$$\Rightarrow \quad q = (e^Q - 1)^2 - \frac{p^2}{4e^{2Q}}$$

$$\Rightarrow \left.\frac{\partial q}{\partial Q}\right|_{p\text{ fixed}} = 2(e^Q - 1)e^Q + \frac{p^2 2e^{2Q}}{4e^{4Q}}$$

$$\left.\frac{\partial J}{\partial p}\right|_{q\text{ fixed}} = 2\sqrt{q}\cos p + 2q\,(\underbrace{\cos^2 p - \sin^2 p}_{2\cos^2 p - 1})$$

$$(e^Q - 1) + 4(e^Q - 1)^2 - 2(e^Q - 1)^2 + \frac{2p^2}{4e^{2Q}}$$

$$= 2e^{2Q} - 2e^Q + \frac{p^2}{4e^{2Q}}$$

$$= \left.\frac{\partial q}{\partial Q}\right|_{p\text{ fixed}}$$