Physics 8.20 **IAP 2005**
Introduction to Special Relativity

Final Exam Frequent mistakes

1.

a)everybody got this right. b)"A frame that is not accelerating" Not accelerating with respect to what?
c)"$U = (c, u)$, where u is a 3-velocity" d)"$J = \gamma^3(c, u)$" or "$J = (c, j)$" where j us 3-jerk.
students who did not write the answer of part c) in the form

$$U = \left(\frac{dct}{d\tau}, \frac{dx}{d\tau}, \frac{dy}{d\tau}, \frac{dz}{d\tau}\right)$$

invariably missed part d)

e)"proper acceleration is measured in a frame that is not at rest"
f)"$F = \gamma ma$"
g)$a \cdot b = a_0b_0 + a_1b_1 + a_2b_2 + a_3b_3$ h)$E(v = 0) = 0$ i)not showing asymptote $E = pc$
j)flipping positive and negative β
k)"All frames are equivalent", "the laws of physics takes the same form in all inertial frames"
l)"Yes, we can go to an object's instantaneous rest frame"(True, but not necessary — we can use only inertial frame to work out the equations of motion) m)"twin paradox" (we haven't done this yet, experimentally)
n)many students lacked 1 or 2 of the 3 requested experimental results.

4.

a)
b) not setting starting point correctly (missing -c^2/g)
c) showed assymptotes of A's worldline at 45° from origin. d)some students divided by γ ("$[X_B(0) - X_A(0)]/\gamma$ due to length contraction")
e) ct$'$ not tangent to the worldline of A.
f)" the distance as seen in Σ' is shorter due to length contraction" or "distance is the same because of calibration".
g)most students answered correctly. h)few people recognized that in Σ', B starts moving sooner.
i)"Distance B is contracted in Σ', so A catch B in infinite amount of time" j)yes

5.

a)$\gamma = 1/\sqrt{1-\beta^2} \Rightarrow \gamma = 1/(1-\beta^2)$
b)"$F = ma$", few people explicitly recognized $F = d(\gamma m v)/dt$ and $d\gamma/dt = 0$ for circular motion
c)"$a_x = 1/\gamma^3 \alpha_x$" (using x instead of y) or "$\alpha_y = 1\gamma^2 a_y$"
d)

$$P_1 + P_2 = P_X$$

$$P_1 = (E)p/c, p)$$

$$P_2 = (m_p c, 0)$$

$$P_X = (m_X c, 0)(\texttt{should\ \ be} P_X = (E_X, p))$$

c)no common mistake
f)g) extremely impressed, in general , with the responses.