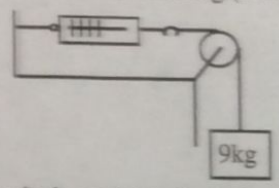
Physics Practice Problems: Forces

Ignore friction and air resistance unless otherwise specified or implied. Treat all pulleys and strings as massless.

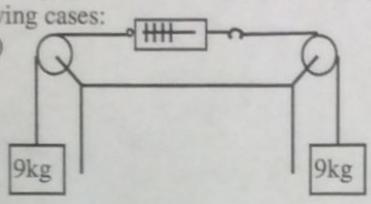
Newtons 3 laws of motion, weight:

1. Answer "zero" if the net force acts on the object is zero. Answer "not zero" if the net force acts on the object is not zero.
   a) a projectile near the surface of the earth. b) a box sliding down a sloped surface along a straight line at constant speed.
   c) a car traveling at constant speed around a curve. d) the moon.
2. Suppose that you pull on the end of a rope whose other end is tied to a wall. The reaction force to this pulling force of yours on the rope is (choose one): a) the rope pulls on you b) the rope pulls on the wall c) the wall pulls on the rope d) you pull on the wall
3. What is the scale reading (in N) in each of the following cases:

a)



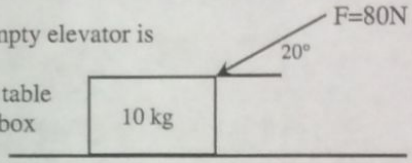
b)



4. What is the weight of a 60-kg astronaut a) on the moon where g is 1/6 of the g on earth, b) in outer space (very far away from all planets and the sun, so g = 0) being pulled by a cable with a force of 300 N?

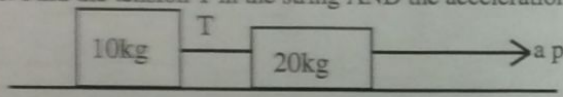
Single-object problems:

5. A 10,000-kg helicopter is accelerating upward. If the lifting force from the rotary wings is 105,000 N, how large is the acceleration of the helicopter?
6. A 2000-kg elevator is supported by a steel cable. Find the tension in the cable when the empty elevator is a) descending at a constant speed, b) descending and slowing down at a rate of $2 m/s^2$?
7. (**Please do this problem after learning about friction.**) A box is being pushed along the table with a slanted force (shown on the right). The coefficient of kinetic friction between the box and the table is 0.25. Find the acceleration of the box.

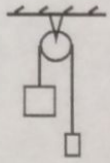


Multi-object problems:

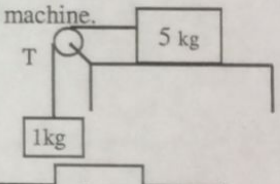
8. Find the tension T in the string AND the acceleration of the boxes. (Ignore friction between the boxes and the table.)



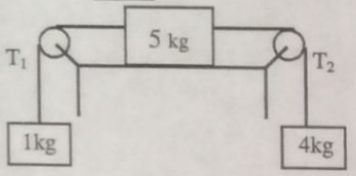
9. A 5000kg helicopter accelerates downward at $0.5 m/s^2$ while lowering a 1000kg car. A) What is the lift force exerted by the air on the rotors? B) What is the tension in the cable (ignore its mass) that connects the car to the helicopter?



10. An Atwood machine (see fig. on right) has a 5kg block hanging on one side and a 3kg block hanging on the other side. A) Find the magnitude of the acceleration of the blocks. B) Find the tension in the string of the Atwood machine.
11. Find the tension in the string and the acceleration of the system on the right, a) if there is no friction.
    b) (**Please do part b after learning about friction.**) if the μ_k between the 5kg and the table is 0.1.

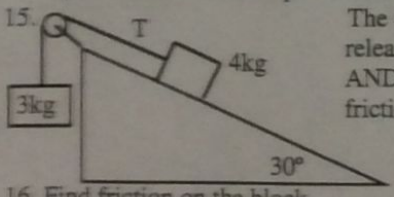


12. Find the tension in each string and the acceleration of the 3-box system on the right,
    a) if there is no friction.
    b) (**Please do part b after learning about friction.**) if the μ_k between the 5kg and the table is 0.1.

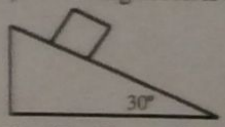


Inclines, etc.:

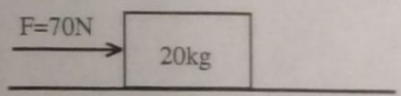
13. A wet bar of soap slides freely from rest down a smooth 25° ramp 4 m long. Neglect friction.a) How long does it take to reach the bottom?
    b) How fast is the soap going the moment before it reaches the bottom?
14. A box is given an initial push at the bottom of a 37° incline so that it starts to slide up the incline at 4m/s. a) How far up the incline will it go?
    b) How much time elapses before it returns to its starting point? Assume no friction.
15. The system on the left starts to move after being released from rest. Find the tension in the string AND the acceleration of the blocks when a) there is no friction, b) the coefficient of kinetic friction between the 4kg block and the incline is 0.1.



16. Find friction on the block.
    a) The 20-kg block is at rest on the 30° incline.



    b) The 20-kg block is being pushed to the right by a 70-N force so the block moves at a constant speed of 2 m/s.



17. Find T_1, T_2, and T_3 in the system on the right.