Answer

a. $X(j0)=\int_{-\infty}^{\infty}x(t)e^{-j0t}dt=0$.

b. $\int_{-\infty}^{\infty}X(j\omega)e^{j\frac{\omega T}{4}}d\omega=2\pi x\left(\frac{T}{4}\right)=-2\pi A$.

c. $\int_{-\infty}^{\infty}\left|X(j\omega)\right|^{2}d\omega=2\pi\int_{-\infty}^{\infty}\left|x(t)\right|^{2}dt=2\pi\cdot 2\cdot\frac{A^{2}T}{2}=2\pi A^{2}T$.

d. Since $x(t)$ and $\frac{dx}{dt}$ do not have any impulses (delta functions), but $\frac{d^{2}x}{dt^{2}}$ has impulses, $\left|X(j\omega)\right|\propto\left|\omega\right|^{-2}$ as $\left|\omega\right|\to\infty$.