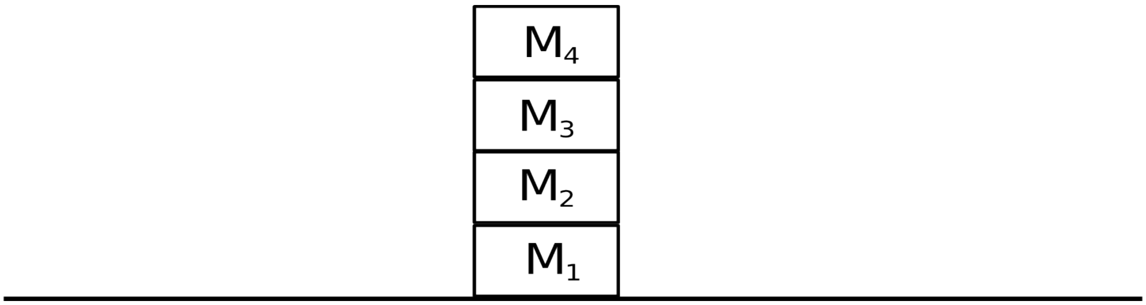
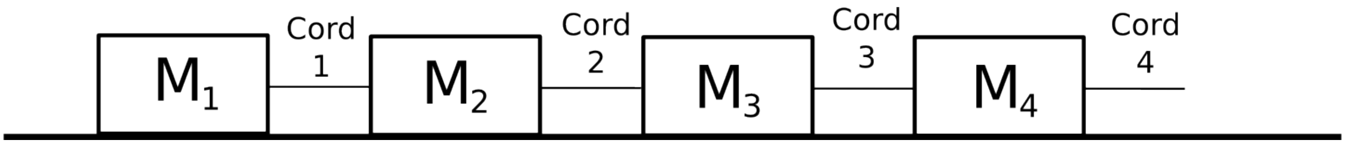
In the picture below, four blocks are stacked on top of each other. Nothing is in motion.



a) Draw a free body diagrams for each block.

b) Rank the reaction forces from the free body diagrams above in order of magnitude, greatest first. If any are equal, place an equals sign between them.

The picture below shows four blocks connected by chords. The system is accelerated to the right by pulling on cord 4.

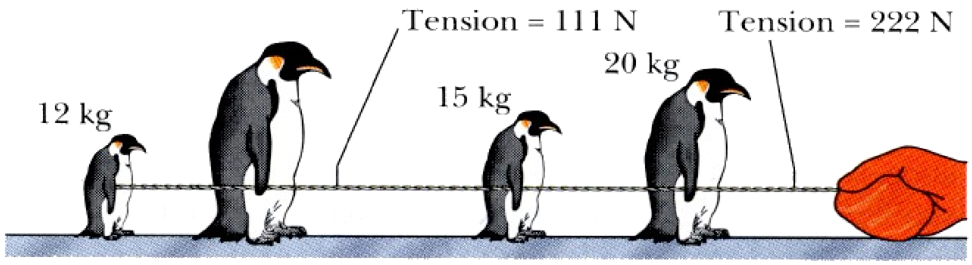


a) Rank the blocks according to their acceleration, greatest first.

b) Rank the cords according to their tension, greatest first.

c) Which is greater: The total mass accelerated by cord 4 or the total mass accelerated by cord 1?

Four penguins are being playfully pulled along a very slippery (frictionless) ice by a zoo keeper. The masses of the first, second, and third penguins and two cord tensions are shown below. Find the mass of the third penguin.



a) Draw four free body diagrams, one for each penguin. Keep very careful track of the tension forces. State the given information.

b) Write Newton's Second Law for each free body diagram.

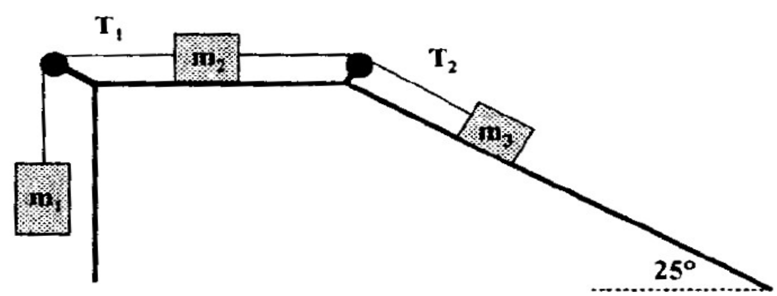
c) Solve the system of equations above to isolate the mass of the fourth penguin.

For the following situations, draw free-body diagrams to indicate all forces acting on the object(s) in question. *Indicate relative magnitudes of forces by drawing long, short, or equal-length vectors.*

a) A block is being pushed across a rough horizontal table at a constant velocity (there's friction).

b) A block is resting on a rough incline plane without sliding.

c) Three blocks are attached by strings as in the diagram. All surfaces are rough. Draw free body diagrams of each block.



A block rests on an incline plane that makes an angle θ with the horizontal. The coefficient of static friction between the block and the plane is μ_s and the coefficient of kinetic friction is μ_k.

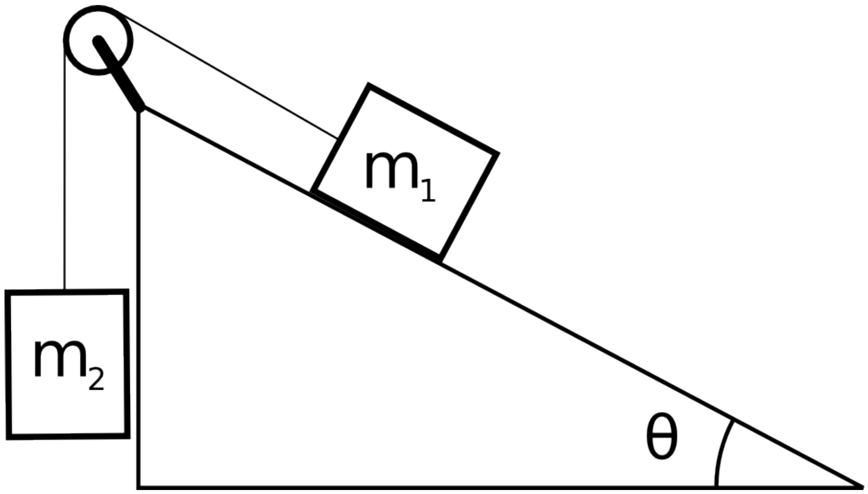
a) Find an expression for the maximum angle of the incline before the block slips.

*HINT: The equation for the force of static friction ($F = \mu_s N$) represents the **maximum** force that friction can provide.*

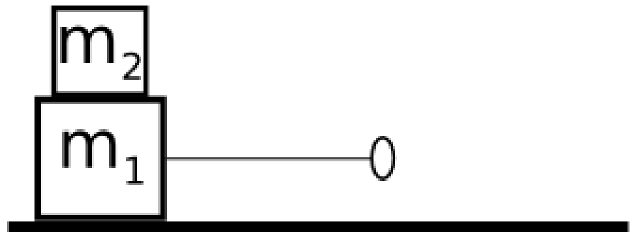
b) Assuming that the block is in motion, find an expression for the acceleration of the block in terms of θ and μ_k.

In the picture below, the coefficient of kinetic friction between the ramp and m_1 is μ_k. A rope connecting m_1 and m_2 passes over a massless frictionless pulley.

Calculate the acceleration of the system.

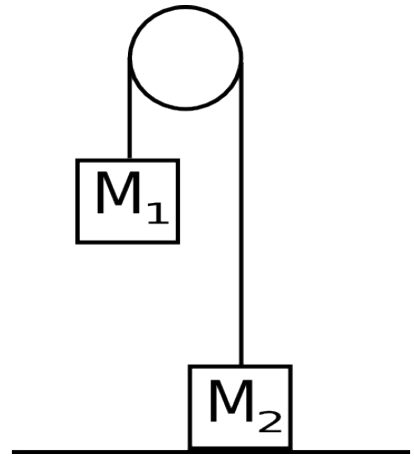


Two blocks with masses m_1 and m_2 are stacked up as shown in the picture below. A rope with a handle is attached to m_1 as shown. There is no friction between m_1 and the table. The coefficient of static friction between m_2 and m_1 is μ_s.



a) Draw free body diagrams for m_1 and m_2.
b) Find an expression for the maximum force that can be applied to to the rope on m_1 without m_2 slipping.
c) Find an expression for the reaction force of the floor acting on m_1 in terms of g, m_1, and m_2.

One end of a rope is connected to a mass M_1=10kg. The rope passes over a massless frictionless pulley and the other end is connected to a mass M_2 = 5kg. M_2 is initially resting on the ground and M_1 is suspended 3m above the ground. The system is initially at rest.



If M_1 is released and allowed to hit the ground, what is the maximum height that M_2 will reach?

HINT: When M_1 hits the ground, M_2 will still have an upward velocity. M_2 will ***continue*** *upward until its velocity is zero.*