12

13 Has the astronaut eaten 2.4 years' worth of food, or five years' worth of food?

Has he consumed 2,4 years worth of Oxygen, or 5 years worth of Oxygen?

13

14 How does the pilot reconcile the fact that the light from his take-off flash on A will still take another 1.6 years to reach planet B, although he has already arrived?

14

15 How will '**b**', on planet B, reconcile the fact that the rocket has arrived before its take-off flash, which (as we have already agreed in answer 3) would not be seen by her for another 1.6 years?

15

Now let's add another character. Another astronaut is travelling in the vicinity of our pilot. The relative speed of the reference frame of this new craft clearly differs from our view of the pilot (in the judgment of relativity). Therefore, this new protagonist will have a different perspective on the pilot's arrival at planet B.

Now we could add *fifty* other passing craft, all having differing relative speeds from our pilot. There will, therefore, be a corresponding number of different opinions of our pilot's arrival time at B.

16 How can we resolve the chaotic results of this situation?

16

17 What advantage are we gaining when we attribute different time experiences for moving observers?

17

18 What if we, by reciprocal thought, agree that it's the planets A and B which are moving (along with the rest of the Universe) and it's the *spaceship* at rest? If by this thought, planet B approaches the rocket at 80%c does his 'trip' now take 5 years and person '**b**' on planet B only experience 2.6 years of aging?

18 X This makes a nonsense of the Lorentz Transformation;	Although this is counterintuitive, and makes no logical sense. I am prepared to live in a world of confusion;

So, to move on from the compared experience of several observers we explore that part of the Lorentz transformation that seeks to transform the single experience of a constant velocity object and its relationship to the passage of a light beam.

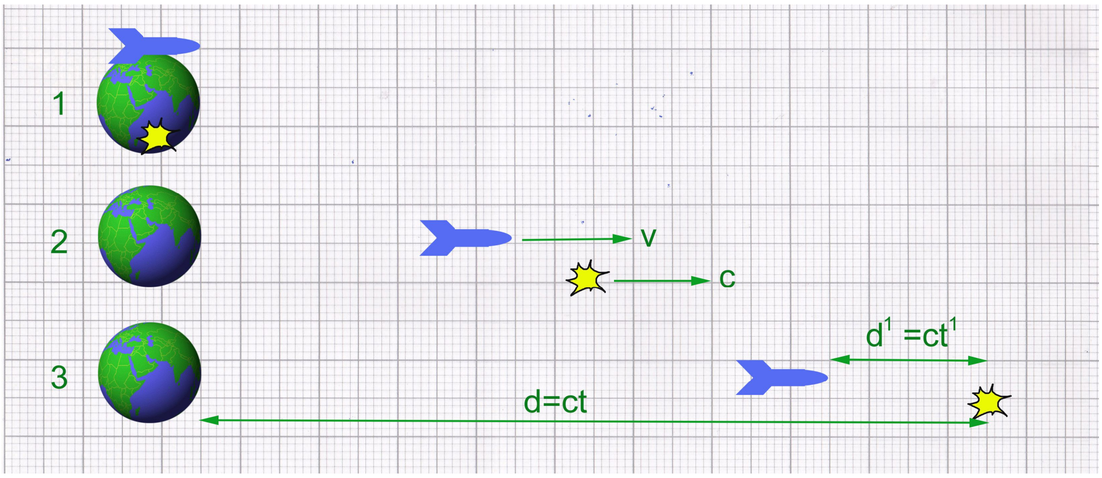
An example given is;

"A spaceship leaves Earth at velocity v and a light pulse is emitted at same time in the same direction. (frame 1 below)

To determine how far the light pulse has travelled from the Earth the displacement is velocity times time. (d=ct).

The spaceship also sees the light pulse travelling at speed c, therefore the distance that the light pulse will have travelled from the spaceship also is $d^1 = ct^1$
(the prime denoting the difference between the two)

As the spaceship is moving with respect to the earth the light cannot be the same distance from both the Earth and the rocket, as the equations suggest, so the conclusion drawn is that time must be different for each reference frame".



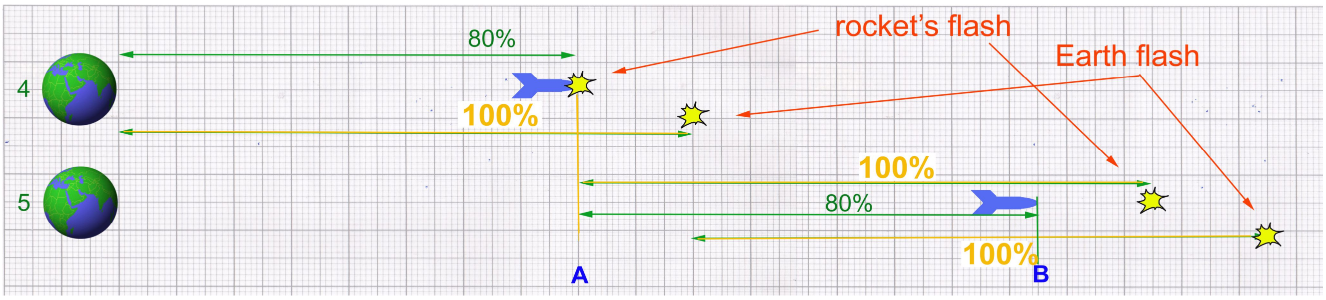
Question 19

Is it *incorrect* to apply the same equation to both situations.

19 X Yes; Although we cannot add or subtract the rocket's *speed* to or from 'c', we *can* add or subtract *distance*, as light obviously takes *longer* to travel *longer* distances. Therefore the 'd's' here are definitely not comparable. The rocket has *not* taken 'no time' to get from frame 1 to frame 3, (at 80% 'c'), and this fact clearly cannot be overlooked or discounted. Wherever the rocket is drawn on this diagram, it does not and cannot influence the line representing the speed 'c' of the flash from Earth. Nor of the flash from the rocket itself.	No; the Lorentz equation stands

20. Although the Lorentz transformation appears to enable one to relate, or locate, two constant velocity objects, does it actually explain the apparent dilemma (inevitably demonstrated in these diagrams) which appears to show that a light flash is being closely chased by the rocket.

20. Yes; It's just counter-intuitive!	No; **X**. The diagrams show graphically the relative speeds of the light flashes and of the rocket. The flashes are clearly travelling at 'c' and the rocket is clearly travelling at 0.08% 'c', as illustrated by the relative number of graph squares (below) each passes. It is disingenuous to consider that the flash should increase its distance, moving away from the rocket at 'c' as such a consideration implies that the speed of the rocket is added to, or subtracted from, the speed of light.



Here we have the same craft, still travelling at 80% speed of light as in diagrams (1), (2) and (3) above.

Having reached position A, (frame 4) where it emits its own flash of light, the rocket progresses to position B, (frame 5) by covering twice the original distance.

In frame (4) the flash of light that occurred on the rocket's take-off (frame 1) has reached beyond A.

At Position B (frame 5) we see the rocket still travelling the graph at 80%c. The Earth's original flash is shown even further ahead, still crossing the graph at 'c'.

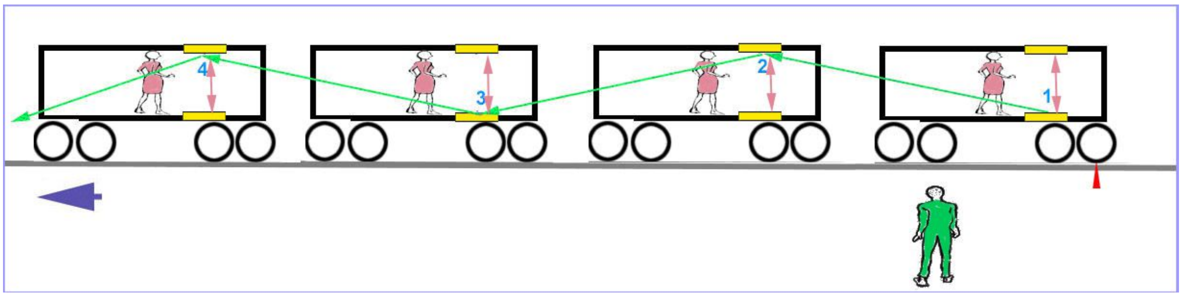
The flash emitted from the rocket at A is obviously ahead of the rocket at B, and not as far forward as that initial flash from Earth.

None of the light paths are affected by the speed or position of the rocket and d can still equal ct, and d^1 can still equal ct^1, because there is an obvious difference in *distance* between d and d^1.

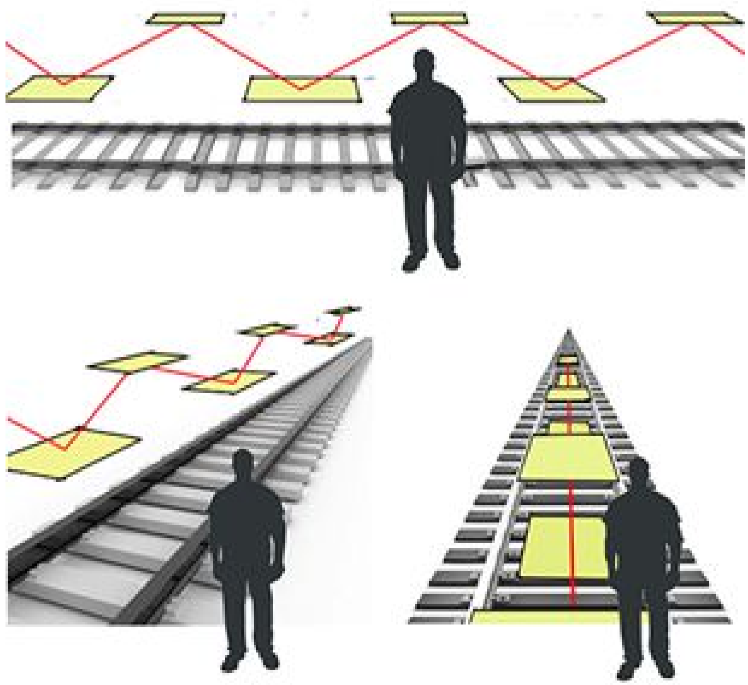
21. Where is the conflict in this straightforward explanation of light's behaviour against the complex sums of Lorentz.

21; **X** This diagram works for me	The Lorentz transformation is required when we need to determine time differences that are not included in the calculations of Galileo

Time differences between two observers are predicated on the theoretical belief that a *travelling* observer, (pink) viewing light bouncing between two accompanying mirrors, sees the light *continue* to bounce through an upright, perpendicular track. Whereas a *stationary* observer, (green) beyond, would see the light follow a diagonal path, as the mirrors move forward each time the light is reflected.



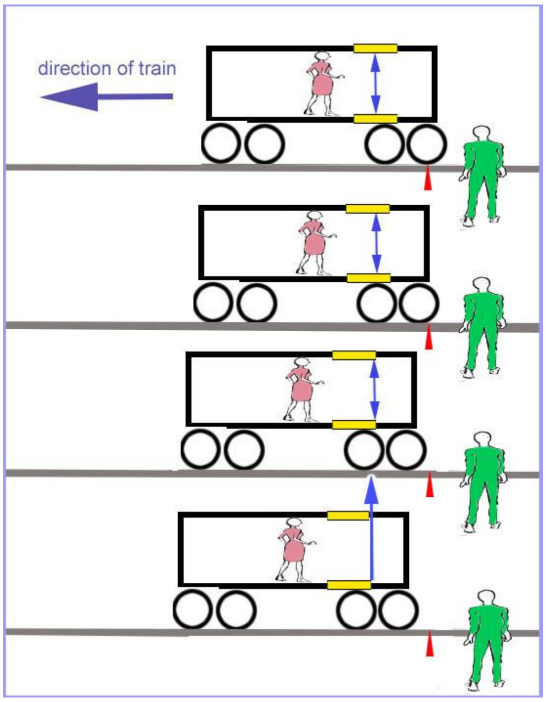
22. What then would happen to the time experiences of additional observers who are not perpendicular to the trains motion and direction? (as in diagram below)



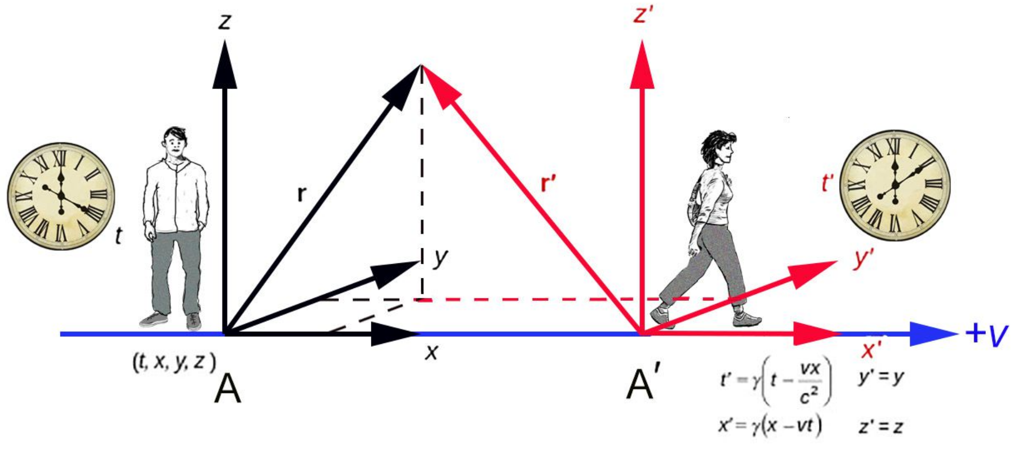
22. X Well, the hypotenuse would *shorten*, until the observer actually standing on the track, seeing the train come towards him, would, like the travelling observer, see an upright line.	But that would blow Einstein's thought experiment.

23. But what about the first observer, perpendicular to the track, (as in question 21), wouldn't he see a diagonal track of light?

23. X No. This is nonsense- the light could not be dragged along by the mirrors, as light is independent of that reference frame. Both observers would see the mirrors move out of the way of the light pulse's path, such that it would, quickly, no longer bounce between them. As in the diagram below. Also consider the scene reciprocally when such time differences would therefore cancel out, negating time dilation.	But we will have to throw out too much current thought to deny this!



24. If, therefore, the time differences calculated in the diagram below are *incorrect*, is it time to re-evaluate and to re-consider time dilation and length contraction?



24; **X** Yes, time contraction and length contraction are predicated on faulty theory and faulty experiment.	But we will have to throw out too much current thought to accept this! Surely maths is incorruptible, it will never generate false conclusions?

How about this example then?

Our Space Pilot stops at a petrol station to fill up his car on the way to the NASA launch base.

He pays $100 to the Attendant for filling the tank.

The Manager spots this transaction as the Pilot climbs back into his vehicle.

The Manager accosts the Attendant saying that we have a special rate for space pilots, you should only have charged him $70, go give him $30 back!

The Attendant approaches the Pilot's car, but sadly he is a dishonest man.

He tells the Pilot that the petrol is 'on offer' at only $90 and gives the Pilot $10 back.

The Pilot drives away happily, he has actually only spent $90. (TRUE)

The Attendant has, in his pocket $20. (TRUE)

The Pilot's $90, with the Attendant's $20 comes to $110.

25. Where did the extra money come from?

25 X mathematics are clearly able to be misread and therefore cannot be considered to be, in all cases, reliable!	I can't answer that.

LOOK BEYOND THE FIGURES

http://gsjournal.net/Science-Journals/Essays-Relativity%20Theory/Download/6738

http://www.gsjournal.net/Science-Journals/Essays-Relativity%20Theory/Download/6227

END.