$$P'_w = Q_w + \overset{*}{Q}_w$$

$$\underbrace{Q_z\varphi}\barwedge\underbrace{Q_w\psi} - \underbrace{\overset{*}{Q}_w\varphi}\barwedge\underbrace{\overset{*}{Q}_z\psi} = \underbrace{\varphi\barwedge\psi}\,\underbrace{z\barwedge w}$$

$$\underbrace{Q_z\varphi}\barwedge\underbrace{\overset{*}{Q}_w\psi} = \underbrace{Q_w\varphi}\barwedge\underbrace{\overset{*}{Q}_z\psi}$$

$$\underbrace{\varphi\barwedge\psi}\,\underbrace{z\barwedge w - w\barwedge z} = \varphi\barwedge\overbrace{\underbrace{P'_zP'_w - P'_wP'_z}\psi} = \varphi\barwedge\underbrace{P'_zP'_w}\psi - \varphi\barwedge\underbrace{P'_wP'_z}\psi$$

$$= \underbrace{P'_z\varphi}\barwedge\underbrace{P'_w\psi} - \underbrace{P'_w\varphi}\barwedge\underbrace{P'_z\psi} = \overbrace{\underbrace{Q_z + \overset{*}{Q}_z}\varphi}\barwedge\overbrace{\underbrace{Q_w + \overset{*}{Q}_w}\psi} - \overbrace{\underbrace{Q_w + \overset{*}{Q}_w}\varphi}\barwedge\overbrace{\underbrace{Q_z + \overset{*}{Q}_z}\psi}$$

$$= \underbrace{Q_z\varphi}\barwedge\underbrace{Q_w\psi} - \underbrace{Q_w\varphi}\barwedge\underbrace{Q_z\psi} + \underbrace{Q_z\varphi}\barwedge\underbrace{\overset{*}{Q}_w\psi} - \underbrace{Q_w\varphi}\barwedge\underbrace{\overset{*}{Q}_z\psi}$$

$$+\underbrace{\overset{*}{Q}_z\varphi}\barwedge\underbrace{Q_w\psi} - \underbrace{\overset{*}{Q}_w\varphi}\barwedge\underbrace{Q_z\psi} + \underbrace{\overset{*}{Q}_z\varphi}\barwedge\underbrace{\overset{*}{Q}_w\psi} - \underbrace{\overset{*}{Q}_w\varphi}\barwedge\underbrace{\overset{*}{Q}_z\psi}$$

$$\Longrightarrow \underbrace{\varphi\barwedge\psi}\,\underbrace{z\barwedge w} = \underbrace{Q_z\varphi}\barwedge\underbrace{Q_w\psi} - \underbrace{\overset{*}{Q}_w\varphi}\barwedge\underbrace{\overset{*}{Q}_z\psi}$$

$$-\underbrace{\varphi\barwedge\psi}\,\underbrace{w\barwedge z} = \underbrace{\overset{*}{Q}_z\varphi}\barwedge\underbrace{\overset{*}{Q}_w\psi} - \underbrace{Q_w\varphi}\barwedge\underbrace{Q_z\psi}$$

$$\underbrace{Q_z\varphi}\barwedge\underbrace{\overset{*}{Q}_w\psi} - \underbrace{Q_w\varphi}\barwedge\underbrace{\overset{*}{Q}_z\psi} = 0 = \underbrace{\overset{*}{Q}_z\varphi}\barwedge\underbrace{Q_w\psi} - \underbrace{\overset{*}{Q}_w\varphi}\barwedge\underbrace{Q_z\psi}$$

$$\underbrace{\varphi\barwedge\psi}\,\underbrace{z\barwedge w} = \underbrace{P'_z\varphi}\barwedge\underbrace{P'_w\psi} = \overbrace{\underbrace{Q_z + \overset{*}{Q}_z}\varphi}\barwedge\overbrace{\underbrace{Q_w + \overset{*}{Q}_w}\psi}$$

$$= \underbrace{Q_z\varphi}\barwedge\underbrace{Q_w\psi} + \underbrace{Q_z\varphi}\barwedge\underbrace{\overset{*}{Q}_w\psi} + \underbrace{\overset{*}{Q}_z\varphi}\barwedge\underbrace{Q_w\psi} + \underbrace{\overset{*}{Q}_z\varphi}\barwedge\underbrace{\overset{*}{Q}_w\psi}$$

$$\Longrightarrow \underbrace{\varphi\barwedge\psi}\,\underbrace{z\barwedge w} = \underbrace{Q_z\varphi}\barwedge\underbrace{Q_w\psi}$$

$$\underbrace{Q_z\varphi}\barwedge\underbrace{\overset{*}{Q}_w\psi} = \underbrace{\overset{*}{Q}_z\varphi}\barwedge\underbrace{Q_w\psi} = \underbrace{\overset{*}{Q}_z\varphi}\barwedge\underbrace{\overset{*}{Q}_w\psi} = 0$$