

Particle Physics Worksheet #2

1. Describe what is meant by a Feynman diagram.
2. Draw Feynman diagrams to represent the following electromagnetic processes:
 - (a) $e^- + e^+ \rightarrow e^- + e^+$
 - (b) $e^- + e^+ \rightarrow \gamma + \gamma$
3. Use the electromagnetic vertex to draw a Feynman diagram for the scattering of a photon off an electron.
4. A meson has quark content $(u\bar{u})$. It decays into two photons. Draw the Feynman diagram for this decay.
5. Beta-minus decay involves the decay of a neutron into a proton according to the reaction $n \rightarrow p^+ + e^- + \bar{\nu}_e$. Draw the Feynman diagram for the process.
6. Using the basic weak interaction vertex involving a W boson and two fermions, draw Feynman diagrams to represent the following processes:
 - (a) $\mu^- \rightarrow e^- + \bar{\nu}_e + \nu_\mu$
 - (b) $e^- + \bar{\nu}_e \rightarrow \mu^- + \bar{\nu}_\mu$
 - (c) $\pi^+ \rightarrow \mu^+ + \nu_\mu$ (quark structure π^+ ($u\bar{d}$))
 - (d) $K^- \rightarrow \mu^- + \bar{\nu}_\mu$ (quark structure K^- ($s\bar{u}$))
7. Using the basic weak interaction vertex involving a Z boson and two fermions, draw Feynman diagrams to represent the following processes:
 - (a) $e^- + e^- \rightarrow \bar{\nu}_\mu + \nu_\mu$
 - (b) $e^- + \nu_\mu \rightarrow e^- + \nu_\mu$
 - (c) $e^- + e^+ \rightarrow e^- + e^+$
8. A neutral meson contains a u quark and a u antiquark and has rest energy equal to 135 MeV. The meson is at rest.
 - (a) Draw a Feynman diagram to represent the decay of this meson into two photons.
 - (b) Explain why the photons must be emitted in opposite directions.
 - (c) Calculate the wavelength of each of the photons.