9th Assignment, due Monday **December 07th** (class, no later than 11:30 am) -
distributed November 25th   (this is not mandatory) TOTAL: 35 points

Please note your name clearly on your solutions, number the pages and write notes
along the way, so that it is easy to follow your thought process.
No pencil!

1.) Explain in your own words: (10 points)
a) Spring A is stiffer than spring B ($k_A > k_B$). The spring force of which spring does more
   work if the springs are compressed the same distance?
b) If you were to build an apparatus to help you fly, what do you have to consider?
c) Materials A, B and C are solids that are at their melting temperatures. Material A
   requires 200 J to melt 4 kg, material B requires 300 J to melt 5 kg, and material C
   requires 300 J to melt 6 kg. Rank the materials according to their heats of fusion,
   greatest first.
d) The doppler shift and its origin.
e) The difference between angular momentum and linear momentum.

2.) A grindstone rotates at constant angular acceleration α = 0.35 rad/s^2. At time t = 0 s,
   it has and angular velocity of ω_0 = -4.6 rad/s and a reference line at the angular
   position Θ_0 = 0. (Remember that the signs in rotational motion give the direction)
(a) At what time after t = 0 s is the reference line at the angular position Θ = 5 rev?
(b) Describe the grindstone's rotation between t = 0 s and t = 32 s.
(c) At what time t does the grindstone momentarily stop?
   (4 points)

3.) The maximum pressure amplitude ΔP_m that the human ear can tolerate in loud
   sounds is about 28 Pa. What is the displacement amplitude s_m for such a sound in
   air of density ρ = 1.21 kg/m^3, at a frequency of 1000 Hz and a speed of 343 m/s?
   (3 points)

4.) Bats navigate and search out prey by emitting, and then detection reflections of,
   ultrasonic waves, which are sound waves with frequencies greater than can be
   heard by a human. Suppose a bat emits ultrasound at frequency f_{be} = 82.52 kHz
   while flying with velocity v_b = (9.00 m/s) as it chases a moth that flies with velocity
   v_m = (8.00 m/s). What frequency f_{md} does the moth detect? what frequency f_{bd} does
   the bat detect in the returning echo from the moth?
   (4 points)

5.) On a hot day in Las Vegas, an oil trucker loaded 37000 liter of diesel fuel. He
   encountered cold weather on the way to Payson, Utah, where the temperature was
   23.0 K lower than in Las Vegas, and where he delivered his entire load. How many
   liters did he deliver? The coefficient of volume expansion for diesel fuel is 9.50 x
   10^{-4}/C°, and the coefficient of linear expansion for his steel truck is 11 x 10^{-6}/C°.
   (3 points)

6.) Two-dimensional explosion: A firecracker placed inside a coconut of mass M, initially at rest on a frictionless floor, blows the coconut into three pieces that slide across the floor. An overhead vies is shown below. Piece C with mass 0.30M, has a final speed v_{fC} = 5.0 m/s. Define the x axis as the direction which particle A is flying. Therefore the angle between the direction of piece B and the x axis is 50° and the angle between the direction for piece C and the x axis is 80°.
 (a) What is the speed of piece B, with mass 0.20M?
 (b) What is the speed of piece A?
     (4 points)
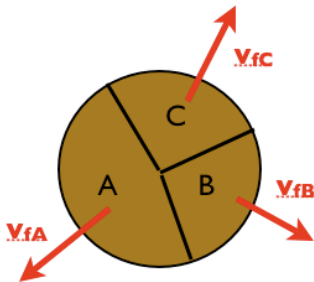
7.) A playful astronaut releases a bowling ball of mass m = 7.20 kg into circular orbit about Earth at an altitude h of 350 km.
(a) What is the mechanical energy E of the ball in its orbit?
(b) How does this change when he does the same thing at Jupiter?
(c) What is the mechanical energy E_0 of the ball on the launch pad at Cape Canaveral (back on earth)? From there to the orbit, what is the change ΔE in the ball's mechanical energy?
    (4 points)

8.) A surfer rides on the front side of a wave, at a point where a tangent of the wave has a slope of Θ = 30.0°. The combined mass of surfer and surfboard is m = 83.0 kg, and the board has a submerged volume of V = 2.50 x 10^{-2} m³. The surfer maintains his position of the wave as the wave moves at constant speed toward shore. What are the magnitude and direction of the drag force on the surfboard from the water? (draw a free body diagram including angles and forces. Choose the x direction in direction of the surfers movement up the wave.)
    (3 points)