Phys 460 HW 1 solutions

1) Let $\vec{V}(\omega) = \int dt\, e^{i\omega t} \vec{V}(t)$

$$\frac{d\vec{v}}{dt} + \frac{\vec{v}}{\tau} = \frac{q\vec{E}(t)}{m}$$

$$\int dt\, e^{i\omega t} \frac{d\vec{v}}{dt} + \frac{\vec{V}(\omega)}{\tau} = \frac{q\vec{E}(\omega)}{m}$$

int. by parts →

$$\int dt\, (-i\omega)\, \vec{V}(t) e^{i\omega t} + \frac{\vec{V}(\omega)}{\tau} = \frac{q\vec{E}(\omega)}{m}$$

$$\left(-i\omega + \frac{1}{\tau}\right)\vec{V}(\omega) = \frac{q\vec{E}(\omega)}{m}$$

$$\vec{V}(\omega) = \frac{q\vec{E}(\omega)/m}{\frac{1}{\tau} - i\omega} = \frac{q\tau\vec{E}(\omega)/m}{1 - i\omega\tau}$$

$$\vec{J}(\omega) = nq\vec{V}(\omega) = \frac{nq^2\tau/m}{1 - i\omega\tau}\vec{E}(\omega)$$

$$\sigma(\omega) = \frac{nq^2\tau/m}{1 - i\omega\tau}$$