HW 4, please submit on Nov. 6

① (a) Describe geometrically an abelian group structure on $\left\{ (f, w) \,\middle|\, \begin{array}{l} S^2 \overset{f}{\looparrowright} M \text{ generic} \\ w \text{ whisker } m_0 \text{ to } f(s_0) \end{array} \right\} \Big/ \begin{array}{l}\text{regular} \\ \text{homotopy}\end{array}$

s.t. the projection to $\pi_2(M, m_0)$ is an epimorphism with infinite cyclic kernel.

(b) Does this group extension split?

(c) Show $\mu(f_1 + f_2) = \mu(f_1) + \mu(f_2) + [\lambda(f_1, f_2)]$

② (a) Draw a non-trivial knot which is slice. Same for a 2-component link (whose components are not seperated by a plane).

(b) Show that the Boromean rings are not slice. Hint: Either reduce to 2-components or consider

$$\mathcal{D} := \left\{ \Delta : D^2 \sqcup D^2 \sqcup D^2 \looparrowright D^4 \,\middle|\, \begin{array}{l} \Delta_1 \text{ is an embedding,} \\ \text{disjoint from } \Delta_2, \Delta_3 \end{array} \right\}$$

$$\partial \downarrow$$

$$\mathcal{L} := \left\{ L : S^1 \sqcup S^1 \sqcup S^1 \hookrightarrow S^3 \,\middle|\, lk(L_1, L_i) = 0 \quad i = 2, 3 \right\}$$