2. a. $f(t) = a\,delta(t-t_0)$

compute $(f(t))^2$

$$|f(t)|^2 = \int_{-\infty}^{\infty} a\delta(t-t_0)(e^{-j\omega t})\,a\delta(t-t_0)(e^{j\omega t})\,dt$$

$$= a^2 \int_{-\infty}^{\infty} \delta(t-t_0)^2 (e^{j\omega t - j\omega t})\,dt$$

$$= a^2$$

b. compute Φ $f(t)$ vs frequency

$$\int_{-\infty}^{\infty} a\delta(t-t_0)(e^{-j\omega t})\,dt = a\cos(\omega t_0) - a\sin(\omega t_0)$$

$$\int_{-\infty}^{\infty} \delta(t-t_0)(e^{-j\omega t})\,dt = \cos(\omega t_0) - \sin(\omega t_0)$$

$$\Phi = 1$$

c. compute $\frac{-d\Phi}{d\omega} = \frac{a\cos(\omega t_0) - a\sin(\omega t_0)}{\delta(t-t_0)(e^{j\omega t})}$