PHY 140Y – FOUNDATIONS OF PHYSICS
2001-2002
Term Test #1 – Make-Up Version
Friday, October 26, 2001
2:00 PM - 4:00 PM

INSTRUCTIONS:

Please give your name, student number, and TA's name on ALL examination booklets used.
Answer ALL questions. Total marks = 100.
Marks, shown in brackets, will be given for workings and units as well as for final answers.
[Non-]programmable calculators may be used. No aid/crib sheets are allowed.
Constants: $g = 9.81\ m/s^2$

Calvin's approach is not recommended!

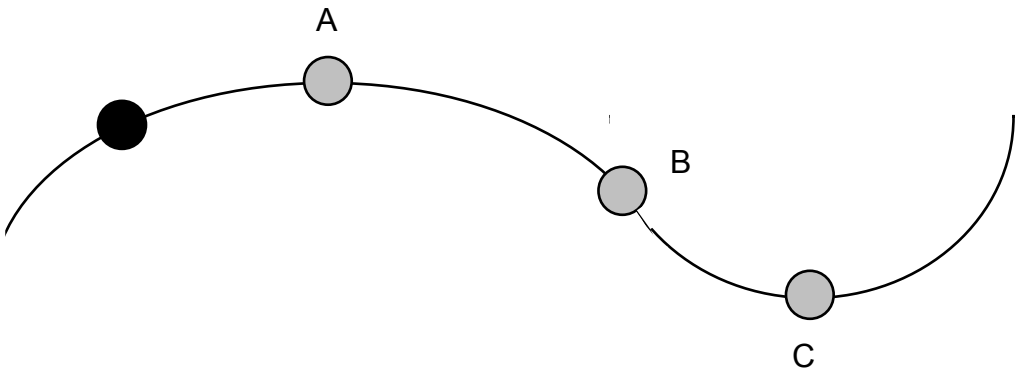
QUESTIONS:

1. Give BRIEF answers to each of the following. ***[5 marks each for 20 total]***

(a) Define and briefly explain the difference between inertial and noninertial frames of reference. What is a fictitious force and why does it arise?

(b) A passenger in a car travelling at 60 km/hour pours a cup of coffee for the tired driver, with it taking the coffee 0.10 seconds to reach the cup. Describe the path of the coffee as it moves from a Thermos bottle into a cup as seen by (i) the passenger, and (ii) someone standing beside the road and looking in the window of the car as it drives past. (iii) What happens if the car accelerates while the coffee is being poured?

(c) A bead slides freely along a curved wire at constant speed, as shown in the following overhead view. At each of the points A, B, and C, describe the magnitude and direction of the force that the wire exerts on the bead in order to cause it to follow the path of the wire at that point.

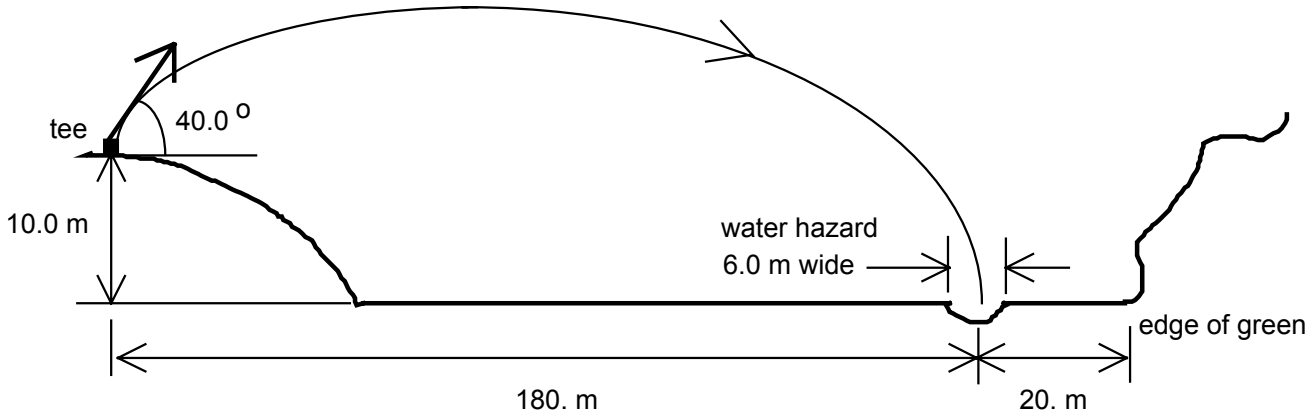


(d) A person steps from a boat towards a dock. Unfortunately s/he forgot to tie the boat to the dock, and the boot scoots away as s/he steps from it. Analyze this situation in terms of Newton's Third Law. Would the outcome be the same for a small dog jumping from the boat? Why or why not?

[Each of the following five questions is worth 16 marks.]

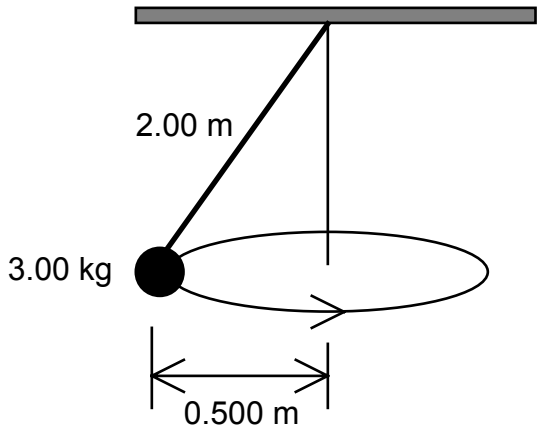
2. A basketball is dropped from rest 3.0 m above the floor. After bouncing from the floor, the ball reaches a height of 1.5 m.
   (a) What is the speed of the ball the instant before hitting the floor?
   (b) What is the speed of the ball just after leaving the floor?
   (c) The ratio of the speed after the bounce to the speed before the bounce is called the coefficient of restitution ε of the ball. Find ε for this basketball.
   (d) If the ball is in contact with the floor for 0.025 s, what is the magnitude of the average acceleration of the ball during this time interval?

3. The 18^{th} green lies 200. m from a golf tee as indicated in the figure below. Golf pro Sandy Trappe clubs the ball heroically, and it leaves the tee making an angle of 40.0° with the horizontal. Unfortunately, the ball lands in a water hazard 180. m from the tee.
   (a) What was the speed of the golf ball as it left the tee?
   (b) If the ball left the tee at the same speed, but at an angle of 45.0° to the horizontal, could the ball have landed on the green?
   (c) Does the 45.0° launch angle ensure that the ball will travel the maximum horizontal distance? Explain your answer.

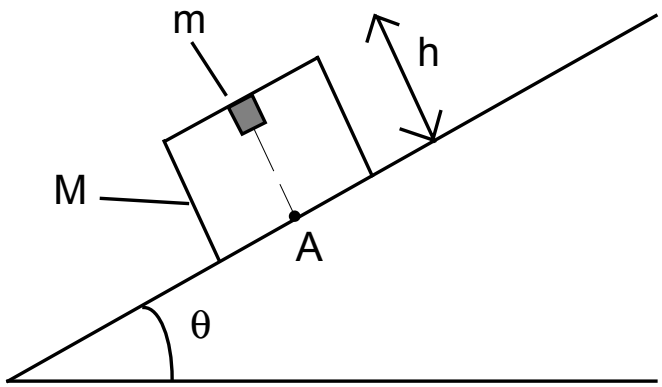


4. You are flying an airplane in a strong wind. An air traffic controller reports your velocity to be 700. km/hour 30.0° east of north. The wind is reported to be 120. km/hour due east.
   (a) Sketch the situation and introduce an appropriate coordinate system.
   (b) What is the velocity of the air with respect to the airplane?
   (c) What is the speed of the air with respect to the airplane?

5. A 3.00 kg mass attached to a string is swung around at constant speed in a circle of radius 0.500 m by means of a massless string of length 2.00 m, as indicated in the figure below.
   (a) Draw the force diagram, indicating the forces on the mass at some instant.
   (b) Is the total force on the mass zero? Explain.
   (c) Find the magnitude of the tension in the string.
   (d) What is the speed of the mass?
   (e) What is the time needed for the mass to complete one circular trajectory?



6. A block of mass M and height h slides down a slope as shown below. The slope is inclined at angle θ from the horizontal. Connected to the top of the box is an object of mass m. The object is directly above point A on the floor of the box, as shown.
   (a) Draw free-body diagrams for mass m and for mass M and identify all forces acting on each at the point when mass m has just been released from the top of the box (i.e., ignore any normal force between the two masses).
   (b) If mass m drops from the top of the box, where will it fall relative to A when it reaches the floor, and how long will it take to fall, assuming that the slope is frictionless.
   (c) Repeat part (b) for the case in which the coefficient of kinetic friction between the box and the slope is μ_k.



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