Yichao Yu
8.311 Problem Set 5
Recitation Section 1

1.

(a)

$$\begin{aligned}\frac{\mathrm{d}W_{rad}}{\mathrm{d}t'} =& \frac{e^2}{4\pi\varepsilon_0}\frac{2}{3c}\gamma^6\left(\Omega^2\beta^2 - \Omega^2\beta^4\right)\\ =& \frac{e^2}{4\pi\varepsilon_0}\frac{2}{3c}\gamma^4\Omega^2\beta^2\\ =& \frac{e^2}{4\pi\varepsilon_0}\frac{2\omega_0^2}{3c}\gamma^2\beta^2\end{aligned}$$

(b)

$$\begin{aligned}\frac{\mathrm{d}\gamma}{\mathrm{d}t}mc^2 =& -\frac{e^2}{4\pi\varepsilon_0}\frac{2\omega_0^2}{3c}\gamma^2\beta^2\\ \frac{\mathrm{d}\gamma}{\mathrm{d}t} =& -\frac{e^2}{4\pi\varepsilon_0}\frac{2\omega_0^2}{3mc^3}\gamma^2\beta^2\\ =& -\frac{2\omega_0^2 r_e}{3c}\gamma^2\beta^2\\ T_0 =& \frac{3c}{2\omega_0^2 r_e}\end{aligned}$$

(c)

For $\gamma \gg 1$, $\beta \approx 1$

$$\begin{aligned}\frac{\mathrm{d}\gamma}{\mathrm{d}t} =& -\frac{\gamma^2}{T_0}\\ \frac{1}{\gamma} =& \frac{1}{\gamma_0} + \frac{t}{T_0}\\ T =& \frac{\gamma_0 - \gamma}{\gamma\gamma_0}T_0\end{aligned}$$

(d)

(e)

(f)

2.

(a)

(b)

3.

(a)

(b)

(c)

(d)

(e)

4.

(a)

(b)

(c)