Due: 28 September 2006

1. 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 from anywhere on the west bank to anywhere on the east bank?

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

   (c) How long does the due east path take?

2. A plumb bob hangs from the ceiling of a car. What angle does the bob make with the vertical if

   (a) the car accelerates at 2 m/s^2 along a straight highway?

   (b) the car has instantaneous speed 20 m/s around a turn with radius of curvature 50 m?

3. An elevator in a building has the accelerations listed below. For each, what is the effective weight of a 100 kg passenger, that is, what would a bathroom scale read? Also, describe the locations of a baseball and a helium balloon in the elevator.

   (a) 2 m/s^2 up

   (b) 2 m/s^2 down

   (c) 9.8 m/s^2 down

   (d) 15 m/s^2 down

4. 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) $x(t)$

5. 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?