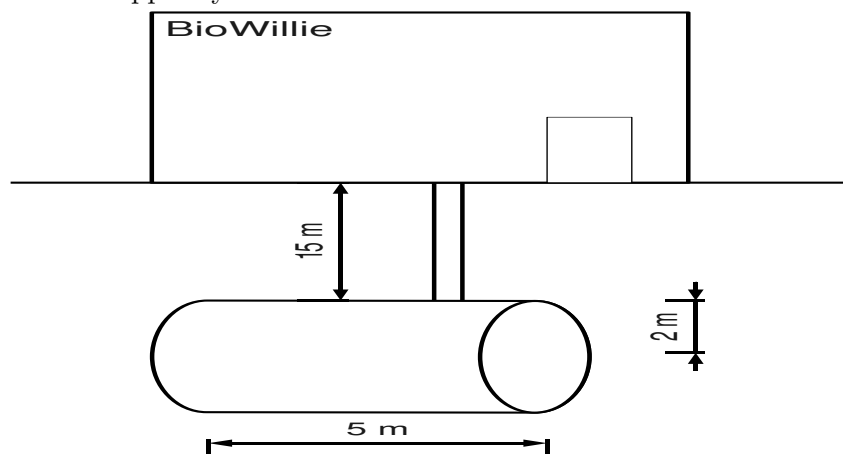


7. [12 points] Country music legend Willie Nelson is concerned about our dependence of fossil fuels. In 2005, he started a company which sells a bio-diesel fuel called BioWillie. He recently added a new cylindrical underground storage tank at his factory, and he needs to know how much work is required to pump all the fuel in a full tank to the surface. The tank is pictured below. It is 5 meters long and has a radius of 2 meters. Its center line is 17 meters underground. BioWillie fuel has a density of 900 kg per cubic meter. Make sure to include appropriate units and justification to support your answers.



- a. [7 points] Write an expression that approximates the work done in lifting a horizontal slice of fuel that is  $h_i$  meters below the ground's surface, given that the thickness of the slice is  $\Delta h$  meters.
- b. [5 points] Help Willie Nelson by computing the work required to pump all the fuel in a full tank to the ground's surface. You can use your calculator to compute your final answer.