RELATIVITY (STR)

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Tute 01

1.

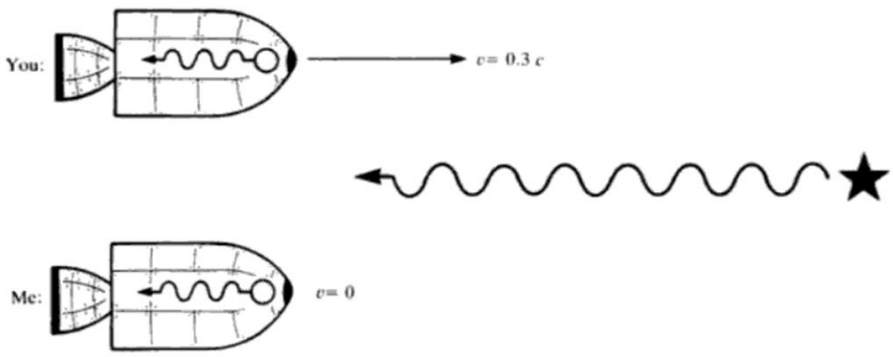


Figure 1

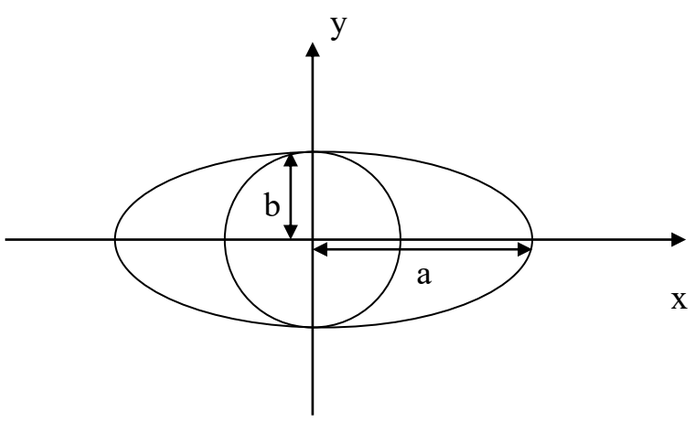
Figure 1 shows a distant star and two rocket ships, my ship at rest with respect to the star and your ship moving towards it at a of *0.3c* Do you and I measure the same speed for the light from the star?

2. Charlie has just caught a lake trout 20 inches long. Zipping by in her motor bike, the game warden sees the fish as 12 inches long. Uh-oh! the minimum length legal length is 16inches. How fast the game warden going?

3. What will be the distance a pion travels before decaying, If its speed is $v = 0.99c$ and its average life time is $2.6 \times 10^{-8} s$? How much will be the distance traveled classically?

4. A rod of length $2l$ is held at an angle of 45^o to the horizontal. It s now projected with a velocity of $0.9c$ along the horizontal such that the rod always keeps the same angle of 45^o during the motion. What will be the length of the rod as seen by,
   (a) An observer stationary on the ground.
   (b) An observer moving with the rod.

5.



An ellipse having an area πab is project with a certain velocity. It was observed that the ellipse appears as a circle of area πb^2. Determine the velocity of projection of the ellipse.(Where ,a > b).

6. The first human trip to the moon took about *three days* (approximately $3\text{x}10^5$ *seconds*) each way. The distance from the earth to the moon is roughly $4\ \text{x}10^8$ *m*. When they returned, how much younger were the astronauts than their twin brother who remained on earth?

7. A certain spectral line in the spectrum of a double star ordinary has a frequency of $0.5\text{x}10^{15}$ *cycles/sec*. If the star is approaching the earth at *200km/sec*, approximately by what fraction $\Delta f / f$ will the frequency be changed?

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Tute 02

8. (a) Derive an expression for variation of mass according to relativistic mechanics.
   (b) The rest mass of the electron is $9\text{x}10^{-31}$*kg*. What will be its mass if it were moving with velocity *0.8c* ?

9. Prove that the velocity of a particle having the rest energy E_0 and kinetic energy K is given by, $v = \dfrac{c\sqrt{K(K+2E_0)}}{K+E_0}$

10. For a particle of the rest mass m_0, relativistic mass m, rest energy E_0 and total relativistic energy E prove the following relations
    (a) $v = \dfrac{c\sqrt{(m+m_0)(m-m_0)}}{m}$
    (b) $v = \dfrac{c\sqrt{(E+E_0)(E-E_0)}}{E}$

11. If *1.0 grm* of matter could be converted entirely into energy, what would be the energy in *kWh* (kilo-watt-hour).

12. A *muon* decays with a mean life-time T_a when it is at rest. *Muons* in motion are observed to decay with a mean life-time $6T_a$. Determine their velocity.

13. What is meant by "**Twin Paradox"** in relativity?

    Let A be the twin on the earth and B be the twin in the ship in the twin paradox episode. Comment on the following statement using your Knowledge of special of relativity.

    "The twin B can go to the future, but can not go to the past"

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