Name: _____ Date: _____ Skill and Practice

7A Work Done against Gravity

Read:

Any time you lift an object, you do work against gravity. We use the same formula for work that you already know (Work = force × distance), but it's expressed in a slightly different form:

$$\text{Work against gravity} = \text{mass} \times \text{acceleration due to gravity} \times \text{height}$$

$$W = mgh$$

Force is written in the form mg, where m is mass and g is the acceleration due to gravity, 9.8 m/s^2. We use h for height because only the *vertical* distance an object moves matters for calculating work against gravity.

Did you know...If you have to lift a new sofa to a second-floor apartment, the work done against gravity is the same whether you haul it straight up the side of the building with ropes or take a longer path up the stairs. Only the vertical distance matters because the force of gravity is vertical.

Example:

You lift a 2-liter bottle of cola from a grocery bag on the floor to a refrigerator shelf that is 0.8 meter high. If the bottle has a mass of 2.02 kilograms, how much work did you do against gravity?

Looking for The amount of work done against gravity.	Solution $W = mgh$ $W = 2.02 \text{ kg} \times 9.8 \text{ m/s}^2 \times 0.8 \text{ m}$ $W = 15.8 \text{ joules}$
Given mass of bottle = 2.02 kilograms acceleration due to gravity = 9.8 m/s^2 height = 0.8 meter	
Relationship $W = mgh$	

Practice:

1. Jai-Anna, who has a mass of 45 kilograms, climbed 3 meters up a ladder to rescue her cat from a tree. How much work against gravity did she do?

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2. A tram inside the Gateway Arch in Saint Louis, Missouri lifts visitors to a window-lined observation room 192 meters above the ground. How much work does the tram's motor do against gravity to carry two 55-kilogram passengers to this room? (You may ignore the work done by the motor to carry the tram itself).

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3. You pick up a 10-newton book off the floor and put it on a shelf 2 meters high. How much work did you do?

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Skill and Practice

4. Elijah does 44 joules of work against gravity to pull a 0.5-kilogram rope with a 1.0-kilogram bucket attached up to the floor of his tree house. How many meters high is his tree house?

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5. Alejandra weighs 225 newtons. How much work does she do against gravity when she climbs to a ledge at the top of a 15-meter climbing wall?

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6. A window-washer stands on a scaffolding 30 meters above the ground. If he did 23,520 joules of work to reach the scaffolding, what is his mass?
