Exam #1

1) Cosmic Speedometer   *(3 points)*

If you see a person traveling through space at half the speed of light, you will also see his clocks running:

a) at half their normal speed

b) slower than half their normal speed

c) slower, but not slowed to half speed

d) at normal speed

e) backwards

2) High-speed spear   *(3 points)*

A spear 10m long is thrown at a relativistic speed through a pipe that is 10 m long. Both these dimensions are measured when each is at rest. When the spear passes through the pipe, which of the following statements best describes waht is observed?

a) The spear shrinks so that the pipe completely covers it as some point

b) the pipe shrinks so that the spear extends from both ends at some point

c) both shrink equally so the pipe just covers the spear at some point

d) any of these, depending on the motion of the observer

3) Invariants   *(3 points)*

Which of the following are invariant (ie: agreed on by all interital observers)?

a) time ordering of time-like separated events

c) component of the velocity of a pojectile paralell to relative direction of motion

b) component of the velocity of a pojectile perpendicular to relative direction of motion

c) time between events

c) distance between events

c) total particle speed when beta < 1

c) total particle speed when beta = 1

4) Relative velocities *(3 points)*

A rocket ship moving at 0.5c wrt earth fires a missle which moves at 0.8c wrt the rocket. What is the speed of the rocket wrt earth, assuming classical physics (Galilean transformations)? What is the speed of the rocket wrt earth, assuming relativity (Lorentz transformations)?

5) Causality *(3 points)*
a) Argue with a space diagram that casualty (ie: time-ordering) is preserved is causes propogate at beta < 0.

b) Argue with a space diagram that casality (ie: time-ordering) is NOT preserved if beta > 1

6) Michelson and Morely in fixed star frame *(3 points)*

7) Olsen twins   *(3 points)*