Board Meeting Gamma

PHYSICS 203: PROFS. BEAN, KLAFEHN, MARTENS YAVERBAUM
JOHN JAY COLLEGE OF CRIMINAL JUSTICE, THE CUNY

Make certain to read THESE procedures BEFORE beginning to solve problems.

1) Take at least one large white board for each group.

   With as much clarity, completeness, color, and vivacity as possible, on group white boards, ***show a correct method to find and justify the answer to each problem part*** on the next page.

   You may certainly use more than one white board per group.

2) We will leave AT LEAST 45 minutes to 1 hour for the following:

   Gather in an approximate circle, all Boards facing in.

   Discuss the Boards with respect to and for any leading questions posed by the Instructor.

   The Instructor, however, will play a noticeably minimal role. Whenever s/he is silent and whenever you wonder what to discuss, do the following:

   a) Begin by attempting to identify and reconcile disagreements among boards,

   b) Freely but respectfully follow whatever conceptual/conversation paths emerge from the attempt to reconcile boards.

   c) Emphasize ***Depth*** over ***Breadth***:

      Once the class discovers that it is disagreement or confusion over a particular and fundamental point—

      whether or not this point was originally intended for discussion--

      STICK WITH THE CONCEPT ***PAST*** THE POINT OF FRUSTRATION & SEEMING 'CIRCLES'.

   d) Do not interrupt colleagues.

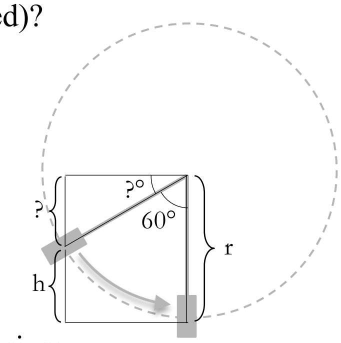
The Problem

A simple pendulum is constructed by attaching a .5 kg mass to a 2m length of string.

PART 1: The mass (pendulum bob) is lifted to an angle of 60 degrees and released from rest.

a. Draw a ***pure FBD*** of the mass at the moment it is released.
b. Draw a radial axis and a tangential axis.
c. Draw a ***component FBD*** of the mass at this moment.
d. What is the ***speed*** of the mass at this moment (the moment it is released)?
e. Compute the ***centripetal acceleration*** of the mass at this moment.
f. Write down ***Newton's Second Law*** and apply it to the ***radial axis***.
g. Compute the ***force of tension*** on the string at this moment.
   HINT: the answer is 2.5 newtons.

h. Compute the ***height of the bob*** above equilibrium at this moment.
   HINT: refer to the diagram to the right.



PART 2: The mass swings downwards, gaining speed as it approaches equilibrium.

a. Compute the ***work done by gravity*** as the mass swings downwards from its initial position (in part 1) to the bottom of its swing. (This motion is shown in the diagram above-right.)
b. Compute the ***work done by tension*** as the mass swings downwards from its initial position to the bottom of its swing.
c. Compute the ***speed*** of the bob when it reaches the bottom of its swing.
   HINT 1: Use the Work-KE theorem.
   HINT 2: the answer is $\sqrt{20}$ m/s.
d. Compute the centripetal acceleration of the mass at this moment.
e. Draw an ***FBD*** of the mass at this moment. (There will be no need for a CFBD.)
f. Write down ***Newton's Second Law*** and apply it to the ***tangential axis***.
i. Compute the tangential acceleration of the mass at this moment.
g. Write down ***Newton's Second Law*** and apply it to the ***radial axis***.
h. Compute the ***force of tension*** on the string at this moment.
   HINT: the answer is 10 newtons.

PART 3: The mass swings back up to a 60 degree angle on the other side.

a. How much work does gravity do on the pendulum as it swings up from equilibrium to a 60 degree angle?
b. What will be the speed of the bob when it reaches a 60 degree angle on the other side?
c. At what point in its swing does the bob have the highest centripetal acceleration?
d. At what point in the swing is the force of tension strongest?