**PHYSICS B**
SECTION II
Time—90 minutes
7 Questions

Directions: Answer all seven questions, which are weighted according to the points indicated. The suggested times are about 17 minutes for answering each of Questions 1 and 5, and about 11 minutes for answering each of Questions 2-4 and 6-7. The parts within a question may not have equal weight. Show all your work in this booklet in the spaces provided after each part.
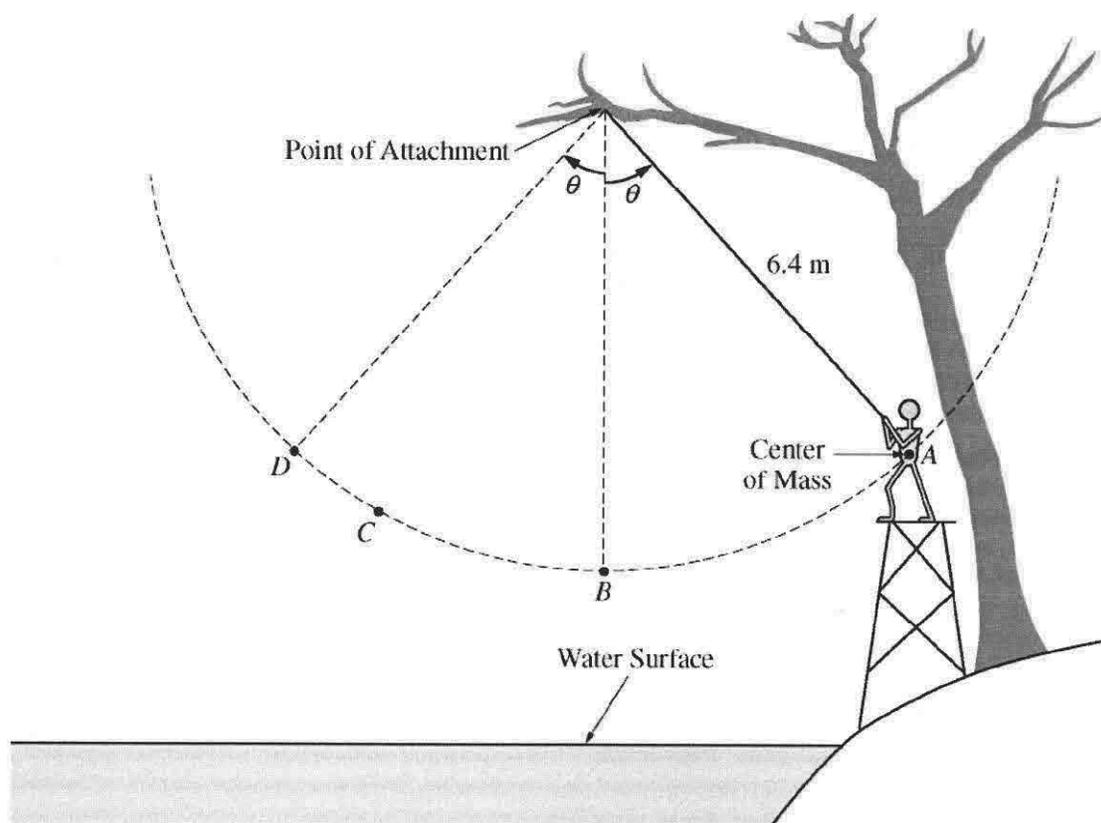
1. (15 points)

Starting from rest at point A, a 50 kg person swings along a circular arc from a rope attached to a tree branch over a lake, as shown in the figure above. Point D is at the same height as point A. The distance from the point of attachment to the center of mass of the person is 6.4 m. Ignore air resistance and the mass and elasticity of the rope.

(a) The person swings two times, each time letting go of the rope at a different point.

    i. On the first swing, the person lets go of the rope when first arriving at point C. Draw a <u>solid</u> line to represent the trajectory of the center of mass after the person releases the rope.

    ii. A second time, the person lets go of the rope at point D. Draw a <u>dashed</u> line to represent the trajectory of the center of mass after the person releases the rope.

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(b) The center of mass of the person standing on the platform is at point A, 4.1 m above the surface of the water. Calculate the gravitational potential energy when the person is at point A relative to when the person is at the surface of the water.

(c) The center of mass of the person at point B, the lowest point along the arc, is 2.4 m above the surface of the water. Calculate the person's speed at point B.

(d) Suppose that the person swings from the rope a third time, letting go of the rope at point B. Calculate R, the horizontal distance moved from where the person releases the rope at point B to where the person hits the water.

(e) If the person does not let go of the rope, how does the magnitude of the person's momentum p_C at point C compare with the magnitude of the person's momentum p_B at point B ?

——— $p_C > p_B$ ——— $p_C < p_B$ ——— $p_C = p_B$

Provide a physical explanation to justify your answer.