(3) Suppose that a reversal of the Earth's magnetic field, starting now, is completed in 10^4 years. The equatorial line integral of E during that time will be about how many millivolts?

The flux through the circle of Earth radius R that represents the magnetic equator is equal to the flux returning through the equatorial plane outside the Earth. We may assume the external field is that of a central dipole, with intensity B_0 at $r = R$. For $r > R$ the field strength at the equatorial plane is $B_0(R/r)^3$. The flux crossing the equatorial plane is $\int_R^\infty 2\pi r B(r)\, dr = 2\pi R^2 B_0$. With $B_0 = 0.3$ G and $R = 6 \times 10^8$ cm, the flux is 6.6×10^{17} G cm^2. If this reverses in 10^4 years, or 3×10^{11} s, changing at a constant rate, the voltage induced in the equatorial ring will be approximately 40 mV.