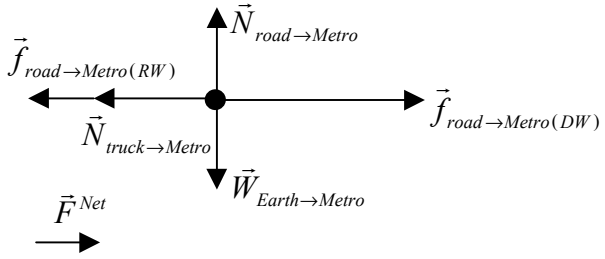
Physics 2048C Test 2 Solutions Dr. Jeff Saul
Fall 2001

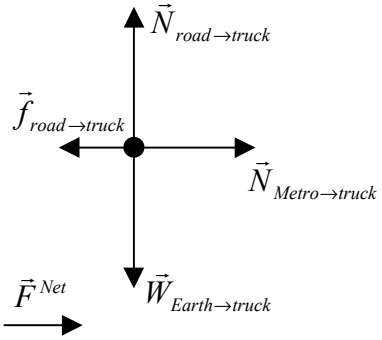
Problem 4 (15 points)

a. Free body diagrams

Geo Metro



Truck



Ranking the horizontal forces

Since the car and truck are accelerating to the right, we know from Newton's 2nd law of motion that the net force must also be to the right. Thus the sum of forces to the right must be greater than the sum of forces on the left. So

$$f_{road\to Metro(DW)} > \begin{matrix} N_{truck\to Metro} \\ f_{road\to Metro(RW)} \end{matrix} \quad \text{and} \quad N_{Metro\to truck} > f_{road\to truck}$$

The following forces are equal because they are a Newton's 3rd law pair

$$N_{Metro\to truck} = N_{truck\to Metro}$$

Since the car and the truck are moving, the resistive friction forces = μ N = μ W (For both the car and the truck vertical acceleration = zero, this implies that N = W for both vehicles.)

Since the mass of the truck is greater than the mass of the Geo Metro

$$f_{road\to truck} > f_{road\to Metro(RW)}$$

Therefore $f_{road\to Metro(DW)} > N_{truck\to Metro} = N_{Metro\to truck} > f_{road\to truck} > f_{road\to Metro(RW)}$

b. From a student paper:

$v_f = 20$ mph $v_i = 0$ mph $\Delta t = 5$ min $= .08\bar{3}$ hr

Looking for a so we can find Δs

$v_f = v_i + a\Delta t$

$a = \frac{v_f - v_i}{\Delta t} = \frac{20\ mph - 0\ mph}{.08\bar{3}\ hr} = 240\ mph/h$

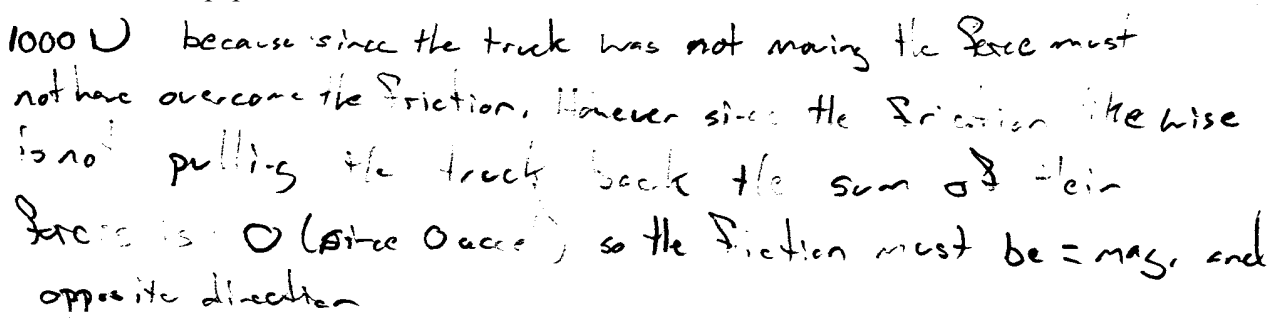
$v_f^2 = v_i^2 + 2a\Delta s$ $a = 240$ mph/h $v_f = 20$ mph $v_i = 0$ mph

$\Delta s = \frac{v_f^2 - v_i^2}{2a} = \frac{20^2 - 0^2}{2(240\ mph/h)} = .8\bar{3}$ mi

Good solution to part b. Note how the student included the given information and what they were trying to find. Also note how the student started from the general equations and solved for the unknowns symbolically before substituting numbers with units.

Problem 4 (cont.)

c. From a student paper:



1000 N because since the truck is not moving, the force must not have overcome the friction, however since the friction likewise is not pulling the truck back (*since the truck is stationary*), the sum of their forces is zero (since 0 accel – *should cite Newton's 1st or 2nd law of motion here*) so the friction must be = mag. and opposite direction. (*Italics – comments by Dr. Saul*)