

Problem 5-58 in Walker, Physics, 3rd ed.

Your groceries are in a bag with paper handles. The handles will tear off if a force greater than 51.0 N is applied to them. What is the greatest mass of groceries that can be lifted safely with this bag, (a) given that the bag is raised with constant speed, or (b) with an acceleration of 1.35 m/s<sup>2</sup>?

Note the use of inequalities to represent the limiting condition.

Given:

bag breaks if  
 $T > 51.0 \text{ N}$



$\uparrow \vec{a}$   $\uparrow \vec{v}$

a)  $v = \text{constant} \Rightarrow a = 0$

b)  $a = +1.35 \frac{\text{m}}{\text{s}^2}$

Goal: Find greatest  $m$

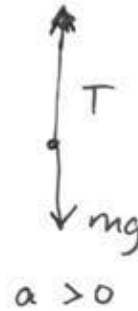
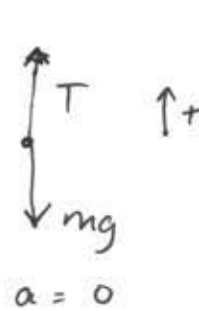
$$F_{\text{net}} = +T - mg$$

$$ma = T - mg$$

$$m(a+g) = T$$

$$m = \frac{T}{a+g}$$

$$m \leq \frac{T_{\text{max}}}{a+g}$$



a)  $= \frac{51.0 \text{ N}}{0 + 9.8 \frac{\text{m}}{\text{s}^2}}$   
 $= 5.2 \text{ kg}$

checks: sign +  
 units  $\text{N}/\text{m/s}^2 = \text{kg}$   
 sense:  $5.2 \text{ kg} \approx 10 \text{ lb}$

b)  $m \leq \frac{T_{\text{max}}}{a+g}$   
 $\leq \frac{51.0 \text{ N}}{1.35 \frac{\text{m}}{\text{s}^2} + 9.8 \frac{\text{m}}{\text{s}^2}}$   
 $\leq 4.6 \text{ kg}$

sense:  $m_{\text{max}}$  for b <  
 $m_{\text{max}}$  for a ✓