1 Bottle in a Bottle

The internal energy of helium gas at temperature T is to a very good approximation given by

$$U = \frac{3}{2} N k_B T \tag{1}$$

Consider a very irreversible process in which a small bottle of helium is placed inside a large bottle, which otherwise contains vacuum. The inner bottle contains a slow leak, so that the helium leaks into the outer bottle. The inner bottle contains one tenth the volume of the outer bottle, which is insulated. What is the change in temperature when this process is complete? What fraction of the helium will remain in the small bottle?