Consider the following transformation from a set of canonical coordinates \((q, p)\) to a new set of coordinates \((Q, P)\):
\[
Q = \ln p, \quad P = -qp.
\]
(a) Verify that this transformation is canonical by investigating its Jacobian determinant. (b) Determine the generating function \(F_1(q, Q)\) by integration of the total differential \(dF_1\). (c) Determine the generating function \(F_2(q, P)\) by integration of the total differential \(dF_2\). (d) Determine the generating function \(F_2(q, P)\) from \(F_1(q, Q)\).

Solution: