2021Q18 (POTENTIAL ENERGY, GRAVITY)

One Energy's wind turbines convert wind energy into electrical energy. However, many kinds of energy exist in the world. Specifically, gravitational potential energy influences us every day. We all notice it when it is easier to walk down the steps than walk up the steps. At One Energy, we deal with gravitational potential energy as we climb tower ladders and lift rotors. The equation for the gravitational potential energy of an object is:

$$Gravitational\ Potential\ Energy = mass * gravitational\ acceleration * height$$

The gravitational acceleration depends on a lot of factors, but we will assume that it is 9.81 m/s^2. The mass is measured in kilograms while the height is measured in meters. This results in the potential energy being calculated as a joule, a standard unit of energy.

Level 1: One of our technicians just climbed a tower and is now 80 meters off the ground. The technician has a mass of 62 kilograms. However, the technician stands at the top of the tower with their tools and safety equipment. The combined mass of the technician, tools, and safety equipment is 87 kg. As the technician stands atop the tower with all their equipment, what is their total potential energy in joules and kilojoules? How much potential energy do just the tools and safety equipment have in joules and kilojoules?

Level 2: Even the turbine itself has potential energy! Here, we will exclude the potential energy of the blades, hub, and nacelle and only discuss the potential energy of the tower. While the base of the tower is sturdily connected to the ground, the structure still has height. If the tower is made of steel, which weighs about 8,000 kilograms for each meter of height, and reaches 80 meters into the air, what is its total gravitational potential energy?

A One Energy employee has huge potential energy when standing atop the nacelle during construction.