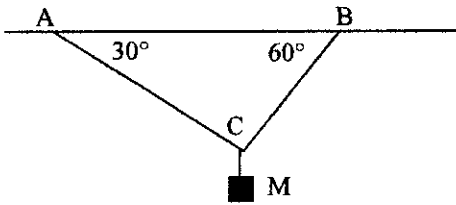
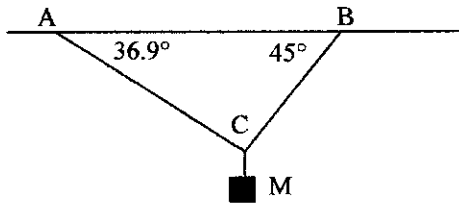


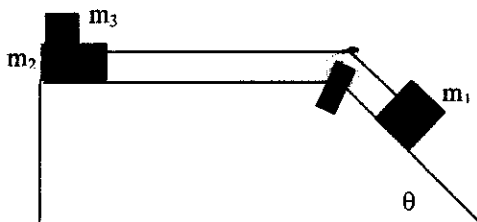
1. A mass M is hanging at the joint of two pieces of ropes AC and BC as shown in the figure. Draw appropriate free body diagrams and find the tension in each rope. b) If ropes break when tension exceeds $200(\sqrt{3})g$ N, what is the maximum mass you can hang? c) Which rope breaks first? Ignore the mass of the ropes.



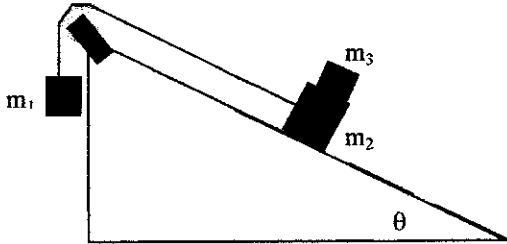
2. A mass M is hanging at the joint of two pieces of ropes AC and BC which are attached to the ceiling as shown in the figure. Draw appropriate free body diagrams and find the tension in each rope. b) If ropes break when tension exceeds $100(\sqrt{2})g$ N, what is the maximum mass you can hang? c) Which rope breaks first? Ignore the mass of the ropes.



3. Three blocks with masses m_1 , m_2 , and m_3 are connected using a mass less rope which runs over a frictionless pulley as shown in the figure. Block m_2 slides on a frictionless surface and m_1 slides on a surface with coefficient of kinetic friction μ_k . Draw appropriate free body diagrams. b) Obtain an expression for the acceleration of mass m_1 . c) Given that the maximum value for coefficient of static friction between blocks m_2 and m_3 is same as μ_k obtain an expression for the minimum value of μ_k (using θ and other given terms) if mass m_3 is to stay with mass m_2 . Pulley is mass less and ignore air resistance.



4. Three blocks with masses m_1 , m_2 , and m_3 are connected using a mass less rope which runs over a frictionless pulley as shown in the figure. Block m_3 slides up on a surface with coefficient of kinetic friction μ_k . Draw appropriate free body diagrams. Assume pulley is mass less and ignore air resistance. b) Obtain an expression for the acceleration a of mass m_1 . Given that the maximum value for coefficient of static friction between blocks m_2 and m_3 is μ_s , obtain the maximum value of a (in terms of μ_s and θ) if m_3 is to stay together with mass m_2 .



5. A 4kg block of ice is placed against a horizontal spring that has force constant $k=200\text{N/m}$ and is compressed by 0.025m . Ignore the mass of the spring and the friction. a) Calculate the work done by the spring against the ice block when the spring is released while it expands to its natural length. b) What is the speed of the block when it leaves the spring? c) What would be the speed if the spring was compressed by 0.05m ?
6. A leg press is made with two side by side horizontal springs and you push against them horizontally for your daily work out. You burn 80J when you press the platform 0.2m from their relaxed length. Ignore the mass of the spring. a) What is the magnitude of your force to hold the platform in this position? b) How many more joules are needed to press the platform 0.2m further from this position. c) What is the new force?
7. A force of 160N is required to stretch a spring 0.05m from its un-stretched length. a) What is the force required to stretch the spring further 0.05m . b) How much work is done to stretch the spring further in part a)? c) What is the work needed to compress the spring by 0.05m from relaxed position?
8. A crate delivery ramp has a slope of $\theta=30^\circ$ downward from a horizontal conveyer belt. A crate moving with a velocity of $(4.9/2)\text{m/s}$ horizontally drops down the ramp which has a coefficient of (both kinetic and static) friction $\mu=1/\sqrt{3}$. A spring with spring constant k is fixed at the bottom of the ramp so that the crate compresses the spring by a distance x before it stops. Total distance traveled by the crate (down the ramp) before it stops is l . Once stopped the crate must not go up the ramp. Calculate x . b) Calculate the force constant of the spring to satisfy this if the crate is 1500N ? (Draw figures needed before proceeding with the problem, use work energy theorem).
7. You are asked to design a spring that will shoot a mass m from a canon that has an upward angle θ , of which $\sin\theta=5/13$ and $\cos\theta=12/13$. The spring is compressed by a length x to shoot the mass and the mass travels a total distance of l through the cannon before it exists with a velocity $v\text{m/s}$. Inside of the canon is coated and the value of coefficient of kinetic friction is $1.5/12$. The maximum acceleration that the mass can be subjected to is $2g$. a) Obtain an expression that relates x , v^2 and l . b) Calculate the force constant k of the spring if $v=(4.9/2)\text{m/s}$, $l=2\text{m}$ and $m=70\text{kg}$. (use work energy theorem).

- 9 A car in an amusement park ride rolls without friction around a track shown in the figure. It starts from rest at point A at a height h above the bottom of the loop. Treat the car as a particle and ignore air resistance. a) Find the velocity v_B of the car at point B assuming it moves around the loop. b) What is the normal force at B? c) What is the minimum value of h such that the car moves around the loop without falling off the loop? d) What is the acceleration of the car at point C?(extra 5 points)