$$\vec{L}_{cm}^{\,2} \log\left[\frac{1}{s(t_2)}\right] \le -\vec{L}_{cm}^{\,2} \log s(t_1) + 4W\int_{t_1}^{t_2} \dot{s}\, dt' - 4\int_{t_1}^{t_2} \dot{s}\ddot{s}\, dt'$$

But $-4\int_{t_1}^{t_2} \dot{s}\ddot{s}\, dt' = -2\dot{s}^2\Big|_{t_1}^{t_2} = 2\dot{s}^2(t_1) - 2\dot{s}^2(t_2) \le 2\dot{s}^2(t_1)$

$$4W\int_{t_1}^{t_2} \dot{s}\, dt' = 4W\left[s(t_2) - s(t_1)\right]$$

$$\therefore\ \vec{L}_{cm}^{\,2} \log\left[\frac{1}{s(t_2)}\right] \le -\vec{L}_{cm}^{\,2} \log s(t_1) + 4W\left[s(t_2) - s(t_1)\right] + 2\dot{s}^2(t_1)$$

Let $c \equiv -\vec{L}_{cm}^{\,2} \log s(t_1) - 4W s(t_1) + 2\dot{s}^2(t_1)$

Then we get

(F) $$\vec{L}_{cm}^{\,2} \le \frac{4W s(t_2) + c}{\log\left(\frac{1}{s(t_2)}\right)}.$$

Also, we know $\vec{L}_{cm}^{\,2} \ge 0$.

Letting $t_2 \to t_c$ gives $\vec{L}_{cm} = 0$, which means that only under this exceptional condition may all the bodies collide.