1. A freefalling 75.0 kg skydiver is pulled by how much gravitational force?

2. Determine the net force acting on the fan cart based on measurements of its mass and the time it takes to travel a known distance starting from rest. Is the net force equal to the thrust produced by the fan? Add 500 grams to the cart, repeat the experiment, and this time predict the time to accelerate through the same distance.

3. A 15.0 kg object experiences a *single* force of 25.0 N, 30.0° (assume there is no gravity).
   (a) What is the acceleration of the object?
   (b) What additional force would be required to cause its acceleration to be zero?

4. Two forces act on a 2$\underline{0}$ kg object (assume there is no gravity):
   $\mathbf{F}_1 = 4\underline{0}$ N, 180.0° and $\mathbf{F}_2 = 76$ N, 0.0°.
   (a) Determine the acceleration.
   (b) If $\mathbf{F}_1$ stays the same, what different value of $\mathbf{F}_2$ would cause acceleration of 3.6 m/s^2, 180.0°?

5. Two forces act on a 5.00 kg object (assume there is no gravity): $\mathbf{F}_1 = 30\underline{0}$ N, 90.0° and $\mathbf{F}_2 = 15\underline{0}$ N, 0.0°. Determine its acceleration.

6. A student lifts a book bag with mass 2.50 kg. The force of gravity on the bag is 24.5 N. What force must the student exert on the bag so that: (a) it accelerates 2.00 m/s^2, 90.0°, and (b) it moves with constant velocity 1.00 m/s, 90.0°.

7. A certain climbing rope can exert a force of up to 4.5 kN without breaking (its tensile strength). What is the maximum upwards acceleration the rope can produce with a 5$\underline{0}$ kg climber attached at the end? Repeat for a 10$\underline{0}$ kg climber attached.

8. Determine the acceleration of the space shuttle at liftoff. The space shuttle's mass at liftoff: orbiter = 79000 kg, external tank = 756000 kg, solid rockets = 590000 kg each (× 2). The engines produce thrust as follows: main engines = 1.67 MN each (× 3), boosters = 11.8 MN each (× 2).

9. A junkyard crane lifts and lowers a smashed car. Suppose the mass of the car is 2000 kg. Find the tension in the cable when the car: (a) accelerates 2.00 m/s^2, 90.0°, (b) accelerates 1.00 m/s^2, 270.0°, and (c) rises at a constant 2.00 m/s, 90.0°.

10. A balloon is released from the ceiling and falls to the floor. Determine the average force of friction (air resistance) acting on the balloon based on measurements of its mass and of the time and distance of the fall.

11. An 85.0 kg parachutist falls from an airplane. The table below shows an "account" of the fall. Determine the 5 values missing from the table. Note: the first missing value is an instantaneous value – the others are average or constant values found "between" two points in time.

t (s)	v (m/s)	a (m/s^2)	drag (N)	description:
0.00	0.00	9.8 down	0	man drops from airplane
5.00	36.0		535 up	falling through air
15.0	45.0			reaches terminal velocity
		0		falling fast!
20.0	45.0			pulls "rip cord"
				chute is opening
22.0	5.00			chute is completely open
		0		falling slow!
25.0	5.00			continues to drift down

12. Aboard the space shuttle, a “floating” and “weightless” 95 kg astronaut pushes a “floating” and “weightless” 150 g notepad with a force of 5.0 N, 10.0°. Determine the acceleration of both the notepad and the astronaut.

13. Use a ranging device to measure the motion of a book of a known weight that falls and is caught by a student. Determine the force of the book on the student’s hands.

14. An airborne basketball player of mass 70.0 kg accelerates a ball of mass 0.50 kg downward at a rate of 24 m/s^2, just before dunking it. Determine the acceleration of the basketball player at that instant.

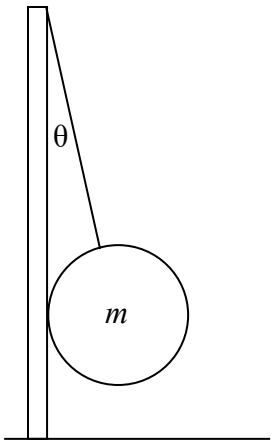
15. A 2.00 kg book rests on a level table. Determine the normal force acting on the book.

16. A person applies a force of 10.0 N downward on the top of the same 2.00 kg book. Determine the normal force acting on the table in this situation.

17. A person with mass 80.0 kg is in contact with the floor. Determine the normal force acting on the person in each of the following circumstances: (a) Person stands at rest. (b) Person is pulled upward by a rope exerting 100 N of force (but remains at rest). (c) Person jumps upward with acceleration 1.00 m/s^2.

18. A stack of two boxes is lifted by a person. The top box is 1.00 kg and the bottom box is 10.0 kg. The person applies force to the bottom box, which causes both boxes to accelerate upwards at 2.00 m/s^2. (a) Determine the force of the top box acting on the bottom box. (b) Determine the applied force.

19. Given the mass, *m*, and the angle, θ, determine the tension in the cable and the force of the ball acting on the rod.



20. What amount of force is needed to push a 250 N crate at constant velocity across a floor where $\mu = 0.175$? What is the deceleration rate of the crate if it is released?

21. Find the minimum stopping distance for a car traveling 26.8 m/s given coefficients of friction for tire on pavement: $\mu_s = 0.95$, $\mu_k = 0.80$. What must be true of the braking in order to achieve this?

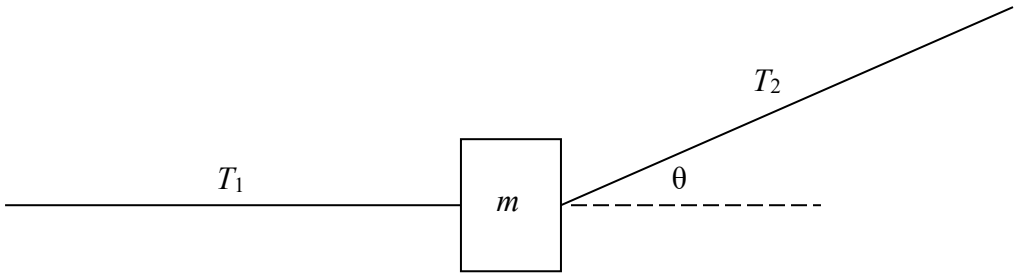
22. Using the same coefficients from the previous problem, determine the maximum possible forward acceleration of a kid running on dry pavement.

23. A horizontal cable is used to pull the top beam from a stack of steel beams that each weigh 9.0 kN. The tension in the cable is gradually increased until the beam moves. Find its acceleration at the instant it starts to move.
For steel on steel: $\mu_s = 0.74$, $\mu_k = 0.57$

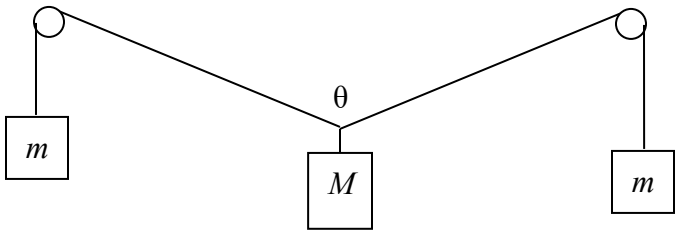
24. Two men are initially standing at rest on a frozen lake. The coefficients of friction for both men are: $\mu_s = 0.20$, $\mu_k = 0.10$. The larger man, mass 100.0 kg shoves the smaller man, mass 70.0 kg. This causes the smaller man to accelerate 1.50 m/s^2, 0.0°. (a) Find the acceleration of the larger man. (b) What is the greatest magnitude shove for which neither man slides on the ice?

25. Suppose you press a 15 N book against a wall and hold it in place. If the coefficient of static friction for the book against the wall and/or against your hand is 0.30, determine the force you must exert to keep the book from sliding down.

26. Use a motion detector to measure the motion of an object tossed upward into the air. Measure the mass of the object. (a) Determine the air resistance acting on the object at a particular speed, moving up and moving down. (b) Predict the terminal velocity of the object assuming air resistance proportional to speed. (c) Repeat using a speed squared proportion.



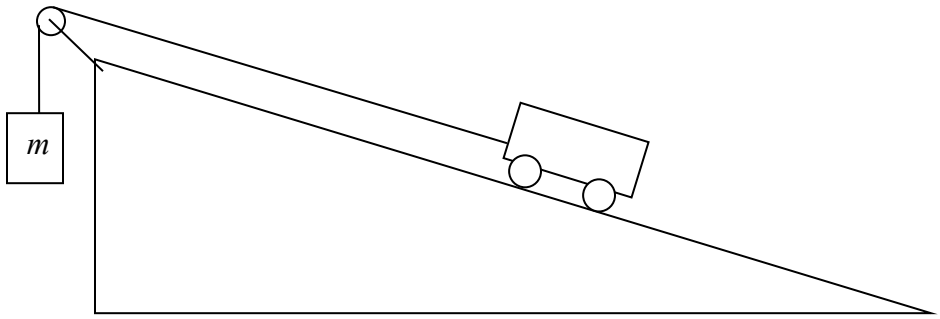
27. A mass, *m*, is supported by two strings as shown above. Measure the angle θ and the tension in one of the two strings. Use these values to determine the mass and the other tension value.



28. Two identical masses are attached to strings which pass over pulleys and support a third mass as shown in the above diagram. Given the value of the mass *M* and the angle θ, determine the tension in each string and the value of *m*.

29. A 6.00 kg box is pulled across a level floor by a rope that exerts a force of 40.0 N, 30.0°. The coefficient of sliding friction is 0.25. Determine the acceleration rate of the box.

30. A small toy car is released from rest and rolls down a ramp. Assuming the coefficient of friction is small, estimate the time for the car to roll down the ramp based on measurements of its mass and the length and angle of incline of the ramp.



31. Determine the mass needed on the end of the string in order to pull the cart up the ramp at a constant velocity as shown in the diagram above. Base your answer on measurements of the cart's mass, the angle of incline, and the coefficient of friction.

32. A book of weight _____ is placed on a ramp that is inclined at angle _____ . μ_s = _____ , μ_k = _____
(a) What force at the same angle would keep the book from moving? (b) Find the acceleration of the book if it is released.

33. A certain block has mass _____ and μ = _____. It is dragged down a slope by a cart with mass _____ that has negligible friction. The slope forms an angle of _____ with the horizontal. (a) Find the acceleration of the two objects. (b) Find the force of the cart acting on the block.