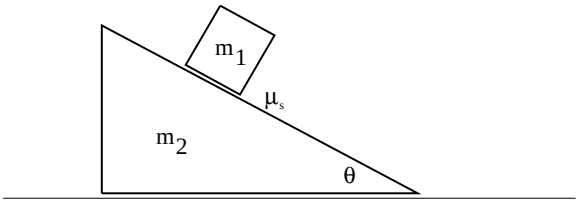
Physics 3344 **Professor Scalise**
Spring 2000 **Assignment #9**

Due: 28 March 2000

1. A block of mass m_1 sits on a wedge of mass m_2 tilted at angle θ from the horizontal. The surface between the box and the wedge has coefficient of static friction μ_s while the surface between the wedge and the Earth is smooth. The system is in static equilibrium.



   (a) Sketch free-body diagrams for the box, the wedge, and the Earth, labeling the forces carefully.

   (b) In words, explain what each force acts on and what causes the force.

   (c) Identify all action-reaction pairs.

   (d) Give the magnitudes of all the forces you have drawn in terms of the givens: m_1, m_2, θ, and μ_s.

2. A boat can travel at 5 m/s in still water. A river 100 m wide is flowing at 3 m/s due North.

   (a) What is the shortest time it takes to cross the river?

   (b) At what angle must the bow point in order for the boat to cross the river in a straight line perpendicular to the river? (Quote the answer as, for example, 20° North of East.)

   (c) How long does this take?

3. An elevator has acceleration $\vec{a}_{eg}$ with respect to the ground. Find the acceleration (magnitude and direction) of a point mass inside the elevator as measured by an observer inside the elevator if

   (a) $\vec{a}_{eg} = 2$ m/s^2 up

   (b) $\vec{a}_{eg} = 2$ m/s^2 down

   (c) $\vec{a}_{eg} = 9.8$ m/s^2 down

   (d) $\vec{a}_{eg} = 15$ m/s^2 down

   (That is, find the *effective* gravity inside the elevator.) Where will a helium balloon be found, on the ceiling or on the floor of the elevator for each case?

4. A point mass is subject to the time-dependent driving force $F(t) = F_0 \sin(\omega t)$ in one dimension.

   (a) If the mass starts from rest at the origin at time 0 seconds, what is the position of the particle for all future times?

   (b) Plot the position $x(t)$ versus time.

   (c) How many times does the particle pass through the origin?

5. A parachutist falls from rest in gravity and experiences (hopefully) aerodynamic drag $\vec{F}_{Aero} = -cv\vec{v}$. Find:

   (a) $v_{terminal}$

   (b) $v(t)$

   (c) $x(t)$

6. Solve the previous problem, part (c), by numerical methods. DO NOT use your derived expression for $v(t)$, but instead integrate the force directly, as in the lecture notes.

   Use:

   $m = 70$ kg $\qquad t_0 = 0$

   $c = 0.3$ N.s^2/m^2 $\qquad x_0 = 0$

   $v_0 = 0$

   (a) Generate a table

	$x(t)$			
t (sec)	$\Delta t = 1$ sec	$\Delta t = 0.1$ sec	$\Delta t = 0.01$ sec	Theory
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

   (b) Plot the four curves.

7. Marion & Thornton 2-12.

8. Marion & Thornton 2-27.