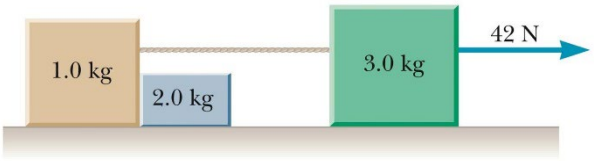
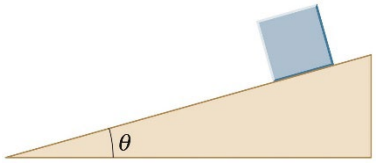
University Physics I

Homework Set 7

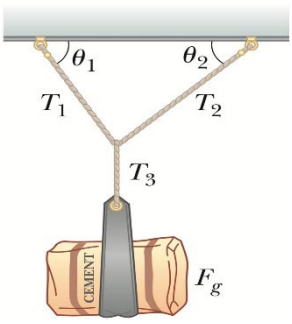
1. An elevator cabin has a mass of 363.7 *kg*, and the combined mass of the people inside the cabin is 177.0 *kg*. The cabin is pulled upward by a cable, in which there is a tension force of 7638 N. What is the acceleration of the elevator?
2. An iron bolt of mass 65.0 *g* hangs from a string 35.7 *cm* long. The top end of the string is fixed. Without touching it, a magnet attracts the bolt so that it remains stationary, but is displaced horizontally 28.0 *cm* to the right from its initial vertical position. The magnet is located to the right of the bolt and at the same horizontal level in the final configuration.
    a. Draw a free-body (force) diagram of the bolt.
    b. Find the magnitude of the tension in the string.
    c. Find the magnitude of the magnetic force on the bolt.
3. Assume the three blocks portrayed in the figure at right move on a frictionless surface. A 42 N force, attached to the 3.0 *kg* block, is pulling on them all to the right. Determine:



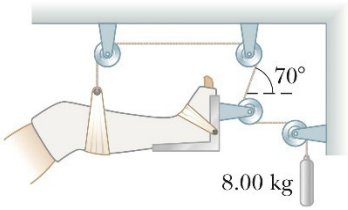
    a. The acceleration of the system.
    b. The magnitude of the tension in the connecting cable between the 1.0 *kg* and 3.0 *kg* blocks.
    c. The force exerted by the 1.0 *kg* block on the 2.0 *kg* block.
4. A block slides down a frictionless incline that is 2 *m* long and has an angle of 15.0° relative to the horizontal. The block starts from rest at the top:



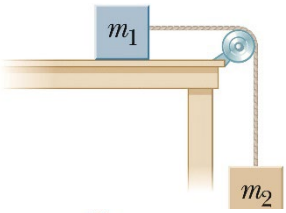
    a. Find the acceleration of the block
    b. Find the speed of the block at the bottom of the incline.
5. A block is given an initial velocity of 5.00 *m/s* up a frictionless incline with an angle of 20.0°. How far up the incline does the block slide before coming to rest?
6. A bag of cement weighing 325 N hangs from three wires as shown in the figure at right. Two of the wires make angles of $\theta_1 = 60.0°$ and $\theta_2 = 40.0°$ with the horizontal. Assuming the system is in equilibrium, find the tensions T_1, T_2, and T_3 in the wires.



7. A setup similar to the one shown at right is often used by hospitals to support and apply a horizontal traction force to an injured leg.
    a. Determine the force of tension in the rope supporting the leg.
    b. What is the traction force exerted to the right on the leg?

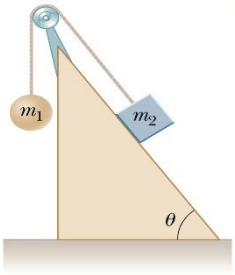


8. An object of mass $m_1 = 5.00\ kg$ is placed on a frictionless, horizontal table and is connected to a string that passes over a frictionless pulley and finally attached to a hanging mass of 9.00 *kg* as shown in the figure at right.



   a. Find the magnitude of the acceleration of both masses.
   b. Find the tension in the string.

9. Two objects are connected by a light string that passes over a frictionless pulley as shown at right. Assuming the incline is also frictionless, $m_1 = 2.00$ *kg*, $m_2 = 6.00$ *kg*, and $\theta = 55.0^o$, Find:

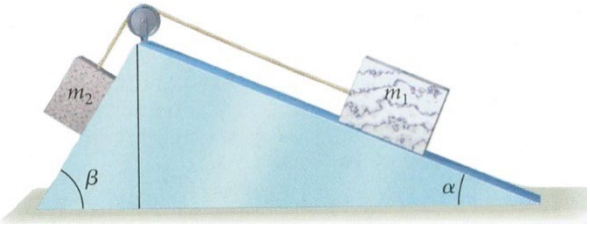


   a. The magnitude of the acceleration of the masses.
   b. The tension in the string.
   c. The speed of each object 2.00 sec after being released from rest.

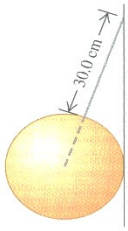
10. In an Atwood machine in which $m_1 = 2.00\ kg$ and $m_2 = 7.00\ kg$ are connected over a frictionless pulley, m_1 is released with a sharp pull that sets it into motion at $v_o = 2.40\ m/s$ downward.
   a. How far will m_1 descend below its original level before coming to rest?
   b. Find the velocity of m_1 after 1.80 *sec*.

11. A mass $m_2 = 20.0\ kg$ sits on a frictionless incline and is attached to a hanging mass m_1 by a string over a frictionless pulley. If the incline makes an angle of 30.0° above the horizontal and m_2 moves up the incline at a constant speed, find the value of m_1.

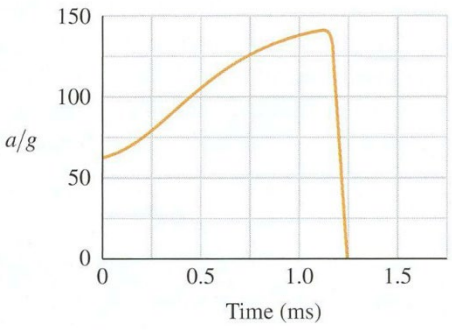
12. A marble block of mass $m_1 = 567.1\ kg$ and a granite block of mass $m_2 = 266.4\ kg$ are connected to each other by a rope that runs over a frictionless pulley as shown in the figure at right. Both blocks are located on inclined planes, with angles $\alpha = 39.3^o$ and $\beta = 53.2^o$. If blocks move without friction, what is the acceleration of the marble block.



13. A solid uniform 45.0 *kg* ball of diameter 32.0 *cm* is supported against a vertical, frictionless wall by a thin, 30.0 *cm* wire of negligible mass as show in the figure at right. How hard (*or with how much force*) does the ball push against the wall?



14. ** High-speed motion pictures (3500 *frames/second*) of a jumping 210 μg flea yielded the data to plot the flea's acceleration as a function of time, as shown in the figure at right. (See "The Flying Leap of the Flea", by M. Rothschild et al, *Scientific American*, Nov. 1973). This flea was about 2 *mm* long and jumped at nearly a vertical takeoff angle. Using the graph:



   a. Find the initial net external force on the flea.
   b. Find the maximum net external force on the jumping flea and when it occurs.
   c. Find the flea's maximum speed.