5-6)

First, we align the magnetic moment of the atom with the external magnetic field. On reversal, the moment is aligned anti-parallel to the B-field, and it has an energy

$$U_i = -\vec{\mu} \cdot \vec{B} = -(1.8 \times 10^{-23})(12)\cos(180^o) = +2.16 \times 10^{-22} \text{ Joules.}$$

After the moment swings around to be parallel to the field, it has energy

$$U_f = -\vec{\mu} \cdot \vec{B} = -(1.8 \times 10^{-23})(12)\cos(0^o) = -2.16 \times 10^{-2} \text{ Joules.}$$

The change in its energy is

$$\Delta U = U_f - U_i = -4.32 \times 10^{-22} \text{ Joules.}$$

This means the atom got rid of 4.32 × 10$^{-22}$ Joules.