Problem 1. (a) The displacement is given by

$$x(t) = \frac{1}{2\pi}\int_{-\infty}^{\infty} \alpha(\omega)e^{i\omega t}\,\mathrm{d}\omega$$

where the integral over the contour (the upper semicircle in the figure from Kittel) is zero since $\alpha(\omega)$ is analytic in the uppper plane. (b)

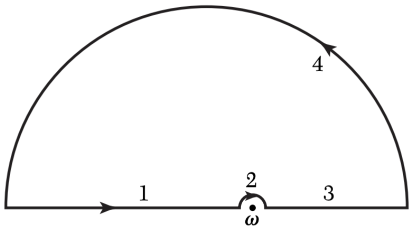

Figure 2 Contour for the Cauchy principal value integral.

$$x(t) = \frac{1}{2\pi}\int_{-\infty}^{\infty} \frac{e^{i\omega t}}{\omega_0^2 - \omega^2 - i\omega\rho}\,\mathrm{d}\omega$$

Since the integral vanishes over the infinite semicircle, the Cauchy integral at the lower half-plane, and with the residues at

$$\pm\frac{1}{2}\left(\omega_0^2 - \frac{1}{4}\rho^2\right)^{1/2} e^{-\rho t/2}e^{\mp i(\omega_0^2 - \frac{1}{4}\rho^2)^{1/2}t}$$

the displacement is the imaginary part of the sum of the residues:

$$x(t) = \left(\omega_0^2 - \frac{1}{4}\rho^2\right)^{1/2} e^{-\rho t/2}\sin\left([\omega_0^2 - \frac{1}{4}\rho^2]^{1/2}t\right)$$

2 (a) Ferromagnetic Insulators:

- EuO, Crystal Structure: SC, Curie Temp: 69 K (Kittel)
- EuS, Crystal Structure: SC, Curie Temp: 16 K (https://doi.org/10.1002/smll.200500294)
- $CrBr_3$, Crystal Structure: Hexagonal, Curie Temp: 37 K (https://doi.org/10.1016/j.physleta.2023.128980)

(b) Ferromagnetic Metals: (All from Kittel Ch 12 Table 1)

- Fe, Crystal Structure: BCC, Curie Temp: 1043 K
- Co, Crystal Structure: HCP, Curie Temp: 1388 K
- Ni, Crystal Structure: FCC, Curie Temp: 627 K

(c) Antiferrromagnetic Insulators:

- MnO, Crystal Structure: FCC, Neel Temp: 116 K (Kittel)
- MnS, Crystal Structure: FCC, Neel Temp: 160 K (Kittel)
- MnTe, Crystal Structure: Hexagonal, Neel Temp: 307 K (Kittel)

(d) Antiferromagnetic Metals:

- Cr, CS: BCC, NT: 308 K (Kittel)
- VO_2, CS: Monoclinic, NT: 340 K(https://doi.org/10.1063/5.0027674)
- MnAs, CS: Hexagonal, NT: 480 K (DOI: 10.1103/PhysRevLett.111.047001)