

State Any Assumptions You Need To Make – Show All Work – Circle Any Final Answers
Use Your Time Wisely – Work on What You Can – Be Sure to Write Down Equations
Short Answers Should Be Short! – Feel Free to Ask Any Questions

“Here From Hype Central at The-Stadium-Formerly-Known-as-Joe Robbie” (50,000 points)



1.) This exam is based on live coverage from the *Nike™-Budweiser®-Apple™-www.nfl.com*-Super Bowl XXXIII™. With five minutes to go in the 2nd Quarter, Bronco QB #7 John Elway drops back and throws a pass that covers 50 yards (45.7 m) in 3.56 seconds. What is the average speed of the football?



(b) The receiver, #80 Rod Smith, then runs with the ball another 40 yards (36.6 m) in 4.11 seconds for a touchdown, making the score 17 - 3 at that point. What is the average speed of the runner?



(c) Find the average speed of the football, from the time John Elway throws it to the time the play is over and the Denver fans are cheering. *This can be solved without the answers to (a) and (b).*



(d) #5 Morton Anderson of the Atlanta Falcons kicked off the football after their “first blood” field goal at 9:24 in the 1st quarter. The ball travels downfield 52 yards (47.5 m) in 5.85 secs. Neglecting air resistance, as usual, find the velocity (speed with direction) of the football in the *y*-direction when it leaves the ground (v_{oy}) and when it lands again (v_y).



(e) How high does the football go? *This can be solved without an answer to (d).*

Reel Stories of The Michigan State Police (50,000 points)

2.) A Michigan State Police cruiser, parked along the side of the road, observes a car driving at fifty-five m.p.h. (24.6 m/s) in a thirty-five m.p.h. (15.6 m/s) speed zone. At the moment that the speeding car passes the state patrolman, she begins to accelerate, from rest, at $a = 2.53 \text{ m/s}^2$. (a) At what *time* will the police car reach the same speed as the speeding car?

(b) At what *distance* will the police car have traveled at the *time* found in (a)? *If you did not get an answer to (a), use $t = 10.0$ seconds.*



(c) How far will the speeding car have traveled in the *same time* as the police car? Has the police car caught up to the speeder yet? Why or why not? *Short answer!! If you did not get an answer to (a), use $t = 10.0$ seconds.*

In a classic *pursuit* problem like this, it is well-known that since both cars must have the same *average* speed (same distance and same time) in order to meet, that the accelerating car must have *twice* the speed of the car undergoing uniform motion. (d) Find the time it takes for the police car to accelerate from rest to 49.2 m/s with $a = 2.53 \text{ m/s}^2$. *In case you care... for constant acceleration, the equation for average speed is $v_{average} = (v+v_0)/2$, and for the cop, $v_0 = 0$.*

(e) Use calculations to show that at the time found in (d), that the two cars have traveled the same distance. *If you are not able to get an answer to (d), then do this problem instead: If the two cars were to meet at $\Delta x = 100.0 \text{ m}$, then calculate the acceleration of each car.*

