1. a) Spontaneous emission rate is

$$\frac{1}{t_{sp}} = \frac{1}{3ms}$$

Stimulated emission rate is

$$P_{st} = N \frac{c}{V} \sigma(\nu)$$

Here $\sigma(\nu_0) = \frac{\lambda^2}{8\pi t_{sp}} g(\nu_0)$

$$g(\nu_0) = \frac{\Delta\nu/2\pi}{(\Delta\nu/2)^2} = \frac{2}{\pi\Delta\nu} \quad \left(\text{or } \frac{1}{\Delta\nu}\right)$$

$$\sigma(\nu_0) = \frac{\lambda^2}{4\pi^2 t_{sp}\Delta\nu}$$

$$= \frac{(0.7\mu m)^2}{4\pi^2 \times 3ms \times 50GHz} = 8.28 \times 10^{-19} cm^2.$$

so, need

$$N = \frac{1}{t_{sp}} \frac{V}{c\sigma}$$

$$= \frac{1}{3ms} \frac{100\ cm^3}{3\times 10^{10} cm/s \cdot 8.3 \times 10^{-19} cm^2}$$

$$\boxed{N = 1.34 \times 10^{12} \text{ photons}} \quad (\text{or } 8.55 \times 10^{11} \text{ photons})$$

b) $$W = \frac{I\sigma}{h\nu_0} = \frac{1}{t_{sp}}$$

$$\boxed{I = \frac{h\nu_0}{\sigma t_{sp}}}$$