Let us define the z-axis as parallel to the magnetic field. Let us now look at a particle with velocity v_{xy} in the x-y-plane. Since $\frac{dB}{dt} \ll \frac{B^2 e}{m}$, the radius of the electron's trajectory is kept nearly the same during one revolution. This radius is r, then $\frac{v_{xy}^2}{r} = \frac{e v_{xy} B}{m} \Rightarrow r = \frac{m v_{xy}}{eB}$. The potential difference induced by the changing magnetic field is $\mathcal{E} = \frac{d\Phi}{dt}$ per revolution. The energy gained per revolution is thus $e\mathcal{E} = e\frac{d\Phi}{dt} = e\pi r^2 \frac{dB}{dt} = \Delta \frac{m v_{xy}^2}{2} = m v_{xy} \Delta v_{xy}$

$m v_{xy} \Delta v_{xy} = e\pi r^2 \frac{dB}{dt} = \frac{e\pi m^2 v_{xy}^2}{e^2 B^2} \frac{dB}{dt} \Rightarrow$ per revolution $\Delta v_{xy} = \frac{\pi m v_{xy}}{eB^2} \frac{dB}{dt}$.

From here $\frac{dv_{xy}}{dt} = \frac{\frac{\pi m v_{xy}}{eB^2} \frac{dB}{dt}}{\left(\frac{2\pi r}{v_{xy}}\right)} = \frac{v_{xy}}{2B} \frac{dB}{dt} \Rightarrow \frac{2\, dv_{xy}}{v_{xy}} = \frac{dB}{B}$.

Integrating from the initial state to the state with $B = 2B_0$

$$2\int_{v_{xy0}}^{v_{xy1}} \frac{dv_{xy}}{v_{xy}} = \int_{B_0}^{2B_0} \frac{dB}{B} \Rightarrow 2\left(\ln v_{xy1} - \ln v_{xy0}\right) = \ln 2B_0 - \ln B_0 = \ln \frac{2B_0}{B_0}.$$

$\ln \frac{v_{xy1}}{v_{xy0}} = \frac{\ln 2}{2} \Rightarrow v_{xy1} = \sqrt{2} \cdot v_{xy0}$, where v_{xy1} is the speed after the increase to $B = 2B_0$ and v_{xy0} is the initial speed. This means that the kinetic energy in the x-y-plane is multiplied by $(\sqrt{2})^2 = 2$, meaning it is now $2 \cdot 2 \cdot \frac{kT_0}{2} = 2kT_0$ per particle. The kinetic energy in the z-axis is unaffected by this process, meaning the total kinetic energy is now $2kT_0 + \frac{kT_0}{2} = \frac{5kT_0}{2}$ or $\frac{5kT_0}{2\cdot 3} = \frac{5}{6}kT_0$ per degree of freedom. This means that after many collisions the energy in the x-y-plane is $\frac{5}{6} \cdot 2kT_0 = \frac{5}{3}kT_0$. Since the reduction from $2B_0$ to B_0 is the reverse process of the initial increasing, the energy is divided by 2 during the decreasing. Thus the energy in the x-y-plane will be $\frac{5}{3}kT_0 \cdot \frac{1}{2} = \frac{5}{6}kT_0$ and the total energy will be $\frac{5}{6}kT_0 + \frac{5}{6}kT_0 = \frac{5}{3}kT_0 = \frac{3}{2}kT' \Rightarrow$

$\Rightarrow T' = \frac{10}{9} \cdot T_0$