PART I Problems

Problem 2

Egg Drop. You are on the roof of the physics building, 46.0 m above the ground. Your physics professor, who is 1.80 tall, is walking alongside the building at a constant speed of 1.20 m/s. If you wish to drop an egg on your professor's head, where should the professor be when you release the egg? Assume that the egg is in free fall.

ANSWER: the professor should be a distance 3.60 m away from the building.

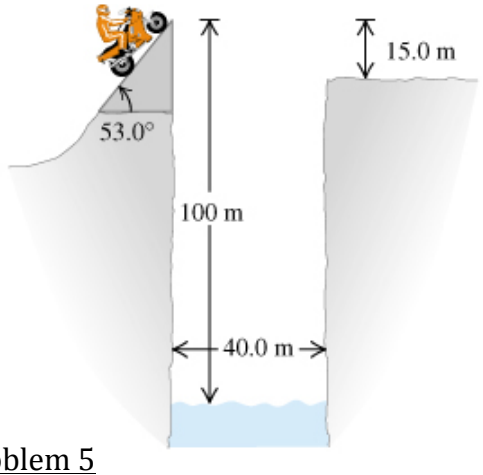
Problem 3

A shot putter releases the shot some distance above the level ground with a velocity of $12 m/s$, 51° above the horizontal. The shot hits the ground 2.08 seconds later. Ignore air resistance. (a) What are the components of the shot's acceleration while in flight? (b) What are the components of the velocity at the beginning and end of the trajectory? (c) How far did she throw the shot horizontally? (d) How high was the shot above ground when she released it?

ANSWER: c) range 15.7 m; d) 1.79

Problem 4

A Physics Professor did a daredevil stunt in his spare time. In the figure below he tries to cross a river from a 53° ramp at an unknown initial speed v_o. The river is 40 m wide, and the far bank is 15 m lower than the top of the ramp. The river itself is 100 m below the ramp. A) What should his speed at the top of the ramp be for him to just make it to the edge of the far bank. B) If his speed were only half the value found in part A, where would he land in the river?



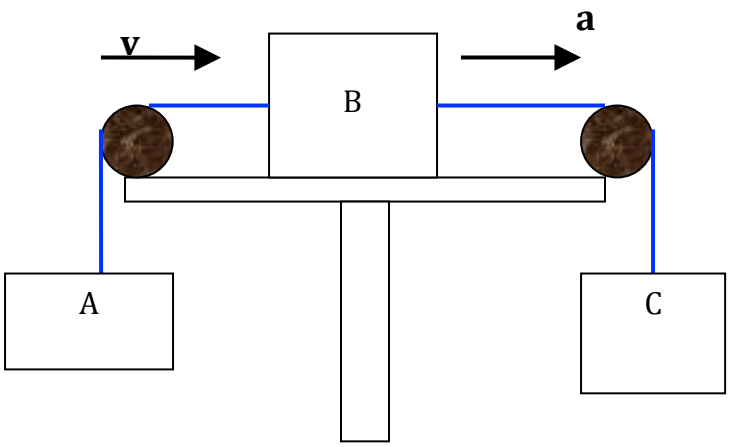
ANSWER:

A) $v_0 = 17.8 m \bullet s^{-1}$

B) Range 28.3 m into the water

Problem 5

In the diagram below block A has a mass of 4.00 kg, block B has mass 12.00 kg, and block C is 12.9kg. The coefficient of kinetic friction between block B and the table is $\mu_k = 0.25$. Block B is moving right and accelerating to the right with $a = 2.00$ m/s^2.



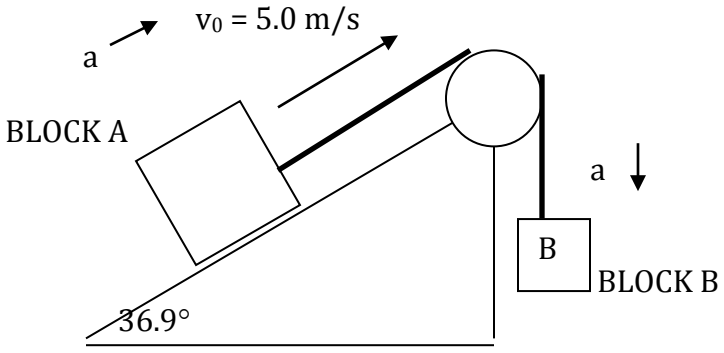
The rope is massless and there is no friction in the pulley

A) Draw a free-body-diagram on block A, B and C, and use Newton's second law to find the acceleration, a, the tension in the rope connecting B and C, T_{BC} and the tension in the rope connecting A and B, T_{AB} . B) if the initial velocity of B is $v_0 = 1 m \cdot s^{-1}$, use kinematics equations to find its velocity after C has fallen 0.2 m.

ANSWER: A) $a = 2.0 m \cdot s^{-2}$, $T_{AB} = 47.2 N$, $T_{BC} = 100.6 N$; B) $v_F = 1.34 m \cdot s^{-1}$

Problem 6

In the diagram below, Block A of mass m_A = 2.0 kg is moving up a 36.9° incline with a speed of v_0 = 5.0 m/s. It is attached to block B of mass m_B = 4.0 kg, by a massless frictionless rope-pulley system. The coefficient of kinetic friction between Block A and the surface of the incline is μ_k = 0.2. Block A moves up 0.5 m to the top of incline. Assume block A accelerates up incline and B is accelerating downward as in diagram.



A) Draw a free-body diagram of block B, then use Newton's second to write an equation that includes the tension of the rope, T and the acceleration, a. B) Draw a free body diagram on block A showing all the forces on A and the direction of its acceleration, a. Draw the x-y axes parallel and perpendicular to the incline. C) Use the diagram in part B) to find the normal force (perpendicular to incline) and the force of friction (parallel to incline) on block A. D) Using diagram from part B, determine the x-component (parallel to incline) of the net force, and use the second law to write an equation that include the tension of the rope, T and the acceleration,

a. E) The two equations from part A) and D) are two equations with two unknown a and T. Solve them to obtain the tension T and acceleration a.

PARTIAL ANSWERS: A) $T - 39.2N = -(4kg)a$; C) $F_N = 15.68N$, $f_k = 3.14N$; D) $T - 14.9N = (2.0kg)a$; E) Subtract part D by part A to obtain $24.3N = 6kg \times a$, $a = 4.05m \bullet s^{-2}$, T = 23 N.