\[ Q = \cos q \left( 1 + \sqrt{q} \cos \rho \right) \]
\[ P = 2 \left( 1 + \sqrt{q} \cos \rho \right) q^{1/2} \sin \rho \]

a) With problem 12 we only have to show that:

\[ \begin{vmatrix} P & Q \end{vmatrix}_{q, \rho} = 1 \]

\[ \left( -2 \sqrt{q} \sin \rho \frac{\sqrt{q}}{2} + 2 \left( 1 + q^{1/2} \cos \rho \right) q^{1/2} \cos \rho \right) \frac{1 - \sqrt{q} \cos \rho}{1 + q^{1/2} \cos \rho} \]

\[ = -q^{1/2} \sin \rho \left( \sqrt{q} \cos \rho + \frac{1}{2} \left( 1 + q^{1/2} \cos \rho \right) q^{-1/2} \sin \rho \right) \]

\[ = \frac{\left( 1 + q^{1/2} \cos \rho \right) \left( \cos^2 \rho + \sin^2 \rho \right)}{1 + q^{1/2} \cos \rho} = 1 \quad \text{o.k.} \]

b) Generating functional:

\[ F_2 = - (e^{-Q} - 1)^2 \tan \rho \]

\[ F_2(Q, P) \Rightarrow P = -\frac{\partial F_2}{\partial Q} \quad q = \frac{\partial F_5}{\partial P} \]

\[ \Rightarrow P = 2 e^Q \]

\[ q = + \sqrt{Q - 1} \]

\[ \Rightarrow Q = \sqrt{\sqrt{Q - 1}} \cos \rho \]

\[ \Rightarrow Q = \log (1 + \sqrt{q} \cos \rho) \]

\[ P = 2 \left( 1 + \sqrt{q} \cos \rho \right) \tan \rho \sqrt{q} \cos \rho \]

\[ = 2 \left( 1 + \sqrt{q} \cos \rho \right) \sqrt{q} \sin \rho \]

\[ \begin{array}{c}
\text{Legendre transform}
\end{array} \]

\[ F_5 = F(Q, Q) - P Q \]