1. Show that the total cross section for $e^+e^- \rightarrow f\bar{f}$ ($f \neq e$) at $\sqrt{s} = M_Z$ can be written

$$\sigma_{f\bar{f}} = \frac{12\pi \Gamma_e \Gamma_f}{M_Z^2 \Gamma_Z^2}$$

where

$$\Gamma_f = N_c \frac{G_F M_Z^3}{6\pi \sqrt{2}} \left((c_V)^2 + (c_A)^2\right)$$

2. Prepare a graphs showing $A_{FB}$ as a function of $\sqrt{s}$ for the following processes:

$$e^+e^- \rightarrow \mu^+\mu^- \quad (1)$$
$$e^+e^- \rightarrow b\bar{b} \quad (2)$$
$$e^+e^- \rightarrow c\bar{c} \quad (3)$$

For each graph, assume the following three different values of $\sin^2 \theta_W$: 0.231, 0.22 and 0.24, so as to demonstrate the sensitivity of these measurements in the determination of $\sin^2 \theta_W$. What experimental complications would one encounter when trying to measure $A_{FB}$ for these three processes? Which would be the easiest to measure? Which would be the most difficult?