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

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