4 a)

$$I(\omega) = \frac{\hbar}{4\pi^2 c^2} \frac{\omega^3}{e^{\frac{\hbar\omega}{k_B T}} - 1}$$; Put $x = \frac{\hbar\omega}{k_B T} \Rightarrow dx = \frac{\hbar}{k_B T} d\omega$

$\Rightarrow \boxed{d\omega = \frac{k_B T}{\hbar} dx}$ & $\boxed{\omega = \frac{k_B T}{\hbar} x}$

$$W = \int_0^\infty I(\omega)\, d\omega = \int_0^\infty \frac{\hbar}{4\pi^2 c^2} \frac{\omega^3}{e^{\frac{\hbar\omega}{k_B T}} - 1} d\omega$$

$$= \int_0^\infty \frac{\hbar}{4\pi^2 c^2} \frac{\left(\frac{k_B T}{\hbar} x\right)^3}{e^x - 1} \frac{k_B T}{\hbar} dx$$

$$= \int_0^\infty \left(\frac{k_B T}{\hbar}\right)^4 \frac{\hbar}{4\pi^2 c^2} \frac{x^3}{e^x - 1} dx = \frac{k_B^4 T^4}{4\hbar^3 \pi^2 c^2} \int_0^\infty \frac{x^3}{e^x - 1} dx$$

$$\boxed{W = \frac{k_B^4 T^4}{4\pi^2 c^2 \hbar^3} \int_0^\infty \frac{x^3}{e^x - 1} dx}$$

(b) First, this integral is converted to integral with limits (0, 1) by substituting $x = \frac{3.5 z}{1 - z} = \frac{7}{2(1-z)}$

$\Rightarrow$ ~~$W = \int_0^1 \frac{3.5}{(1-z)^2} \ldots e$~~

$$\Rightarrow \boxed{W = \frac{k_B^4 T^4}{4\pi^2 c^2 \hbar^3} \int_0^1 \frac{7}{2(1-z)^2} \frac{\left(\frac{7}{2}\frac{z}{1-z}\right)^3}{e^{\frac{7}{2}\frac{z}{1-z}} - 1} dz}$$

Using simpson's rule (with even number of intervals), we integrate it numerically.