

# Physics 1D Test One

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Please explain LOTS!!!!!!!!!!!!

Questions 1-5 count, 6 is extra credit.

## 1. TIME DILATION DERIVATION

Derive time dilation from Einstein's assumptions, probably using a light clock.

## 2. TIME DILATION FROM INTERVEL

Show that the fact that interval is independent of the observer implies time dilation.

## 3. SYNCHRONIZING CLOCKS

How are clocks synchronized in relativity? Why not just carry a clock from place to place to synchronize separated clocks? For full example.

## 4. FREE FLOAT FRAME

What is a "Free Float Frame"? What are the limits on the size and time duration of a free float frame? Give examples.

## 5. NUMERICAL TRIP TO FAR GALAXY

You plan to go to a galaxy  $4.8 \times 10^6$  light years away in 49 years of your time. If you express your velocity as the conventional velocity over the speed of light, how much does your velocity differ from 1?

A.  $2.53 \times 10^{-12}$ , B.  $1.82 \times 10^{-11}$ , C.  $3.64 \times 10^{-11}$ , D.  $5.21 \times 10^{-11}$ , E.  $1.6 \times 10^{-8}$

## 6. OBSERVER

Does an "observer" really "see" the things we have been deducing with relativity? Explain lots!

# Physics 1D Test Two

Select the four of questions from 1 to 6 to count.

Select either 7 or 8 for extra credit.

1. **SIMULTANEITY**  
Give an example showing that simultaneity is relative.
2. **LORENTZ AND VELOCITY ADDITION**
  - a. Use the Lorentz transformations to find how velocities add.
  - b. Show that velocities less than  $c$  always add to less than  $c$ .
3. **INVARENCE OF DISTANCES TRANSVERSE RELATIVE TO THE VELOCITY**  
Prove.
4. **INTERVEL**  
Use Einstein's assumptions to prove the invariance of the interval.
5. **NO PAIR PRODUCTION**  
Prove that pair production is impossible in a vacuum
6. **PHOTON BRAKING**  
A moving radioactive nucleus of mass  $M$  emits a gamma ray in the forward direction and drops to a stable state of mass  $m$  and zero velocity. Find the energy of the energy of the gamma ray.

Extra credit possibilities:

7. **TWINS**  
Give a clear resolution of the twin paradox.
8. **POLE VAULTER OR CRUSE MISSILE**  
Give a proof of the result as seen by both observers. Arm waving will not do!

