

Chapter 4
Exercises

7. At constant velocity the net force is zero, so friction also equals 400 N.
8. The force of friction on the crate must be $-F$. Then the net force on it is zero, which accounts for the state of rest.
15. A dieting person loses mass. Interestingly, a person can lose weight by simply being farther from the center of the Earth, at the top of a mountain, for example.
22. A rocket overcoming Earth gravity field uses more fuel than one overcoming the weaker gravity of the Moon.
27. Note that 30 N pulls 3 blocks. They must each have the same mass if they are identical. To pull 2 blocks then requires a 20-N pull, which is the tension in the rope between the second and third block. Tension in the rope that pulls only the third block is therefore 10 N. (Note that the net force on the first block, $30\text{ N} - 20\text{ N} = 10\text{ N}$, is the force needed to accelerate that block, having one-third of the total mass.)
34. The acceleration at the top or anywhere else in free fall is g , 10 m/s^2 , downward. The velocity of the rock is momentarily zero, but the rate of change of velocity is still there. Or better, by Newton's 2nd law, the force of gravity acts at the top as elsewhere; divide this net force by the mass and you have the acceleration of free fall. That is, $a = F_{\text{net}}/m = (mg)/m = g$.
39. When held at rest the upward support force equals the gravitational force on the apple and the net force is zero. When released, the upward support force is no longer there and the net force is the gravitational force, 1 N. (If the apple falls fast enough for air resistance to be important, then the net force will be less than 1 N, and eventually can reach zero if air resistance builds up to 1 N.)
54. The terminal speed attained by the falling cat is the same whether it falls from 50 stories or 20 stories. Once terminal speed is reached, falling extra distance does not affect the speed. (The low terminal velocities of small creatures enable them to fall without harm from heights that would kill larger creatures.)

Problems

2. $a = F/m = 200\text{ N}/40\text{ kg} = \mathbf{5\text{ m/s}^2}$.
4. The acceleration of each is the **same**: $a = F/m = 2\text{ N}/2\text{ kg} = 1\text{ N}/1\text{ kg} = 1\text{ m/s}^2$. (Incidentally, from the definition that $1\text{ N} = 1\text{ kg}\cdot\text{m/s}^2$, you can see that 1 N/kg is the same as 1 m/s^2 .)

6. The more massive box has **4 times** the mass, for we're saying $a = F/m = 4F/?$. Ah, that's gotta be $4m$.

9. (a) $a = (\text{change of } v)/t = (1 \text{ m/s})/(2 \text{ s}) = \mathbf{0.5 \text{ m/s}^2}$. (b) $F = ma = (60 \text{ kg})(0.5 \text{ m/s}^2) = \mathbf{30 \text{ N}}$.