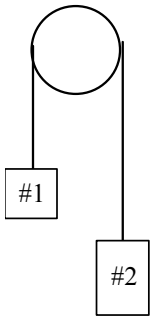
Name: _____ **"Alphabetic" Student No.:**

HOMEWORK HANDOUT #3: Forces I (Phys 207, Fall 2005)
DUE on MONDAY, Sept. 19 by 9pm (TOTAL of FOUR problems – USE the Handout sheets!!!)

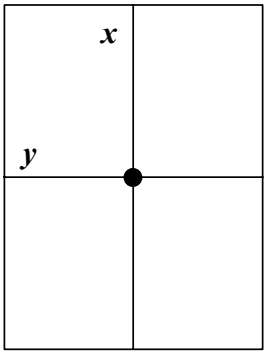
Problem #1: Moving Vertical Blocks (Atwood's Machine)

Two blocks are connected by a massless string that slides over a frictionless peg as shown below (called an Atwood's machine). Assume that Block #2 is heavier and that the blocks accelerate such that Block #1 rises and Block #2 falls.

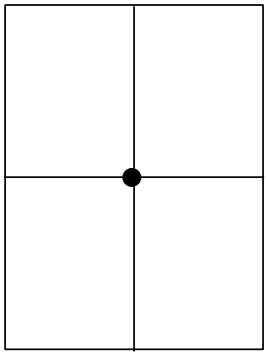
(a) Draw the **free body diagrams** for blocks #1 and #2 in the indicated boxes. Use **SUBSCRIPT notation** to label ALL vectors with appropriate labels as done in class, e.g. W_{1E}, T_{1R}, etc. Mark on the axes drawn in the boxes where the **+*x* and +*y* axes** are located. Remember that +*x* must be in the direction of motion for each block (labels shown in FBD #1 as an example).



FBD of Block #1`



FBD of Block #2`



(b) Write down $\sum F_x = ma_x$ for blocks #1 and #2 using the notation in the FBD's, e.g. W_{1E}, T_{1R}, etc.

$\sum F_{1x} =$

$\sum F_{2x} =$

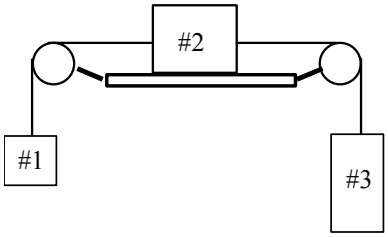
(c) Use the force equations in part (b) to find an **algebraic** expression for the **acceleration *a*** of the blocks in terms of m_1, m_2, and g.

(d) Calculate the **numerical** value for the **acceleration *a*** if: $m_1 = 1.5$ kg and $m_2 = 4.5$ kg. How does this value compare to the "free-fall" value of *g*.

Problem #2: Moving Horizontal and Vertical Blocks

Three blocks are connected by two massless strings that slide over frictionless pegs as shown below. There is also no friction between block #2 and the horizontal surface. Assume that Block #3 is heavier than Block #1 and the blocks accelerate such that Block #1 rises and Block #3 falls.

(a) Draw the **free body diagrams** for blocks #1, #2, and #3 in the indicated boxes. Use **SUBSCRIPT notation** to label ALL vectors with appropriate labels as done in class, e.g. W_{2E}, $T_{2R(left)}$, $T_{2R(right)}$, N_{2S}, etc. Mark on the axes drawn in the boxes where the **+*x* and +*y* axes** are located.



FBD of Block #1`

FBD of Block #2`

FBD of Block #3`

(b) Write down $\sum F_x = ma_x$ for blocks #1, #2, and #3 using the notation in the FBD's.

$\sum F_{1x} =$

$\sum F_{2x} =$

$\sum F_{3x} =$

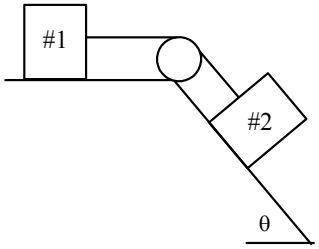
(c) Use the force equations in part (b) to find an **algebraic** expression for the **acceleration *a*** of the blocks in terms of m_1, m_2, m_3, and g.

(d) Calculate the **numerical** value for the **acceleration *a*** if: $m_1 = 1.5$ kg, $m_2 = 2$ kg and $m_3 = 4.5$ kg. How does this value compare to problem #1 which is identical except for the center block?

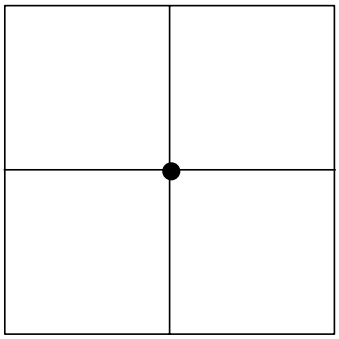
Problem #3: Moving Horizontal and Inclined Plane Blocks

Two blocks of mass m_1 and m_2 are connected by a massless string that slides over a frictionless peg as shown below. Block #1 is on a frictionless horizontal surface and block #2 is on a frictionless incline with angle θ.

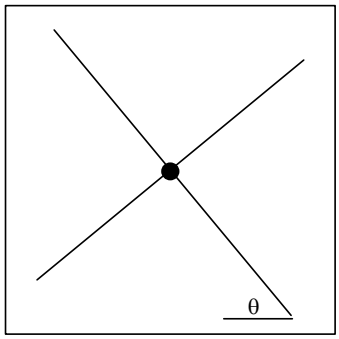
(a) Draw the **free body diagrams** for blocks #1 and #2 in the indicated boxes. Use **SUBSCRIPT notation** to label ALL vectors with appropriate labels as done in class, e.g. W_{1E}, T_{1R}, etc. Mark on the axes drawn in the boxes where the **+*x* and +*y* axes** are located. Also, draw and label the *x*- and *y*-component vectors for any forces not aligned along the indicated axes, e.g. for W_{2E}.



FBD of Block #1`



FBD of Block #2`



(b) Write down $\sum F_x = ma_x$ for blocks #1 and #2 using the notation in the FBD's.

$\sum F_{1x} =$ _____

$\sum F_{2x} =$ _____

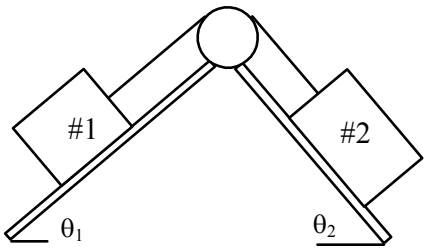
(c) Use the force equations in part (b) to find an **algebraic** expression for the **acceleration *a*** of the blocks in terms of m_1, m_2, θ and g.

(d) Calculate the **numerical** value for the **acceleration *a*** if: $m_1 = 1.5$ k, $m_2 = 4.5$ kg, and $\theta = 35°$.

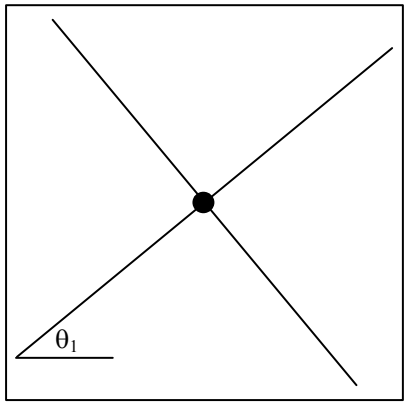
Problem #4: Moving Blocks on Inclined Planes

Two blocks are connected by a massless string that slides over a frictionless peg as shown below. There is also no friction between the blocks and inclined surfaces. Assume that Block #2 is heavier than Block #1 and the blocks accelerate such that Block #1 rises and Block #2 falls.

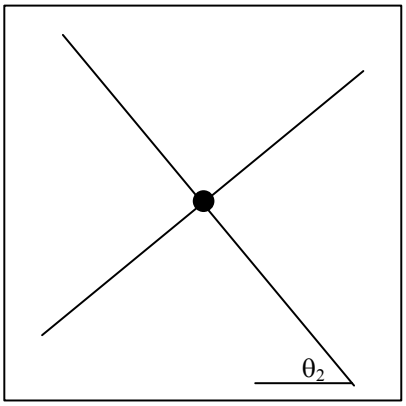
(a) Draw the **free body diagrams** for blocks #1 and #2 in the indicated boxes. Use **SUBSCRIPT notation** to label ALL vectors with appropriate labels as done in class, e.g. W_{1E}, T_{1R}, etc. Mark on the axes drawn in the boxes where the **+*x* and +*y* axes** are located. Also, draw and label the *x*- and *y*-component vectors for any forces not aligned along the indicated axes.



FBD of Block #2`



FBD of Block #2`



(b) Write down $\sum F_x = ma_x$ for blocks #1 and #2 using the notation in the FBD's.

$\sum F_{1x} =$

$\sum F_{2x} =$

(c) Use the force equations in part (b) to find an **algebraic** expression for the **acceleration *a*** of the blocks in terms of m_1, m_2, θ_1, θ_2, and g.

(d) Calculate the **numerical** value for the **acceleration *a*** if: $m_1 = 1.5$ kg, $m_2 = 4.5$ kg, $\theta_1 = 35°$, and $\theta_2 = 45°$.