**Round 2**

Round 2 Experiment 1: Time Dilation

1. **Story Outline**

The experiment involves a spaceship travelling in space freely with a clock present on the spaceship as well as Earth. The velocity of the spaceship can be varied and the effect of Time Dilation can be observed.

1. **Story**
   1. **Set the visual stage discussion:**
2. **Construction of the set-up**

For better visualization, a simulator is provided. Time Dilation is always taught in a theoretical manner but there is always a need of some physical significance. Since performing this experiment in real life is not feasible because of cost issues, a simulation can always act as the best possible alternative. A space ship will be present that is set to move freely in the space on user’s command. Two clocks will be used in the set-up. One will be placed on the spaceship which measures time for the spaceship and the other will be placed on Earth that measures local time.

* 1. **Set User Objectives & Goals:**

1. The prime objective of this experiment is to understand the physical significance of Time Dilation.
2. To understand the working of the phenomenon of Time Dilation.
3. To use the spaceship as a means of transport and understand the difference between two time frames.
4. To let the spaceship move in the free space and note the changes that have happened.
5. To note the difference in time on two different time frames.
6. Compare the observed values.
7. Attempt the assignment questions.
   1. **Set the pathway activities:**
8. The set-up consist of a spaceship which is in space, two clocks kept on earth and space respectively.
9. Additionally there would be a button to increase the speed and reduce the speed of the spaceship.
10. Additionally there would be a ‘start’ button which will start the engine of ship and it will move.
11. You can stop the spaceship anytime you want with the ‘stop’ button and analyze the time between the journeys.
    1. **Set Challenges and Questions/Complexity/Variations in Questions:**
12. A clock is moving with the speed of light c relative to a stationary observer. The observer feels that the clock is
13. Fast
14. Slow
15. Completely stopped
16. None of these
17. Which one is the following is an invariant under Galilean transformations?
18. Velocity
19. Acceleration
20. Momentum
21. None of these
22. An inertial frame of reference is one which
23. Remains at absolute rest
24. Remains at absolute motion
25. Does not accelerate
26. Is attached to an observer
27. The apparent length of a metre stick, as measured by an observer at rest when the stick is moving long its length with a speed (c will be
28. 0.1 m
29. 0.3 m
30. 0.5 m
31. 0.7 m
32. The rest mass of a photon of energy *E* is
33. 0
34. Infinity
35. Ec2
36. E/c2
    1. **Allow pitfalls:**
37. When speed of spaceship is equal to speed of light, the clock will almost stop.
38. When speed of spaceship is greater than speed of light, measurements cannot be taken.
39. MCQ questions have to be answered to enable simulator buttons.

**2.6 Conclusion**

The difference between two time frames has been made clear. Difference of time has been observed for both the clocks, one placed on the moving frame while one on the rest frame.

The clock placed on the rest frame moves faster than the one placed on the moving frame.

* 1. **Equations/Formula**

1. t’ = t /√(1-v2/c2)
2. t’ is the time indicated in the spaceship clock.
3. t is the time on earth’s clock.
4. v is the relative speed of spacecraft w.r.t earth
5. c is the speed of light.
6. **Flowchart**

Press Reset button to reset.

Take readings from both the clocks, compare dilated and proper time.

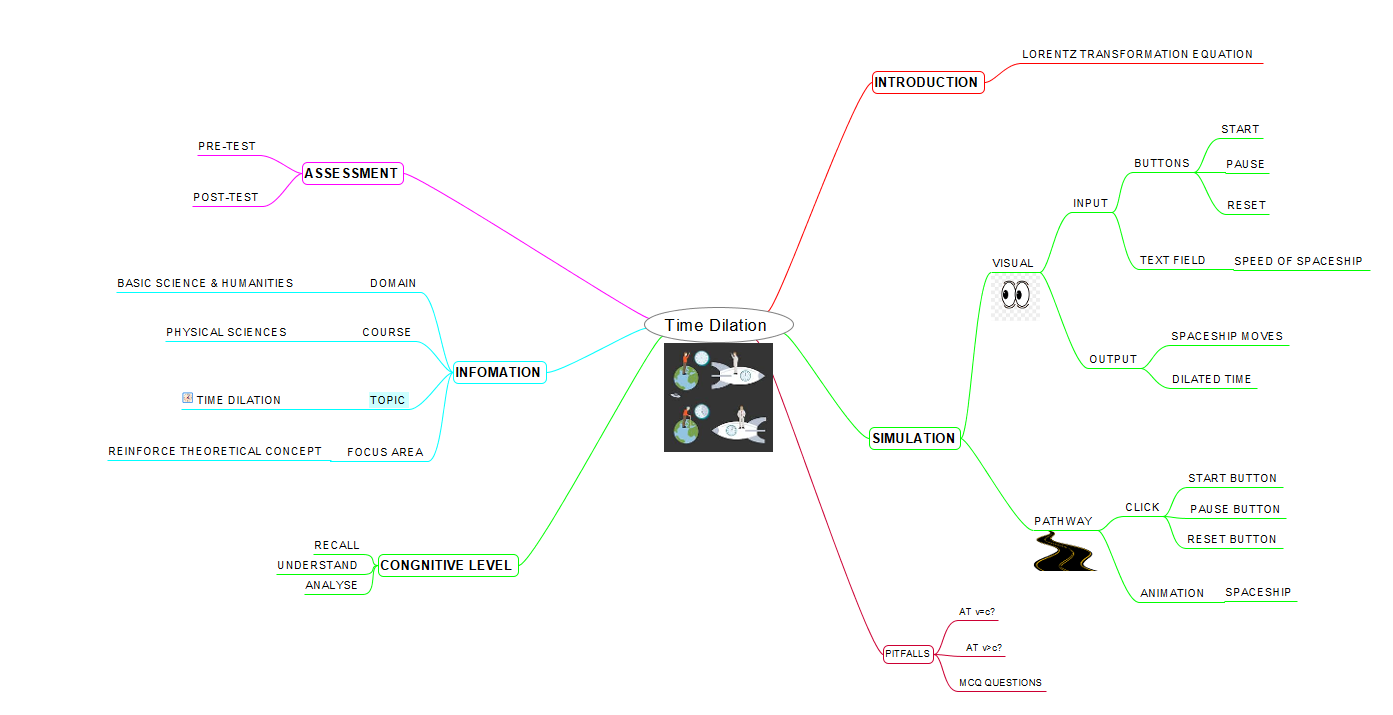
Press the Pause button whenever you want to take observations.

Press the Start button to set the spaceship moving with relativistic speed.

Select two clocks in both inertial frames and synchronize them.

The simulator screen will be displayed. Select Inertial frames.

1. **Mind-map**

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