RAA 3

LBCC PH201 FA2016 Name:________________

November 7, 2016 Class time:______________________

Instructions: You have 40 minutes to work on this assessment. You need to show your work to receive credit. A solution without a picture is not complete. Pictures and Free Body diagrams need to include coordinate systems.

Be wise with your time. Scan all questions first and start with whatever seems “easy points”.

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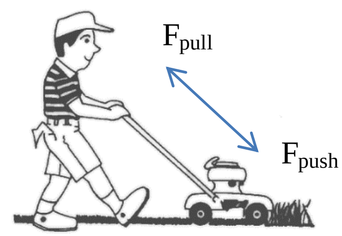
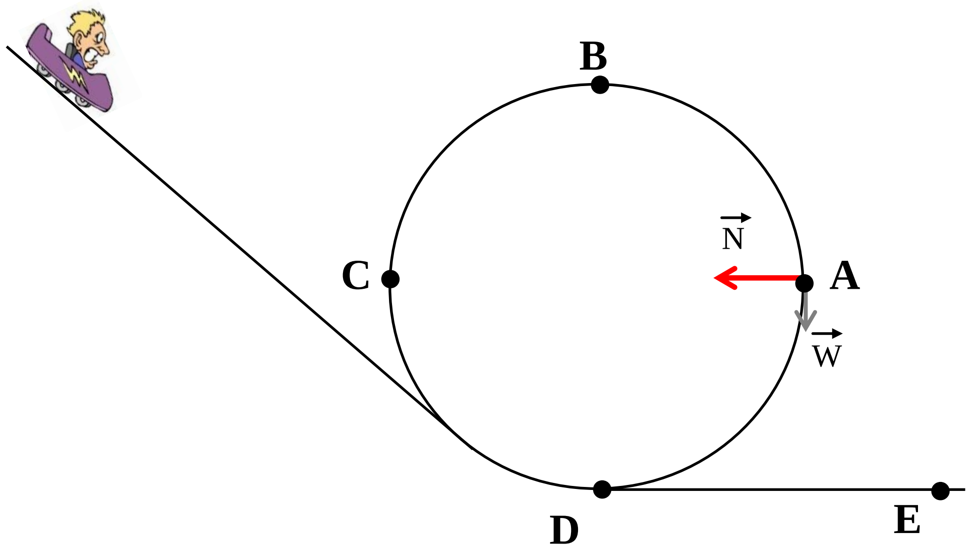
1. (10points) An old fashioned lawn mower can be pushed or pulled to cut the lawn. Use free body diagrams to show if it is easier to push or to pull. You can push or pull the lawn mower along the direction of the handle shown in the picture.

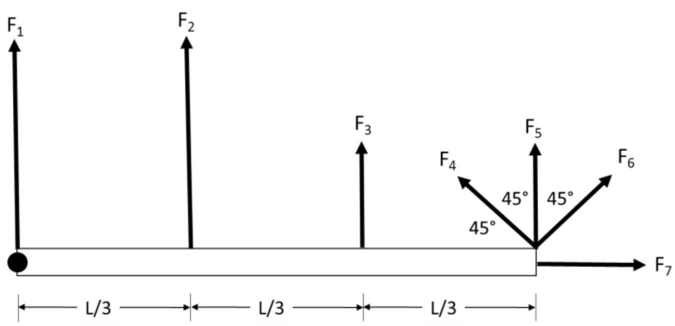


   I. Draw a picture of the lawn mower including all forces acting on the lawn mower, when in use. This is not a frictionless physics lawn mower. Read on through question B., C., and D. to make sure you the picture contains the details you need to solve this problem (3 points)
   II. Draw a free body diagram of the lawn mower when it is pushed forwards with constant velocity. (2points)
   III. Draw a free body diagram of the lawn mower when it is pulled backwards with the same speed as in B. Draw all forces in scale to the FBD of B. (2 points)
   IV. Use your free body diagrams to decide if it is easier to push or pull this kind of lawn mower. (3 points)

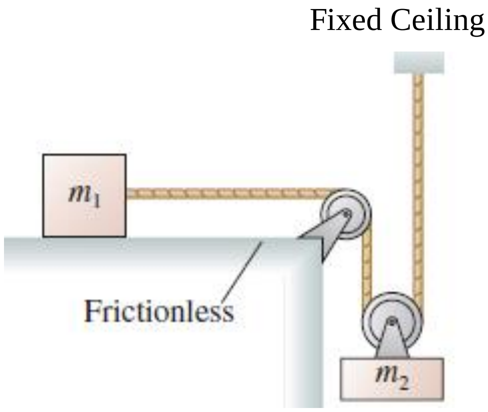
2. (6pts-6min) A fun rollercoaster loop has a loop di loop.
    I. Rank the speed $v_A - v_E$ by magnitude from smallest to largest speed.
    II. Complete the drawing showing the weight and the normal forces the positions B-E shown. Make sure all forces are in scale with the forces already given at position A. Underneath the picture draw the net force for the positions A-E. The track is frictionless and the little car makes it around on the track.



3. (4 points) Six Forces, each of magnitude either F or 2F are applied to a door. Rank in order, from smallest to largest, the six magnitudes of the torques resulting from the forces $F_1 - F_7$ about the hinge.



4. *(10 points)* In the figure, find an expression for the acceleration of box_1 with m_1. The pulleys are massless and frictionless.



   I. How far is m_1 moving when m_2 moves 10cm?

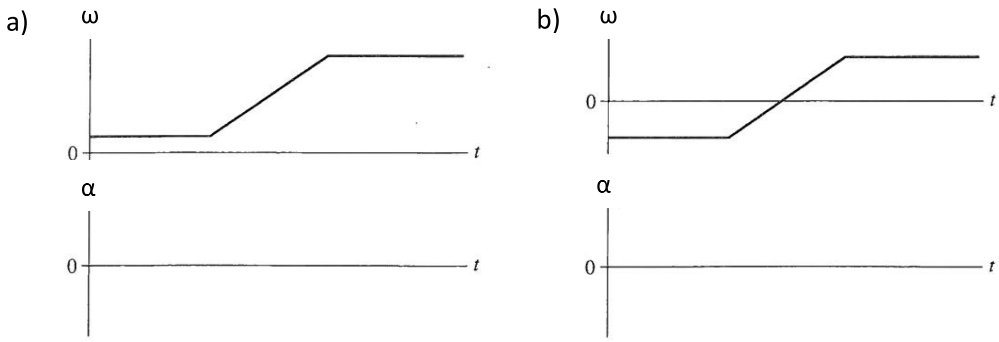
   II. What is the speed of m_1 when m_2 moves with a speed of 1m/s?

   III. Think carefully about the acceleration constraint. How much is box_1 accelerating relative to box_2 ? For full credit show all forces on the picture and include a free body diagram with coordinate system.

   IV. Perform a check for reasonableness of your answer. What is the acceleration of box_1 if box_1 is massless? What is the acceleration of box_1 if $m_2 = 0$? Does that make sense?

5. *(6 points)* This glider is flying in a 2500-m-radius horizontal circle. Assume that a lift force is acting perpendicular to the wings keeping the airplane from falling from the sky. The glider is in circular motion without changing altitude. What is the speed of the airplane? You might have to take some information from careful observation of the picture (you can use the given picture to add the forces, and protractors are available).

6. *(4points)* Below are angular velocity versus-time graphs. For each draw the corresponding angular acceleration-versus-time graphs directly below it. Make sure your 2 graphs correctly indicate the relative accelerations between them?



7. *(3 points)* It is well known that the diameter of the pupil of an LBCC physics student can be predicted by the equation:

$$d = \frac{h}{l * \sqrt[2]{\frac{t}{T_S}}}$$

d = diameter of the pupil in mm
h = distance from the chin to the tip of the nose of student in mm
l = luminosity parameter in the room of experiment = 0.01200
t = total time of sleep during past 4 nights (in hours)
T_S= standard sleep time for LBCC students for 4 nights (in hours)

The data for a measurement performed at a random group of PH211 students at LBCC is shown in the graph to the right. What is the standard sleep time T_S for LBCC students for a 4 day period?
Report the result with reasonable significant figures (explain your choice in words)