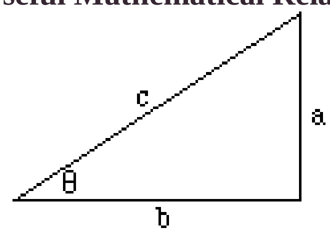
PHYSICS 1301.1 GROUP QUIZ 2 October 18, 2001

This is a closed book, closed notes quiz. Calculators are permitted. The **ONLY** formulas that may be used are those given below. Define all symbols and justify all mathematical expressions used. Make sure to state all of the assumptions used to solve a problem. For this problem, credit is given only for a logical and complete solution that is clearly communicated. Partial credit will be given for a well communicated problem solving strategy based on correct physics such as the strategy illustrated in the Competent Problem Solver. MAKE SURE YOUR NAMES AND ID #s, SECTION #, and TA's NAME ARE ON EACH PAGE!! The problem is worth 25 points: In the context of a unified solution, a useful picture, defining the question, and giving your approach is worth 6 points; a complete physics diagram defining the relevant quantities, identifying the target quantity, and specifying the relevant equations is worth 7 points; planning the solution by constructing the mathematics leading to an algebraic answer and checking the units of that answer is worth 7 points; calculating a numerical value with correct units is worth 3 points; and evaluating the validity of the answer is worth 2 points.

Useful Mathematical Relationships:



For a right triangle: $\sin\theta = \frac{a}{c}$, $\cos\theta = \frac{b}{c}$, $\tan\theta = \frac{a}{b}$,

$a^2 + b^2 = c^2$, $\sin^2\theta + \cos^2\theta = 1$

For a circle: $C = 2\pi R$, $A = \pi R^2$

For a sphere: $A = 4\pi R^2$, $V = \frac{4}{3}\pi R^3$

If $Ax^2 + Bx + C = 0$, then $x = \frac{-B \pm \sqrt{B^2 - 4AC}}{2A}$

$\frac{d(z^n)}{dz} = nz^{n-1}$, $\frac{d(\cos z)}{dz} = -\sin z$, $\frac{d(\sin z)}{dz} = \cos z$, $\frac{df(z)}{dt} = \frac{df(z)}{dz}\frac{dz}{dt}$

Fundamental Concepts and Principles:

$v_{av\,x} = \frac{\Delta x}{\Delta t}$	$s_{av} = \frac{dist}{\Delta t}$	$a_{av\,x} = \frac{\Delta v_x}{\Delta t}$	$\frac{d\theta}{dt} = \frac{v}{r}$
$v_x = \frac{dx}{dt}$	$s = \frac{dr}{dt}$	$a_x = \frac{dv_x}{dt}$	$\sum F_x = ma_x$

Under Certain Conditions:

$x = \frac{a_x}{2}(\Delta t)^2 + v_{xo}\Delta t + x_o$	$a = \frac{v^2}{r}$	$F = \mu_k F_n$	$F \le \mu_s F_n$

Useful constants: 1 mile = 5280 ft, g = 9.8 m/s² = 32 ft/s², 1 km = 5/8 mile

1. You have been asked to help design an emergency baggage handling system for the airport that will function if the electricity goes out. In the design, a container holding luggage is set on a flat cart that rolls up a ramp. The cart is pulled up the ramp by a cable parallel to the ramp that goes over a pulley at the top of the ramp. The other end of the cable is attached to a hanging weight. Your job is to program a battery powered computer so that it gives the mass of the hanging weight that will pull the cart up the ramp as fast as possible without the luggage container falling off the cart. The inputs to the computer are the mass of the cart, the mass of the container with luggage, the angle the ramp makes with the horizontal, the coefficients of both static and kinetic friction for cart-container surface contact.