In Class Problems–Special Relativity Review

1. The factor $\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}$ appears quite often. Calculate some γ values as follows:
   (a) $v = .1c$
   (b) $v = .6c = \frac{3}{5}c$ (Do this one in fractions, it's nice.)
   (c) $v = .8c = \frac{4}{5}c$ (Do this one in fractions, it's nice.)
   (d) $v = .9c$
   (e) $v = .99c$
   (f) $v = .999c$
   (g) $v = .9999c$

2. Given the Lorentz Transformations from S' to S

$$x = \gamma(x' + vt')$$
$$y = y'$$
$$z = z'$$
$$t = \gamma(t' + \frac{v}{c^2}x')$$

   Derive the other set (ie, with the primes on the LHS).

3. Consequences of the Lorentz Transformations
   (a) Relativity of Simultaneity:
   If two events occur at the same time in S, but at different locations, they do not occur at the same time in S'. If $t_A = t_B$, show that:

$$t'_A = t'_B + \gamma\frac{v}{c^2}(x_B - x_A)$$

   (b) Time Dilation
   Moving clocks run slow. $\tau = \gamma\tau_0$ (I'm using τ as a time interval in one frame or the other, so you don't think t is a particular frame.) Do you remember 'proper time'? Derive the time dilation formula.
   (c) Length Contraction
   Moving objects appear shortened. $L = L_0/\gamma$ Hint: how do you measure length? Derive the length contraction formula.
   (d) Velocity addition:
   Derive:

$$u = \frac{u' + v}{1 + \frac{u'v}{c^2}}$$