alpha

$\alpha = \sqrt{1 - \left(\frac{v}{c}\right)^2}$ $\gamma = \frac{1}{\alpha}$
For length contraction or time dilation, *v* is the speed of one reference frame relative to the other reference frame. For an object's total energy or momentum in a reference frame, *v* is the speed of the object in that reference frame.

Given the length of an object in one reference frame,
how to find the length of the object in the other reference frame:
objects that appear to be moving appear to be shorter

First: identify the object, and the two reference frames.	
reference frame in which the object appears to be at rest	reference frame in which the object appears to be moving at speed *v*
object appears to be relatively longer ("rest length", "proper length")	object appears to be relatively shorter (length contraction)

Given the distance between two points in one reference frame,
how to find the distance between the two points in the other reference frame:
points that appear to be moving appear to get closer to each other

First, identify the two points, and the two reference frames.	
reference frame in which the two points appear to be at rest	reference frame in which the two points appear to be moving at speed *v*
distance appears to be relatively longer	distance appears to be relatively shorter

Given the time between two events in one reference frame,
how to find the time between the two events in the other reference frame

First: identify the two events, and the two reference frames.	
reference frame in which the two events appear to occur at different locations	reference frame in which the two events appear to occur at the same location
time between the two events appears to be relatively longer	time between the two events appears to be relatively shorter ("proper time")

Given two of the variables—distance, speed, and time—in one reference frame,
how to find the third variable in the *same* reference frame

$D = v \times t$

relativistic energy and momentum

total energy = $\frac{mc^2}{\alpha}$ momentum = $\frac{mv}{\alpha}$