

1. A human spaceship is flying away from the Earth with velocity $c/4$ (with respect to the Earth). The astronauts notice a hostile alien spaceship which is flying in the opposite direction (i.e. towards the Earth). The velocity of the alien spaceship as measured by the human astronauts is $c/2$. The distance between the spaceships and the Earth at the moment when the two spaceships pass each other is 1 light year (from the point of view of people on the Earth).

(a) The human astronauts send a radiomessage to the Earth to warn about the approaching aliens. How long will people on Earth have to prepare for the arrival of the aliens? (That is, what is the time lag between the arrival of the signal and the arrival of the alien spaceship?)

(b) From the point of view of the aliens, how much time will pass between the time they met the human spaceship and the time of their arrival on the Earth?

(c) What is the velocity of the human spaceship as measured by the aliens?

2. According to a Greek myth, gods punished king Sisyphus by making him roll a boulder up a slope, see it roll down, and then repeat this to eternity.

In an alternative Universe, Greek gods punished Sisyphus by making him push a boulder in vacuum for eternity. Suppose the mass of the boulder is 50 kg, and Sisyphus pushes it with the force $F = 500N$ (500 Newton).

(a) What will be the velocity of the boulder after one year if you use Newton's mechanics (i.e. neglect the effects of relativity theory)? What will it be after two years? What will it be after one thousand years? Express the answer as a multiple of c .

(b) Now answer the same questions taking into account that mass increases with velocity. (Hint: it is best to use the formulation of Newton's law which says that change in momentum is equal to force multiplied by the elapsed time. In this case, the initial momentum is zero, so you can find the final momentum simply by multiplying force by the elapsed time. Knowing momentum you should be able to figure out the velocity.)