**FINAL. PHYS 203. FALL 2002. 12/17/02**

**NAME:**

- Please do all the problems.
- The grades will be posted in my office (Levich Institute, Steinman Hall, T1M-12) Friday December 20 in the morning.
- Good luck!!

**1.** Kinematics.

A dolphin leaps from the water with an initial speed of 12 m/s. It jumps directly toward a ball held by the trainer a horizontal distance of 5.50 m away and a vertical distance of 4.10 m above the water. If the trainer releases the ball the instant the dolphin leaves the water, show that the dolphin and the falling ball meet.

**2. Newton's Laws of Motion**.

Find the acceleration of the masses and tension in each cord given that $m_1 = 1.0$ kg, $m_2 = 2.0$ kg, and $m_3 = 3.0$ kg.

**3. Energy conservation and dissipation.**

The figure shows a 1.50-kg block at rest on a ramp of height $h$. When the block is released, it reaches the bottom of the ramp and moves across a surface that is frictionless except for one section of width 10.0 cm that has a coefficient of kinetic friction $\mu_k = 0.640$. Find $h$ such that the block's speed after crossing the rough patch is 3.50 m/s.

**4. Rigid objects in equilibrium.**

An 85-kg person stands on a lightweight ladder (zero weight). The floor is rough; hence it exerts both a normal force, $f_1$, and a frictional force, $f_2$, on the ladder. The wall, on the other hand, is frictionless; it exerts only a normal force, $f_3$. Using the dimensions given in the figure, find the magnitude of the forces.

**5. Conservation of momentum and energy conservation**

A bullet of mass $m = 0.5$ kg embeds itself in a block of mass $M = 1.2$ kg, which is attached to a spring of force constant $k$= 245 N/m. If the initial speed of the bullet is $v_0 =$ 1.32 m/s, find the maximum compression of the spring.

**6. Fluids**

A stream of water exits from the bottom of a can and land in a second can as shown in the figure. The top of the second can is 0.50 m below the hole in the first can, which has water in it to a depth of 0.150 m. Find the distance $D$.

**7. Temperature and heat**

A 0.500-kg block of metal with an initial temperature of 30.0°C is dropped into a container holding 1.12 kg of water at 20.0°C. If the final temperature of the block-water system is 20.4°C, what is the specific heat of the metal? Assume the container can be ignored, and that no heat is exchanged with the surroundings. [specific heat of water: $c_w = 4186$ J/(kg K)].

**8. Ideal Gas.**

A measuring cylinder of cross-sectional area $A$ is fitted with an airtight piston that is free to slide up and down. Contained within the cylinder is an ideal gas. Initially the pressure applied by the piston is 130 kPa and the height of the piston above the base of the cylinder is 25 cm. When the additional mass is added to the piston, the pressure increases to 170 kPa. Assuming the system is always at the temperature 290 K, (a) find the new height of the piston. (b) What pressure would be required to change the height of the piston to 29 cm?