

**[mex87] Determine canonicity and generating functions I**

Consider the following transformation from a set of canonical coordinates  $(q, p)$  to a new set of coordinates  $(Q, P)$ :

$$Q = \ln \left( \frac{\sin p}{q} \right), \quad P = q \cot p.$$

(a) Verify that this transformation is canonical by investigating its Jacobian determinant. (b) Determine the generating function  $F_3(p, Q)$  by integration of the total differential  $dF_3$ . (c) Determine the generating function  $F_2(q, P)$  from  $F_3(p, Q)$  via Legendre transform.

**Solution:**