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4A QUIZZ #2

This Quizz is closed book.

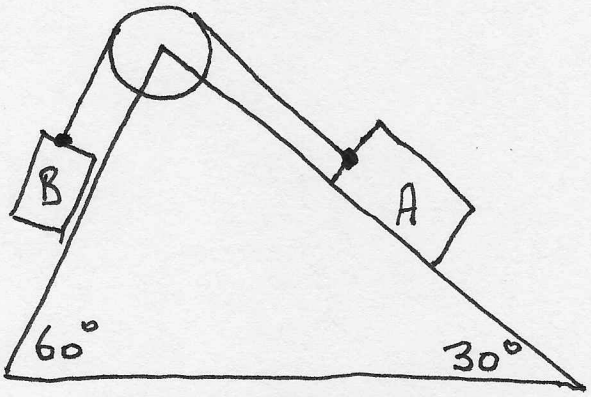
PROBLEM 1 (15 points).

Consider two masses A and B positioned on slopes as shown in the figure. The string connecting them is massless and the masses can move along their surfaces without friction. The mass of A is $m_A = 5\,\text{kg}$. The system is stationary (does not move).

a. Calculate the value of m_B.

b. Calculate the ration of the normal forces acting on A and B.

c. If $m_B = 2m_A$ calculate the acceleration of the system and its direction.



PROBLEM 2 (15 points).

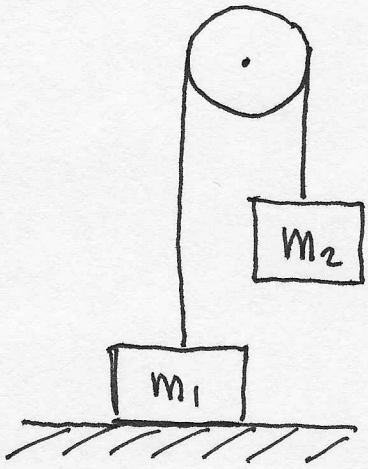
Two masses m_1 and m_2 are suspended by a massless string that is positioned over a pulley as shown in the figure. The pulley can rotate without friction. The mass m_1 rests on the floor and stays there.

a. Calculate the normal force from the ground on m_1.

b. Calculate the tension in the string at m_1.

c. Calculate the tension in the string at m_2.

d. What is (are) the condition(s) under which those two tensions are equal?



PROBLEM 3 (25 points).

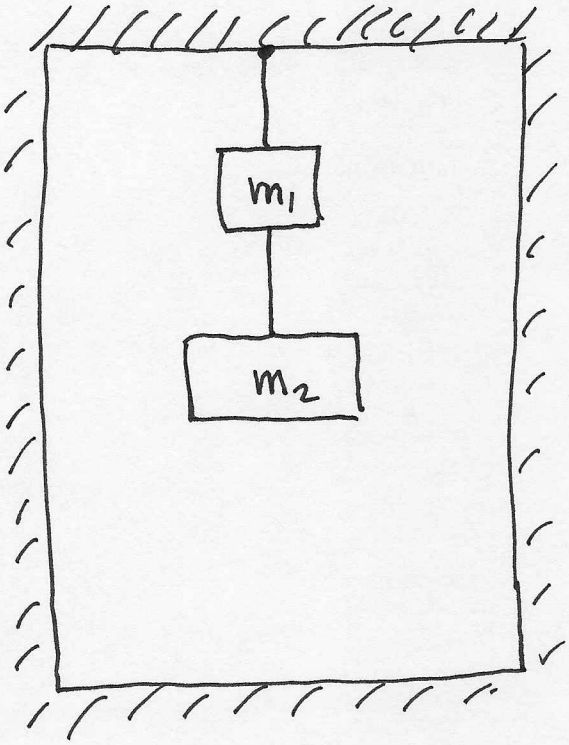
Two masses m_1 and m_2 are suspended from the ceiling of an elevator by massless strings as shown in the figure. The elevator moves up with a constant acceleration a.

a. Calculate the tension in the top most string.

b. Calculate the tension in the bottom most string.

c. If the elevator moves down with a constant acceleration a how large can the acceleration be while keeping both strings taut?

d. Which of the two string will first become slack as a is increased?



2a

PROBLEM 4 (30 points).

Two masses m_a and m_b are positioned on a surface with slope θ as shown in the figure. There is friction between the two masses and the surface with friction coefficients μ_S and μ_K. A force F is exerted on the mass m_a that is parallel to the surface.

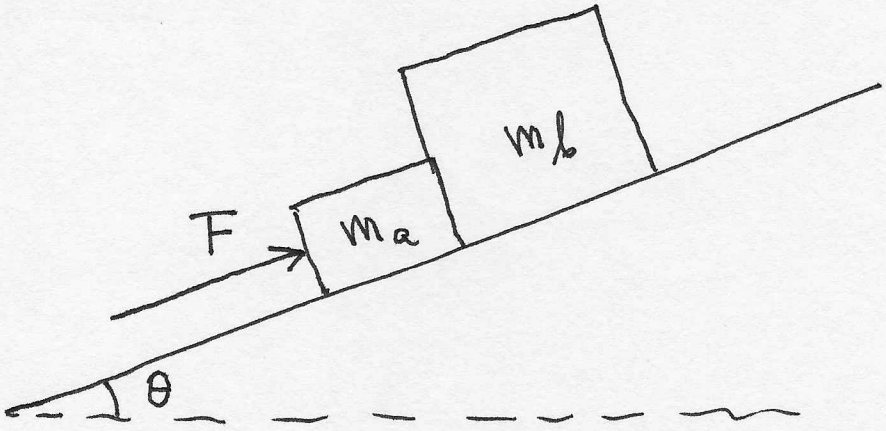
a. Calculate the condition on F that the two blocks do not move.

b. Calculate the condition on F that the two blocks start to move but are not yet moving.

c. Calculate the condition on F that the two blocks move.

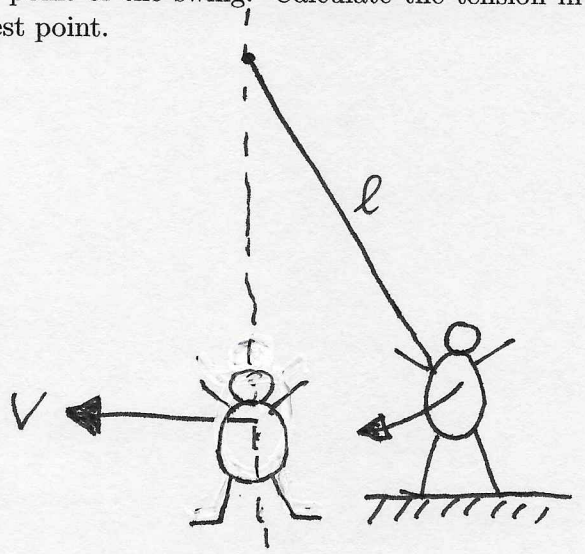
d. Calculate the acceleration in the situation of c).

e. Calculate the force that the body a exerts on body b.



PROBLEM 5 (15 points).

A person of weight W swings from a platform in a circus as shown in the figure. The rope is massless and has a length ℓ. The person's velocity is v at his lowest point of the swing. Calculate the tension in the rope at the person's lowest point.



Extra Credit (20 points).

A person of weight W sits on a chair in a box without windows. She feels the force of gravity but no other forces. At a certain moment $t = 0$ she becomes aware of a horizontal force from the back of her chair of magnitude S that was not there before. Nothing has visibly changed so this is curious to say the least.

a. Was the person in an inertial coordinate system at $t < 0$? Why (not)? Explain and ignore gravity.

b. Was the person in an inertial coordinate system at $t > 0$? Why (not)? Explain and ignore gravity.

c. What might be the reason for the horizontal force? Be quantitative and ignore gravity.