(3) If the moon is receding from the earth at the rate of 4 cm per year, how much power is being dissipated in tidal friction?

In a Kepler orbit the angular momentum is proportional to $r^{1/2}$, so an increase by $\Delta r$ in the time $t$ requires a torque of magnitude $L = (\Delta r/2r)(Mr^2\Omega_m)/t$, where $M$ is the moon's mass and $\Omega_m$ its orbital angular velocity. An equal and opposite torque acts on the Earth in the sense to reduce its rotational velocity $\omega_e$. The power dissipated in tidal friction must be $L\omega_e$. With $r = 4 \times 10^{10}$ cm, $M = 8 \times 10^{25}$ g, $\Omega_m = 2 \times 10^{-6}\ \text{s}^{-1}$, $\omega_e = 6 \times 10^{-5}\ \text{s}^{-1}$, and $t = 3 \times 10^7$ s, $L\omega_e$ amounts to $2.5 \times 10^{12}$ watts. Refinements of order $M/M_e$ are neglected.