~~To Proof~~: To prove: For maps $f: Q \to P$ & $g: P \to Q$, f & g are necessarily inverse of each other

Given: P & Q are products of objects A & B, and for P, Q is test object (T) & for Q, P is test object (T)

so, Proof: Case I: P is Product Q is test object

so, $A \xleftarrow{p_1} P \xrightarrow{p_2} B$ $\quad Q \xrightarrow{q} P$

$A \xleftarrow{q_1} Q \xrightarrow{q_2} B$

$$q_1 = p_1 \circ q \ \& \ q_2 = p_2 \circ q \quad - (i)$$

Case II: Q is Product & P is test object

so, ~~$A \leftarrow Q$~~ $\quad P \xrightarrow{p} Q$

$$p_1 = q_1 \circ p \ \& \ p_2 = q_2 \circ p \quad - (ii)$$

sub (i) in (ii)

$$p_1 = (p_1 \circ q) \circ p$$
$$p_2 = \cancel{(p_2 \circ p) \circ q} \ (p_2 \circ q) \circ p$$
$$p_1 = p_1 \circ (q \circ p)$$
$$p_2 = p_2 \circ (q \circ p)$$

$q \circ p$: $P \to Q \to P$

sub (ii) in (i)

$$q_1 = (q_1 \circ p) \circ q$$
$$q_2 = (q_2 \circ p) \circ q$$

$p \circ q$: $Q \to P \to Q$

$q \circ p$ & $p \circ q$ ~~seem~~ have to be identity on objects P & Q respectively.