- $T_{p,q}(a,\ b) = (bq + aq + ap,\ bp + aq)$

- $T_{p,q}(bq + aq + ap,\ bp + aq) = ((bp + aq)q + (bq + aq + ap)q + (bq + aq + ap)p,\ pe(bp + aq)p + (bq + aq + ap)q)) = (bq\prime + aq\prime + ap\prime,\ bp\prime + aq\prime)$

- If we expand the first parameter:

$$bpq + aqq + bqq + aqq + apq + bpq + apq + app$$
$$= bq\prime + aq\prime + ap\prime$$

Which can be written in the form:

$$b(2pq + qq) + a(2pq + qq) + a(pp + qq)$$
$$= bq\prime + aq\prime + ap\prime$$

Therefore:

$$p = (p^2 + q^2)$$
$$q = (2pq + q^2)$$

As desired.