PHYS-4303 Homework 11 NOT TO HAND IN

This homework is due to `https://uwcloud.uwinnipeg.ca/s/dcYrc2Yys2jsSrz` by 10:59PM on the due date. Your file(s) must be in PDF format; they may be black-and-white scans or photographs of hardcopies (all converted to PDF), PDF prepared by LaTeX, or PDF prepared with a word processor *using an equation editor*.

1. **Quark Creation from Quarks**

   Consider as an example $u+\bar{u}$ quarks annihilating and producing an $s+\bar{s}$ quark pair through the strong force. This process has the same Feynman diagram as $e^+ + e^- \to \mu^+ + \mu^-$ production via electromagnetism except with a gluon replacing that photon.

$$
\mathcal{M} =
\qquad\qquad\qquad (1)
$$

   Because the diagrams are the same, the spinor and gamma matrix factors are all the same as for muon creation.

   (a) Write the color factors for this amplitude. Label the u quark as particle 1, the $\bar{u}$ as particle 2, the s as particle 3, and $\bar{s}$ as particle 4.

   (b) Evalute the color factors for $\langle|\mathcal{M}|^2\rangle$ by averaging over incoming colors and summing over outgoing colors.