2021A18 (POTENTIAL ENERGY, GRAVITY)

Level 1: Solving these problems requires using all the information given:

$$Potential\ Energy = mass * gravitational\ acceleration * height$$
$$= 87\ kg * 9.81 \frac{m}{s^2} * 80m$$
$$= \ 68{,}277\ J = 68.277\ kJ$$

$$Equipments'\ Potential\ Energy = (total\ mass - mass\ of\ person) * graviataional\ acceleration * height$$
$$= (87\ kg - 62\ kg) * 9.81 \frac{m}{s^2} * 80m$$
$$= 19{,}620\ J = 19.62\ kJ$$

Level 2: There are two methods to solving this problem:

1. We can correctly simplify the problem by saying that the average height of the tower is 40 meters and that the weight is evenly distributed along the height of the tower. Therefore, the expression becomes (8000 kg / m * 80 m) * 9.81 m/s² * 40 m which results in a gravitational potential energy of 251,136,000 joules or about 251 MJ.
2. The problem can be solved as an integral as well. We can integrate over the height to determine the gravitational potential energy of the tower.

$$Potential\ Energy = \int_{Tower\ Base}^{Tower\ height} (mass\ per\ height * gravitational\ acceleration * height)dh$$
$$= \int_{0m}^{80m} (\,8{,}000 \frac{kg}{m} * 9.81 \frac{\mathrm{m}}{\mathrm{s}^2} * \mathrm{h})\ \mathrm{dh}$$
$$= \ 9.81 \frac{m}{s} * 8{,}000 \frac{kg}{m} * \left(\frac{1}{2} h^2\right)_0^{80}$$
$$= 9.81 \frac{m}{s} * 8{,}000 \frac{kg}{m} \left(\frac{1}{2}(80m)^2 - \frac{1}{2}(0m)^2\right)$$
$$= 251{,}136{,}000 J = 251\ MJ$$

The tower of One Energy's turbines gains a lot of gravitational potential energy as construction proceeds.