[mex283] Canonicity and generating function V

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

$$Q = -p, \qquad P = q + ap^2,$$

where a is an arbitrary constant.
(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 as constructed from the above transformation relations.
(c) Determine the generating function $F_2(q, P)$ from $F_1(p, Q)$.
(d) Determine the generating function $F_2(q, P)$ directly by integration of the total differential dF_2 as constructed from the above transformation relations.

Solution: