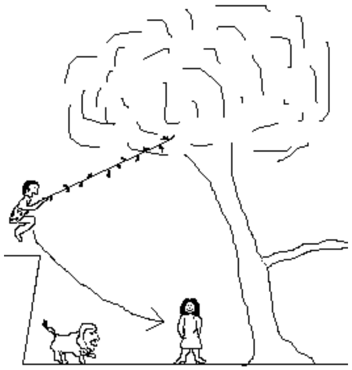
X2.6-8 107

Physics 109 (Kaldon) **Name** ______________________________

WMU - Fall 1998 **Book Title** ______________________________

Exam 2 - 100,000 points Section: 6a 11:00Thu, 6b 12:00Tue, 6c 1:00Thu, 6d 4:00Wed, 7a 9:00Tue, 7b 10:00Wed, 7c 2:00Wed, 7d 3:00Tue, 7e 9:00Thu

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

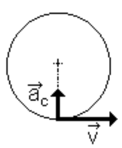


"Me Tarzan – You Jane" (50,000 points)

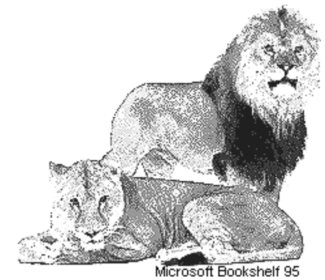
1.) In the movies, Jane is supposed to be a savvy city person, while Tarzan is Lord of the Jungle. One day Tarzan (m = 125 kg) sees a lion (m = 183 kg) sneaking up on Jane (m = 61.25 kg). Tarzan's plan is to swing down on a vine and grab Jane to save her.
(a) Tarzan starts from $y = 9.50$ *m* above Jane. What is his potential energy?

(b) When he reaches Jane, $y = 0$, what is his speed? *Use conservation of energy.*

(c) At the bottom of his swing, we can pretend that he is undergoing Uniform Circular Motion. Find the force that the vine exerts on Tarzan. *HINT: Draw your Free Body Diagram first. Use r = 15.0 meters.*
If you don't have an answer to (b), use v = 10.0 m/s.



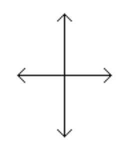
(d) Tarzan grabs onto Jane. Find the speed at which the two of them begin to swing up on the vine. *If you don't have an answer to (b), use v = 10.0 m/s.*



(e) There is a tree branch at $y = 3.50$ *m*. If they can swing up at least that high, they are safe – if they can't, then the lions eat tonight. Show whether the lions go hungry or not. *If you don't have an answer to (d), use v = 10.0 m/s.*

The Invincible Xena – Warrior Princess, Using the Forces of Good Against Evil (50,000 points)

2.) Xena (m = 70.5 kg) is set upon by a bunch of cutthroat goons (m = 105 kg each), so in self-defense Xena beats them all up. She wants to drag them to town to see justice served. (a) If Xena is walking at a constant 1.00 m/s while she is dragging the body of the first goon, then the net force on the body of Goon #1 is *zero*. Right? So take the free body diagram below and label the four forces that are acting *on Goon #1*.



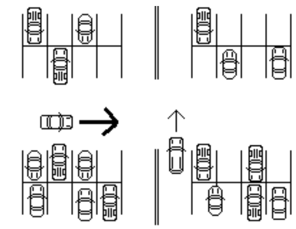
(b) The coefficients of friction between the goon's leather armor and the ground are 0.30 and 0.25 respectively. What is the value of the friction force between Goon #1 and the ground? *If you do not have an answer for this part, use F_f = 200. N as you need in later parts.*

(c) What is the value of the force that Xena pulls on the leg of Goon #1?

The coefficients of friction between Xena's boots and the ground are 0.80 and 0.75. (d) What is the value of the *maximum* friction force between Xena and the ground? *If you don't get an answer here, use F_f = 700. N as needed in later parts.*

(e) What is the *actual* friction force between Xena and the ground, given that she is dragging Goon #1? Can Xena drag more than one of the goons? If so, how many? *Assume the goons are all identical.*

Studio 28: Twenty Movie Screens, Two Thousand Parking Spaces (50,000 points)



3.) A few months ago, as we left Studio 28 in Grand Rapids, I *heard* a car racing along one of the side lanes. As a defensive driver, I slowed and watched them shoot through the intersection without slowing/stopping. The kid's eyes went wide as they saw us, because they were idiots and somehow thought they could race through a parking lot without looking. But suppose I hadn't been so wary… Let the two vehicles have the following numbers: Car #1: 2125 kg, v_x = *28.2 m/s* (about 63 m.p.h.) SUV #2: 2700 kg, v_y = *10.2 m/s* (about 23 m.p.h.). (a) Find the *magnitude (value)* of the total momentum before the wreck. *NOTE: This is a vector problem. If you cannot do this as a vector problem, you may check this box ☐ and do this problem as a head-on collision instead, with a 18,000 point penalty.*

(b) Find the *magnitude (value)* of the total momentum after the wreck. *If you didn't get an answer to (a), use p_x = 64,200 kg·m/s and p_y = 24,100 kg·m/s.*

(c) Find the final velocity vector, $\vec{v}$, of the wreck, after the crash. Give in Standard Form, of course. *If you didn't get an answer to (a), use p_x = 64,200 kg·m/s and p_y = 24,100 kg·m/s.*

(d) The coefficients of static and kinetic friction between asphalt and rubber are 0.95 and 0.82 respectively. Find the friction force that will be causing the sliding wreck to come to a halt. *Hint: the wreck is just the two vehicles combined.*

(e) How far does the wreck slide along the parking lot before it comes to rest? *If you didn't get an answer to (d), use F_f = 25,000 N. If you didn't get an answer to (c), use v_{after} = 19.0 m/s. Assume that the wreck won't run into any parked cars (!).*