Pset 10

1) $pp \to \mu^+\mu^- X$, em interaction

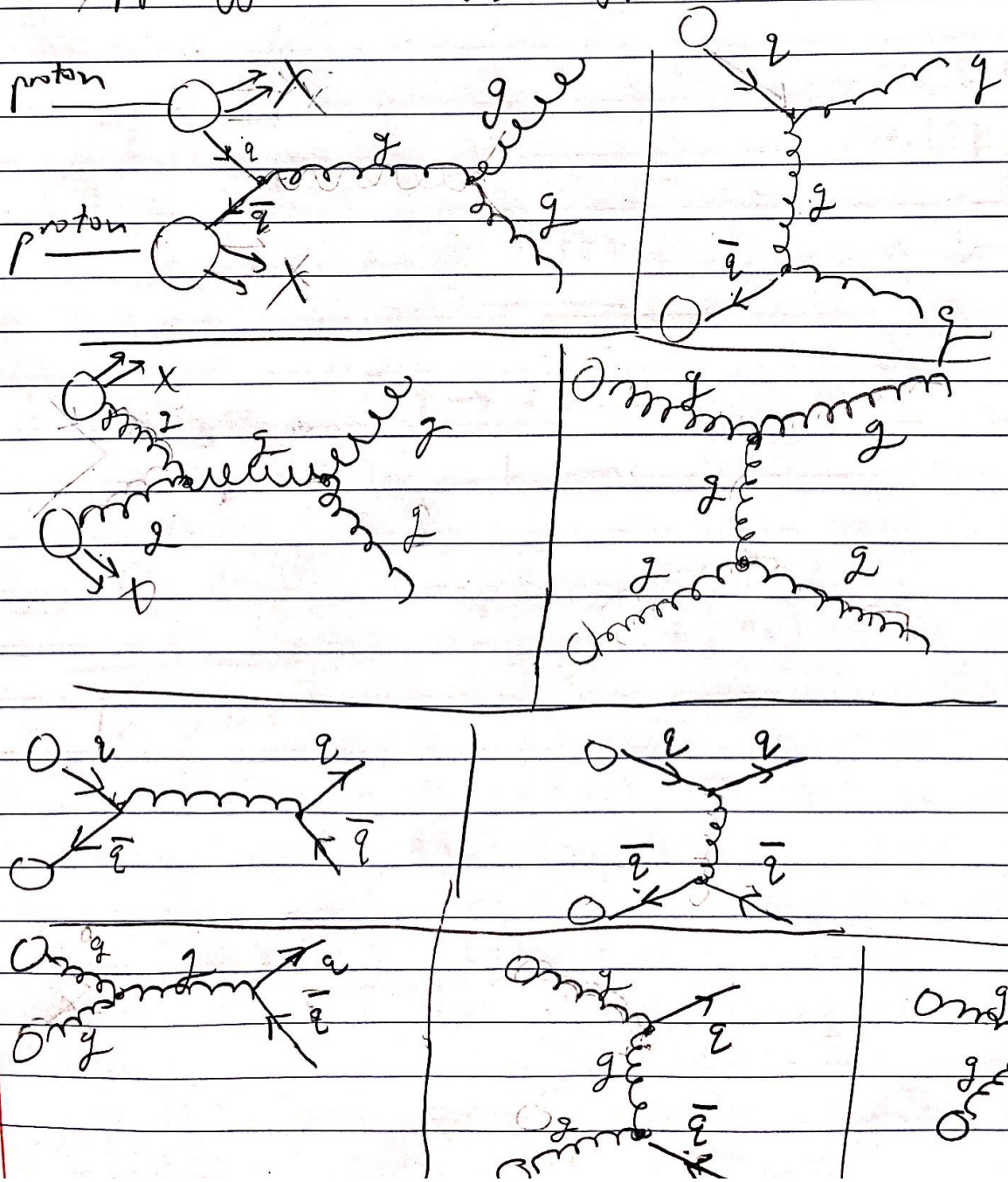
↳ cross section prop. to α^2

$pp \to jj X$: strong interaction, $\propto \alpha_s^2$ (lowest order)

Draw all Feynman Diagrams that contribute to lowest order term

↳ quark from 1 proton and 1 antiquark from the

$pp \to W X \iff q\bar{q} \to W X$.



2) $\Gamma(2\gamma) = \frac{\alpha^5 m_e}{2}$, $\Gamma(3\gamma) = \frac{2(\pi^2-9)}{9\pi}\alpha^6 m_e$

a) J/ψ decays through 3 gluons.

$\Gamma = 87\,keV$ $\quad \alpha \to \frac{4}{3}\alpha_s$

$$\Gamma(3g) = \frac{2(\pi^2-9)}{9\pi}\left(\frac{4}{3}\alpha_s\right)^6 m_e = 87\,keV$$

$$\alpha_s^6 = \left(\frac{3}{4}\right)^6 \frac{9\pi}{2(\pi^2-9)m_e} \cdot 87\,keV$$

↳ $m_e = 0.510\,998\,MeV$
$= 510.998\,keV$

$\alpha_s^6 = 0.4923$

$\therefore \alpha_s \simeq 0.889$ (unit less) ✓

b) estimate $\frac{J/\psi \to \gamma + hadrons}{J/\psi \to hadrons}$

$$\to \frac{\Gamma_{\alpha_s}(3\gamma)}{\Gamma_{\alpha_s}(2g)} = \frac{2(\pi^2-9)}{9\pi}\left(\frac{4}{3}\alpha_s\right)^6 m_e \left(\frac{2}{\left(\frac{4}{3}\alpha_s\right)^5 m_e}\right)$$

$$= \frac{4}{9\pi}(\pi^2-9)\left(\frac{4}{3}\alpha_s\right)$$

$$= 0.14577$$