Review – Forces

Physics

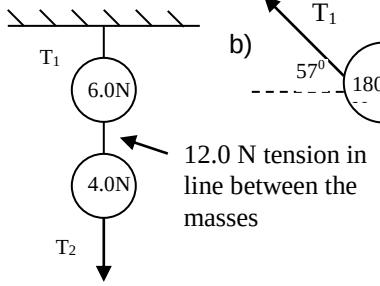
TOPICS TO BE COVERED:

- The difference between weight and mass (weight is the force of gravity on an object and is equal to mass * the acceleration of gravity)
- Springs
- Friction (Kinetic and Static and the difference between the two); $F_{fr} = \mu N$
- Torque = (Perpendicular component of F) x (lever arm)
- Free-body diagrams
- STATICS:
  - Translational Equilibrium: Forces in the x-direction sum to zero, and forces in the y-direction sum to zero.
  - Rotational Equilibrium: Sum of the torques taken about any pivot equal zero.
- DYNAMICS:
  - Sum of all forces = net force = $\Sigma F = ma$
  - Direction of the acceleration of an object is in the direction of the net force.
  - Problems involving inclines (acceleration of gravity down an incline is a fraction of the acceleration of gravity).

PROBLEMS

1. Find the missing forces (F), tensions (T), or angles(θ) for each of the following:

a)



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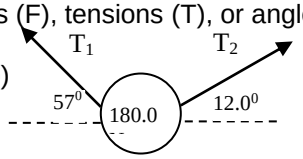

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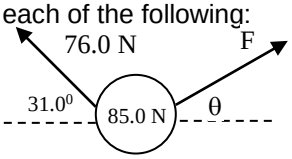

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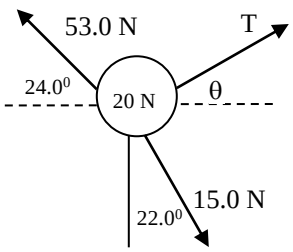


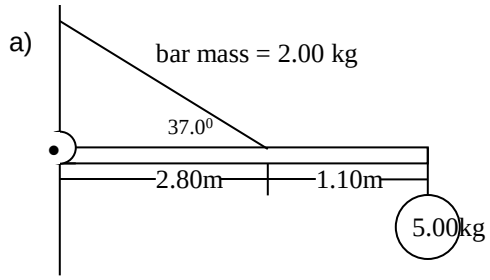
a: [T_1 = 18N, T_2 = 8N]; b: [T_1= 189N, T_2 = 105N]; c: [θ = 35.1^o above +x-axis, F = 79.6N]; d: [θ = 16.1^o above +x-axis, T = 44.5N]

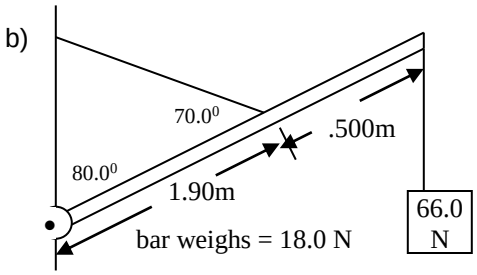
2. What is the weight of a 12.6 kg mass on Earth? [124 N]

3. What mass has a weight of 42.8 lbs? [1.33 slugs]

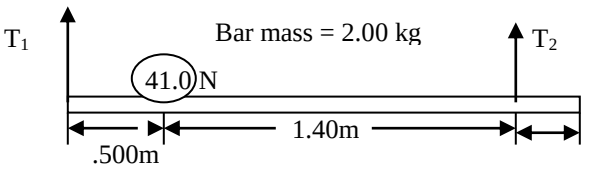
4. A block of wood of density 730.0 kg/m^3 has dimensions 1.20 m by 0.400 m by 0.700 m (remember, density = mass/volume). What is the tension in a string if it is lifted by a string by an astronaut standing on the moon (where gravity is 1.63 m/sec^2)? [4.00x10^2 N]

7. Find the tensions T in each case. [a: 136 N; b: 99.3 N]

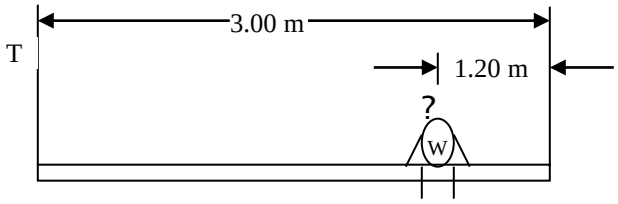




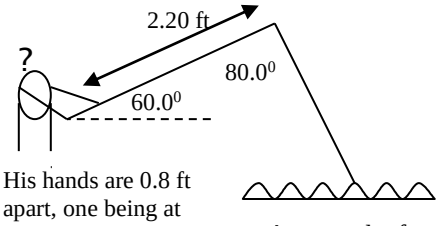
9. Find the tensions in each string supporting the weight and the board. [T_1 = 36.4 N; T_2 = 24.2 N]



10. A painter sits on a 20.0-kg scaffolding, 3.00 m long. If the tension in the right hand rope is 340.0 N, what is the weight of the painter? What is the tension in the left hand rope? [W = 403 N; T = 259 N]



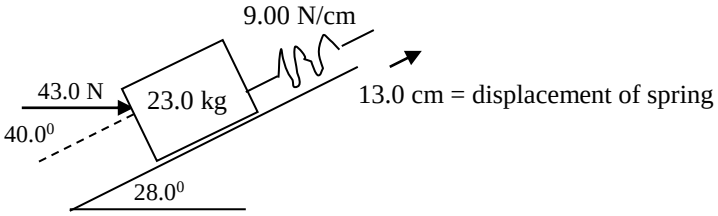
11. Cole LaDrinque snags a big one, which exerts a 30.0 pound tension in his line. What force must he apply with the upper hand to support his 25.0-lb, 3.00-ft long pole as well as the fish? (Cole holds the pole at 60.0 degrees to the horizontal). [F = 134 lb]



His hands are 0.8 ft apart, one being at the end of the pole.

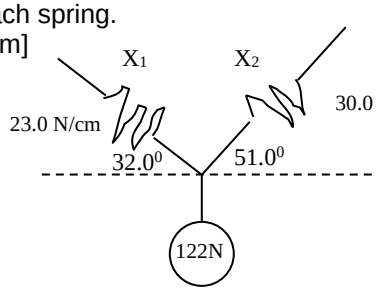
Assume the force from his hand is perpendicular to the pole.

13. Find the acceleration of the mass. [1.92 m/sec^2]



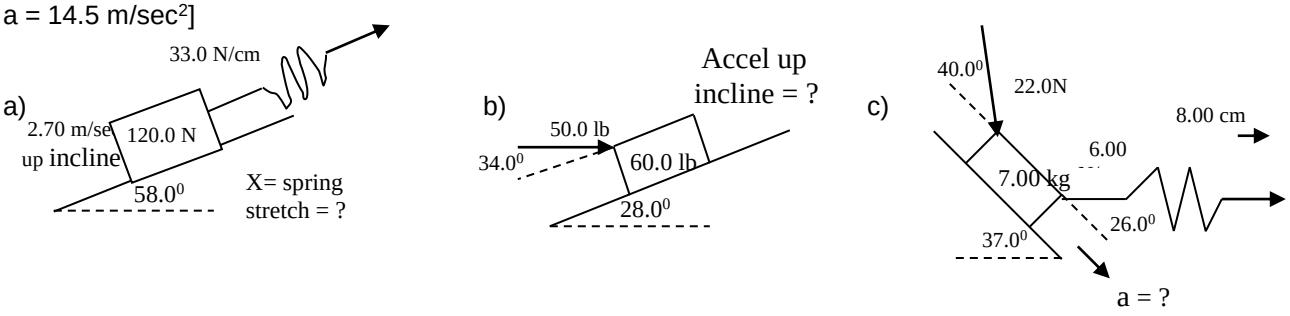
14. A macho-crazed mountaineer slides down a rope. If his weight is 815 N, and he applies a constant force of 55.0 N upward to the rope, what is his downward acceleration? [9.14 m/sec^2]

15. Find the stretch in each spring.
[x_1 = 3.36 cm; x_2 = 3.47 cm]

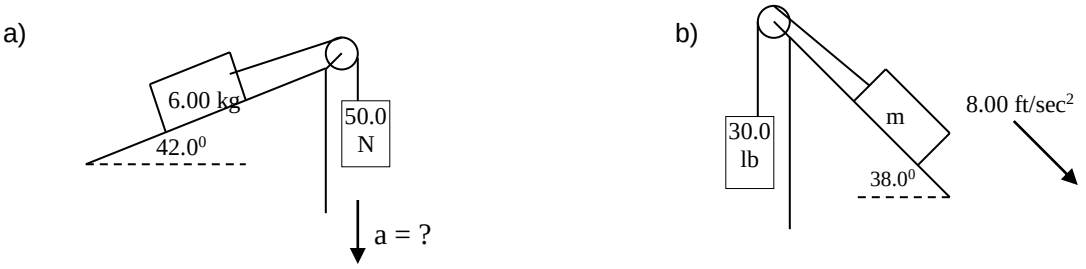


16. Scotty Beameup presses a mass 19.0 cm into a 680.0 N/m spring oriented horizontally (so gravity will not affect its motion). Upon release its initial acceleration is a breathtaking 13.1 m /sec^2. a) What is the mass of the mass? b) What will happen to the velocity as the spring expands? c) What will happen to the acceleration? [a: 9.86 kg; b: increase; c: decrease]

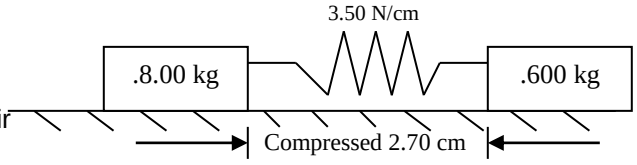
17. Find the missing quantities in each case. Assume no friction. [a: x = 4.09 cm; b: a = 7.13 ft/sec^2; c: a = 14.5 m/sec^2]



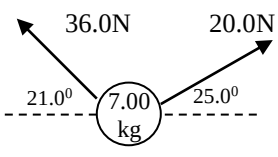
18. Find the acceleration in (a) and the missing mass in (b). [a: a = .960 m/sec^2; b: m = 3.2 slugs]



19. Two masses are scrunched 2.70 cm together against a 3.50 N/cm spring. What is the acceleration of each immediately after their release? [11.8 m/sec^2, 15.8 m/sec^2] /

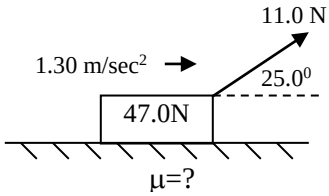


20. Find the magnitude and direction of the acceleration of the mass. Ignore gravity. [3.77 m/sec^2, 54.1^o above the horizontal to the left]



21. Find the coefficient of friction in (a) and the force in (b). [μ = .0882; F = 54.9 N]

a)



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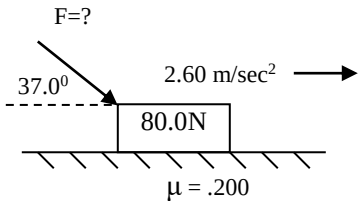
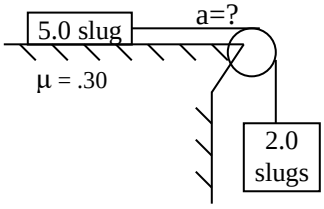
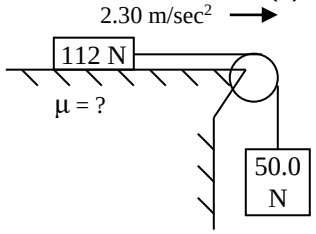


22. What is the acceleration in (a) and the coefficient of friction in (b)? [a: 2.3 ft/sec²; b: μ = .107]

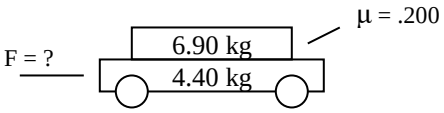
a)



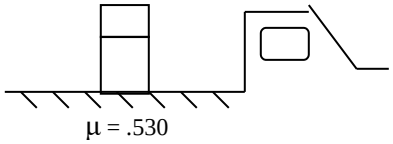
b)



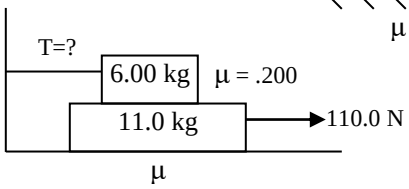
23. The cart shown has frictionless wheels. What is the maximum force that can be applied to it without causing the block to slip? [22.2 N]



24. A 140.0 kg refrigerator with a coefficient of friction of 0.530 is on the bed of a pickup. What maximum acceleration can the pickup have without the refrigerator sliding? [5.19 m/sec²]

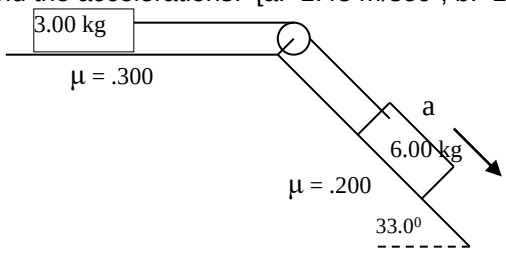


25. A 110.0 N force is applied to the bottom block. This block accelerates at 4.0 m/sec²; the top block stays still. a) What is μ? b) What is T? [.326, 11.8 N]



27. Find the accelerations. [a: 1.48 m/sec²; b: 14.37 ft/sec²]

a)



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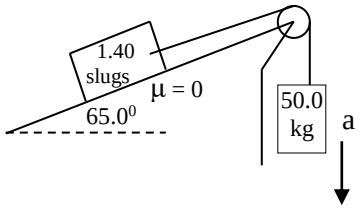
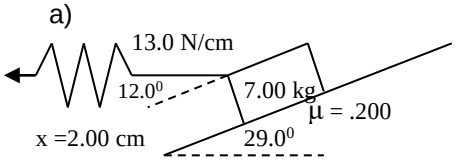


28. For the masses shown, what are the masses' final velocities and how long does it take each mass to slide down the inclines if both masses start from rest and both inclines are 48.0 meters in length? [a: 25.6 m/sec, 3.75 sec; b: 26.3 m/sec, 3.65 sec]

a)



b)