Remember that problems marked with an asterisk are more challenging and or quite calculationally involved. Do the other ones first, if you prefer. Come to me or talk to each other if you would like help/hints. I especially encourage collaboration among you.

**Problem #1**
The Feynman Propagator

Show that the Feynman propagator, \( D_F(x - y) = \langle 0|T\{\phi(x),\phi(y)\}|0 \rangle \) is a Green’s function of the Klein-Gordon operator, i.e., that \((\partial^2 + m^2)D_F(x - y) = -i\delta^{(4)}(x - y)\). Then take the Fourier transform of both sides of this equation and derive the expression for the momentum space propagator \( \tilde{D}_F(p) \) defined by

\[
D_F(x - y) = \int \frac{d^4 p}{(2\pi)^4} e^{-ip \cdot (x - y)} \tilde{D}_F(p). \tag{1}
\]

**Problem #2**
Dimensions, more or less

For a massless scalar particle, using the Feynman propagator, calculate the effective potential energy (analog of \( V \propto 1/r \) in 4-D) between two static sources in an arbitrary number of space-time dimensions.

**Problem #3**
Muon Decay

Schwartz 5.3

**Problem #4**
Kinematics

Schwartz 5.6

**Problem #5**
Operators

Schwartz 6.3

**Problem #6**
Amplitudes

Schwartz 7.1