AS Physics   Name_____

Enrichment – Moments

This experiment will analyze the moments and forces of a system in equilibrium. Consider the following image (from shutterstock.com):

You will be performing the above experiment with a partner at the end of this enrichment opportunity. Choose someone else to do the experiment with (they do not need to be in physics). You will need some data from them so choose someone suitable and appropriate.

Pre-Experiment
- Record each of your weights in Newtons.
- Draw a **quantitative** force diagram for each person
- On your diagram, calculate and label the net force in both the X- and Y-Directions
- On your diagram, calculate and label the net moment.
- Do some research (include your sources in your final report) on where the center of mass is for males and females. Using that research, give a rough estimate of where the center of mass is for each person in your experiment.
- Using the principle of moments, calculate the maximum angle at which each person will need to lean back in order to maintain equilibrium. Include a full Forces/Moments table and clear, detailed work for your solution. Treat this as if you are making an answer key to a question - if your work is incomplete or unclear you will not earn full points. You may need to measure additional values. If so, indicate these values in your final solution.
- You may make the following assumptions in your calculations:
    1. The pivot point is where the people's toes meet.
    2. $g=9.81$ N/kg or $g=9.81$ m/s^2

Experiment
- After calculating the final angles, perform the experiment! Take a picture straight on as shown in the figure above.

Post-Experiment Analysis
- Use the picture to measure the angle of each person. Label these angles on your picture.
- Calculate the percent difference of each angle.
- Give some possible sources of error or limitations.
- Answer the following using complete sentences:
    1. How would your final angles change if the two people had very **similar** weights? Why? Explain.
    2. How would your final angles change if the two people had very **different** weights? Why? Explain.
    3. How would your final angles change if both people **the same** centers of mass? Why? Explain.
    4. How would your final angles change if both people had **lower** centers of mass? Why? Explain.
    5. How would your final angles change if both people had **higher** centers of mass? Why? Explain.