

$$\begin{array}{ccc}
\mathcal{HOM}(Y, A) & & \\
\downarrow \Phi(f, g) & \searrow g_* & \\
\mathcal{HOM}(X, A) \times_{\mathcal{HOM}(X, B)} \mathcal{HOM}(Y, B) & \dashrightarrow & \mathcal{HOM}(Y, B) \\
\downarrow & & \downarrow f^* \\
\mathcal{HOM}(X, A) & \xrightarrow{g_*} & \mathcal{HOM}(X, B)
\end{array}$$

A commutative diagram illustrating the relationship between various Hom sets. The top-left node is $\mathcal{HOM}(Y, A)$. A curved arrow labeled g_* points from $\mathcal{HOM}(Y, A)$ to the top-right node $\mathcal{HOM}(Y, B)$. A dashed arrow labeled $\Phi(f, g)$ points from $\mathcal{HOM}(Y, A)$ to the middle-left node $\mathcal{HOM}(X, A) \times_{\mathcal{HOM}(X, B)} \mathcal{HOM}(Y, B)$. A curved arrow labeled f^* points from $\mathcal{HOM}(Y, A)$ to the bottom-left node $\mathcal{HOM}(X, A)$. A horizontal dashed arrow points from the middle-left node to the middle-right node $\mathcal{HOM}(Y, B)$. A vertical dashed arrow points from the middle-left node to the bottom-left node $\mathcal{HOM}(X, A)$. A horizontal solid arrow labeled g_* points from the bottom-left node $\mathcal{HOM}(X, A)$ to the bottom-right node $\mathcal{HOM}(X, B)$. A vertical solid arrow labeled f^* points from the middle-right node $\mathcal{HOM}(Y, B)$ to the bottom-right node $\mathcal{HOM}(X, B)$.