Note: Show your work and put a box around your answer.

Short Questions (8 points each):

1. A teacher sends her students on a treasure hunt. She gives the following instructions: Walk 300 m north, then walk 400 m northwest, then walk 700 m southwest and the treasure is buried there. As all the other students walk off following the instructions, physics student Jane quickly adds the displacements and walks in a straight line to find the treasure. How far and in what direction does Jane need to walk? [LO 1, 2, 6, 9]

2. A ball is tied to the end of a cable of negligible mass. The ball is spun in a circle with a radius of 2.00 m making 7.00 revolutions every 10.0 secs. What is the magnitude of the acceleration of the ball? [LO 10, 16, 19]

3. A 50.0-N box is sliding on a rough horizontal floor, and the only horizontal force acting on it is friction. You observe that at one instant the box is sliding to the right at 1.75 m/s and that it stops in 2.25 s with uniform acceleration. What magnitude force does friction exert on this box? [LO 14, 21, 23, 26]

4. You want to swim straight across a river that is 76.0 m wide. You find that you can do this if you swim at an angle of $\theta = 28^\circ$ from the upstream direction at a constant rate of 1.5 m/s relative to the water. At what rate does the river flow? The angle $\theta$ is measured from the river bank (directly upstream is $\theta = 0^\circ$ while directly across the river is $\theta = 90^\circ$). [LO 1, 9, 20]

5. A person of mass 70 kg is going up on an elevator accelerating at $1.2 \text{ m/s}^2$. What would a scale under his feet read? [LO 3, 21, 23, 26]

Long Problems (15 points each)

1. Catapult Problem: Catapults date from thousands of years ago, and were used historically to launch everything from stones to horses. During a battle in what is now Bavaria, inventive artillerymen from the united German clans launched giant spaetzle from their catapults toward a Roman fortification whose walls were 8.50 m high. The catapults launched spaetzle projectiles from a height of 3.30 m above the ground, and a distance of 39.1 m from the walls of the fortification at an angle of 60.0 degrees above the horizontal. The projectiles were to hit the top of the wall, splattering the Roman soldier atop the wall with pulverized pasta. (For the following questions, ignore any effects due to air resistance.) (a) What launch speed was necessary? (b) How long were the spaetzle in the air? (c) At what speed did the projectiles hit the wall? [LO 1.1, 1.2, 2, 3.1, 3.2, 5, 14.1, 14.2, 14.3]
2. A pendulum of length $L$ with a bob of mass $m$ swings back and forth. At the lowest point of its motion, the tension in the string is $(3/2)mg$. What is the speed of the bob at this point? [LO 3, 9, 16, 21, 23, 24]

3. The two blocks shown are connected by a heavy uniform rope of mass 4.00 kg. An upward force of 200 N is applied as shown. A) Draw the free-body diagrams for each of the 3 objects. B) What is the acceleration of the system? C) What is the tension at the top of the heavy rope? D) What is the tension at the midpoint of the heavy rope? [LO 3.1, 3.2, 3.3, 23.1-4, 24.1-6, 21.1-3]