9. [10 points] Tracy Johnson is taking the trash out of her apartment on State Street. In order to throw the trash bag into the dumpster, she lifts the bag at a constant speed from the ground up to a height of 2 meters. The bag of trash weighs 5 kg initially, but an unfortunate hole causes the bag to leak trash at a constant rate. Recall that the gravitational constant is $g = 9.8 \text{ m/s}^2$.

If the bag weighs 3 kg when it is one meter from the ground, compute the work required for Tracy to lift the bag of trash into the dumpster. Evaluate by hand any integrals you compute.

**Solution:** The trash bag is leaking at a constant rate, so the weight of the bag is a linear function of the height above the ground. Using the information, the bag has a mass of $5 - 2h$ kg at a height of $h$ meters. Since the force on the bag at height $h$ is $(5 - 2h)g$, the total work is

$$\int_0^2 (5 - 2h)g \, dh = 6g = 58.8 \text{ joules.}$$