

Halliday ♦ Resnick ♦ Walker

**FUNDAMENTALS OF PHYSICS
SIXTH EDITION**

Selected Solutions

Chapter 5

5.9

5.29

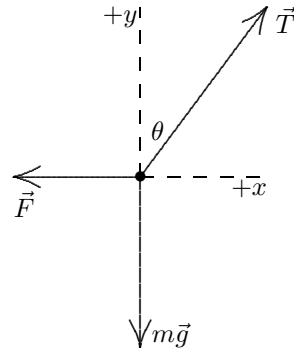
5.43

5.53

9. In all three cases the scale is not accelerating, which means that the two cords exert forces of equal magnitude on it. The scale reads the magnitude of either of these forces. In each case the tension force of the cord attached to the salami must be the same in magnitude as the weight of the salami because the salami is not accelerating. Thus the scale reading is mg , where m is the mass of the salami. Its value is $(11.0 \text{ kg})(9.8 \text{ m/s}^2) = 108 \text{ N}$.

29. The solutions to parts (a) and (b) have been combined here. The free-body diagram is shown below, with the tension of the string \vec{T} , the force of gravity $m\vec{g}$, and the force of the air \vec{F} . Our coordinate system is shown. The x component of the net force is $T \sin \theta - F$ and the y component is $T \cos \theta - mg$, where $\theta = 37^\circ$.

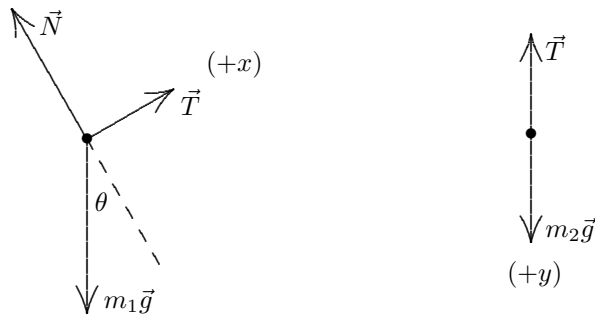
Since the sphere is motionless the net force on it is zero. We answer the questions in the reverse order. Solving $T \cos \theta - mg = 0$ for the tension, we obtain $T = mg / \cos \theta = (3.0 \times 10^{-4})(9.8) / \cos 37^\circ = 3.7 \times 10^{-3}$ N. Solving $T \sin \theta - F = 0$ for the force of the air: $F = T \sin \theta = (3.7 \times 10^{-3}) \sin 37^\circ = 2.2 \times 10^{-3}$ N.



43. The free-body diagram for each block is shown below. T is the tension in the cord and $\theta = 30^\circ$ is the angle of the incline. For block 1, we take the $+x$ direction to be up the incline and the $+y$ direction to be in the direction of the normal force \vec{N} that the plane exerts on the block. For block 2, we take the $+y$ direction to be down. In this way, the accelerations of the two blocks can be represented by the same symbol a , without ambiguity. Applying Newton's second law to the x and y axes for block 1 and to the y axis of block 2, we obtain

$$\begin{aligned} T - m_1 g \sin \theta &= m_1 a \\ N - m_1 g \cos \theta &= 0 \\ m_2 g - T &= m_2 a \end{aligned}$$

respectively. The first and third of these equations provide a simultaneous set for obtaining values of a and T . The second equation is not needed in this problem, since the normal force is neither asked for nor is it needed as part of some further computation (such as can occur in formulas for friction).



- (a) We add the first and third equations above: $m_2g - m_1g \sin \theta = m_1a + m_2a$. Consequently, we find

$$a = \frac{(m_2 - m_1 \sin \theta)g}{m_1 + m_2} = \frac{(2.30 \text{ kg}) - 3.70 \sin 30.0^\circ (9.8)}{3.70 + 2.30} = 0.735 \text{ m/s}^2 .$$

- (b) The result for a is positive, indicating that the acceleration of block 1 is indeed up the incline and that the acceleration of block 2 is vertically down.
(c) The tension in the cord is

$$T = m_1 a + m_1 g \sin \theta = (3.70)(0.735) + (3.70)(9.8) \sin 30^\circ = 20.8 \text{ N} .$$

53. The forces on the balloon are the force of gravity $m\vec{g}$ (down) and the force of the air \vec{F}_a (up). We take the $+y$ to be up, and use a to mean the *magnitude* of the acceleration (which is not its usual use in this chapter). When the mass is M (before the ballast is thrown out) the acceleration is downward and Newton's second law is $F_a - Mg = -Ma$. After the ballast is thrown out, the mass is $M - m$ (where m is the mass of the ballast) and the acceleration is upward. Newton's second law leads to $F_a - (M - m)g = (M - m)a$. The earlier equation gives $F_a = M(g - a)$, and this plugs into the new equation to give

$$M(g - a) - (M - m)g = (M - m)a \implies m = \frac{2Ma}{g + a} .$$