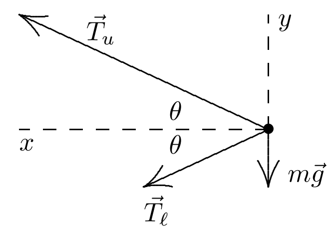
47. (a) The free-body diagram for the ball is shown below. $\vec{T}_u$ is the tension exerted by the upper string on the ball, $\vec{T}_\ell$ is the tension force of the lower string, and m is the mass of the ball. Note that the tension in the upper string is greater than the tension in the lower string. It must balance the downward pull of gravity and the force of the lower string.



(b) We take the $+x$ direction to be leftward (toward the center of the circular orbit) and $+y$ upward. Since the magnitude of the acceleration is $a = v^2/R$, the x component of Newton's second law is

$$T_u \cos\theta + T_\ell \cos\theta = \frac{mv^2}{R} ,$$

where v is the speed of the ball and R is the radius of its orbit. The y component is

$$T_u \sin\theta - T_\ell \sin\theta - mg = 0 .$$

The second equation gives the tension in the lower string: $T_\ell = T_u - mg/\sin\theta$. Since the triangle is equilateral $\theta = 30°$. Thus

$$T_\ell = 35 - \frac{(1.34)(9.8)}{\sin 30°} = 8.74 \text{ N} .$$

(c) The net force is leftward ("radially inward") and has magnitude

$$F_{\text{net}} = (T_u + T_\ell)\cos\theta = (35 + 8.74)\cos 30° = 37.9 \text{ N} .$$

(d) The radius of the path is $[(1.70\,\text{m})/2)]\tan 30° = 1.47\,\text{m}$. Using $F_{\text{net}} = mv^2/R$, we find that the speed of the ball is

$$v = \sqrt{\frac{RF_{\text{net}}}{m}} = \sqrt{\frac{(1.47\,\text{m})(37.9\,\text{N})}{1.34\,\text{kg}}} = 6.45 \text{ m/s} .$$