Understand the Michelson-Morley Experiment
The speed of light does not depend on the direction of light propagation
Ether does not exist

Know and understand the Postulates of Special Relativity . . . Special = Easy

The two basic postulates of the special theory of relativity are as follows:
• The laws of physics must be the same for all observers moving at constant velocity with respect to one another.
• The speed of light must be the same for all inertial observers, independent of their relative motion.

Consequences
· The distance between two points and the time interval between two events depend on the frame of reference in which they are measured.
· There is no such thing as absolute length or absolute time in relativity.
· Events at different locations that occur simultaneously in one frame are not simultaneous in another frame moving uniformly past the first (i.e. the lightning bolt train)

Understand Time Dilation and Length Contraction

We need to be moving at the same velocity to agree on time and length.

Where the Lorentz factor (γ) is

$$\gamma = \frac{1}{\sqrt{1 - (\frac{v^2}{c^2})}}$$

Time Dilation

Δt' is Proper Time, which is measured by whomever goes along with the clock(or rests with the clock).

$$\Delta t = \Delta t' \cdot \gamma = \frac{\Delta t'}{\sqrt{1 - (\frac{v^2}{c^2})}}$$

Length Contraction

L_p is Proper Length, measured by whomever goes along with the clock (or rests with the clock).

$$L = v\Delta t' = v\frac{\Delta t}{\gamma}$$

$$L_p = v\Delta t$$

$$L = \frac{L_p}{\gamma} = L_p \cdot \sqrt{1 - (\frac{v^2}{c^2})}$$

Understand the addition of velocity in the direction of motion of the moving frame.

u'$_x$ is instantaneous velocity measured in S' and u$_x$ is the velocity component of the object measured in S.

$$u'_x = \frac{u_x - v}{1 - \frac{u_x v}{c^2}}$$

Understand the addition of velocity in the direction perpendicular to the direction of motion of the moving frame.

$$u'_y = \frac{u_y}{\gamma(1 - \frac{u_x v}{c^2})}$$

Understand the relationship between Total Energy (E), Kinetic Energy (K) and Mass Energy ($\mathbf{E_0}$)

Total Energy (E)

$$E = \gamma mc^2 = K + mc^2$$

Kinetic Energy (K)

$$K = (\gamma - 1)mc^2 = \frac{mc^2}{\sqrt{1 - (\frac{u^2}{c^2})}} - mc^2$$

Mass Energy (E_0)

Mass and Energy can be converted to one another. Mass is another form of Energy

$$E = \gamma mc^2 = \frac{mc^2}{\sqrt{1 - (\frac{u^2}{c^2})}}$$

When the object is at rest the rest energy is

$$E = mc^2$$

Momentum

Where m is propper mass (measured by person going along with mass) and u is the velocity of the particle

$$\rho = \gamma mu = \frac{mu}{\sqrt{1 - (\frac{u^2}{c^2})}}$$

Energy-Momentum Relation

$$E = \rho c$$

Understand simultaneous events or the lack of simultaneity

We have to be moving at the same speed to agree. If we move relative to eachother we can not agree.

Know and understand the Mach Principle and the basic concepts of the Theory of General Relativity

Mach Principle of Equivalence

- Inertial force and gravitational force are indistinguishable
- "Gravity and inertia are two ways of looking at the same thing"
- If you're moving at a steady state there's nothing you can do to prove that you are moving

General Relativity

The two postulates of Einsteins general theory of relativity are

• The laws of nature have the same form for observers in any frame of reference, whether accelerated or not.

• In the vicinity of any point, a gravitational field is equivalent to an accelerated frame of reference in the absence of gravitational effects. (This is the principle of equivalence...Mach?)

• Uniform motion is relative

General Relativity and Gravity

• Warped space idea.

• Signal has to make longer trip around the sun.

• As the path got closer to the sun the bending became longer.