

$$\begin{aligned} \pi_1(X) &= \\ H_1(X) &= \\ H_2 \end{aligned}$$

$$\begin{aligned} H_2(X, Z) &\xrightarrow{\text{Poincaré duality}} H^2(X, Z) \xrightarrow{\text{evaluation}} (H_2(X, Z), Z) \\ H_2(X, Z) &\times \end{aligned}$$

$$\begin{aligned} Z \\ A \\ B \\ X \end{aligned}$$

$$\begin{aligned} 0, 5! \\ T_X A + \\ T_X B = \\ T_X X \end{aligned}$$

$$\begin{aligned} \in A \cap \\ B \\ T_X A \oplus \\ T_X B = \\ T_X X \end{aligned}$$

$$\begin{aligned} \{ \epsilon_1, \dots, \epsilon_n \} = \\ A \cap \\ C \\ A \end{aligned}$$

$$\begin{aligned} \sum_{i=1}^n \epsilon_i \\ A \\ B \\ A \\ B \end{aligned}$$

$$[A], [B] \in H_2(X, Z).$$

$$\begin{aligned} M \\ H_m(M, Z) \\ [M] \in \\ H_m(M, Z) \end{aligned}$$

$$\int_M \omega = [\omega]([M]), [\omega] \in H_\Omega^m(M), [M] \in H_m(M).$$

0.8!  
 $\beta$   
 cross  
 3  
 times  
 the  
 disk  
 bounded  
 by

$$\begin{aligned} \alpha \\ T_X \alpha + \\ T_X \beta = \\ T_X \Sigma \end{aligned}$$

$$\begin{aligned} \ddot{x} = \\ S^2 \times \\ S^2 \\ H_2(S^2, Z) = \\ H_1(S^2, Z) = \\ H_0(S^2, Z) = \\ Z \\ H_2(\partial X) \rightarrow \\ H_2(X) \rightarrow \\ H_2(X, \partial X) \rightarrow \\ H_1(\partial X) \rightarrow \\ H_1(X) \rightarrow \\ H_1(X, \partial X) \rightarrow \\ H_1(\partial X) \\ H_2(\partial X) \end{aligned}$$

$$\begin{aligned} 0 \\ b_1(X) = \\ b_1(Y) \end{aligned}$$