Name: _____ Date: _____ Skill and Practice

3F Newton's Second Law

Read:

- Newton's second law states that the acceleration of an object is directly related to the force on it, and inversely related to the mass of the object. You need more force to move or stop an object with a lot of mass (or *inertia*) than you need for an object with less mass.
- The formula for the second law of motion (first row below) can be rearranged to solve for mass and force.

What do you want to know?	What do you know?	The formula you will use
acceleration (a)	force (F) and mass (m)	$\text{acceleration} = \frac{\text{force}}{\text{mass}}$
mass (m)	acceleration (a) and force (F)	$\text{mass} = \frac{\text{force}}{\text{acceleration}}$
force (F)	acceleration (a) and mass (m)	$\text{force} = \text{acceleration} \times \text{mass}$

Example:

- How much force is needed to accelerate a truck with a mass of 2,000 kilograms at a rate of 3 m/s^2?

$$F = m \times a = 2{,}000 \text{ kg} \times 3 \text{ m/s}^2 = 6{,}000 \text{ kg-m/s}^2 = 6{,}000 \text{ N}$$

- What is the mass of an object that requires 15 N to accelerate it at a rate of 1.5 m/s^2?

$$m = \frac{F}{a} = \frac{15 \text{ N}}{1.5 \text{ m/s}^2} = \frac{15 \text{ kg-m/s}^2}{1.5 \text{ m/s}^2} = 10 \text{ kg}$$

Practice:

1. What is the acceleration of a 2,000-kilogram truck if a force of 4,200 N is used to make it start moving forward?

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2. What is the acceleration of a 0.30-kilogram ball that is hit with a force of 25 N?

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3. How much force is needed to accelerate a 68-kilogram skier at 1.2 m/s^2?

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4. What is the mass of an object that requires a force of 30 N to accelerate at 5 m/s^2?

5. What is the force on a 1,000-kilogram elevator that is falling freely under the acceleration of gravity only?

6. What is the mass of an object that needs a force of 4,500 N to accelerate it at a rate of 5 m/s^2?

7. What is the acceleration of a 6.4-kilogram bowling ball if a force of 12 N is applied to it?