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> restart;
> alias (q=q(z), p=p(z), sigma=sigma(z), w=w(z)) :
> P1:=diff(w,z,z)-6*w^2-z; sigma1:=diff(sigma,z,z)^2+4*diff(sigma,z)
  ^3+2*z*diff(sigma,z)-2*sigma;

$$P1 := \frac{\partial^2}{\partial z^2} w - 6 w^2 - z$$


$$\sigma 1 := \left( \frac{\partial^2}{\partial z^2} \sigma \right)^2 + 4 \left( \frac{\partial}{\partial z} \sigma \right)^3 + 2 z \left( \frac{\partial}{\partial z} \sigma \right) - 2 \sigma \quad (1)$$

> H:=p^2/2-2*q^3-z*q;

$$H := \frac{1}{2} p^2 - 2 q^3 - z q \quad (2)$$

> H1:=diff(q,z)=p; H2:=diff(p,z)=6*q^2+z;

$$H1 := \frac{\partial}{\partial z} q = p$$


$$H2 := \frac{\partial}{\partial z} p = 6 q^2 + z \quad (3)$$

> S:=sigma=H;

$$S := \sigma = \frac{1}{2} p^2 - 2 q^3 - z q \quad (4)$$

> S1:=simplify(subs(H1,H2,diff(S,z))) ; S2:=simplify(expand(subs(H1,
H2,diff(S1,z)))) ;

$$S1 := \frac{\partial}{\partial z} \sigma = -q$$


$$S2 := \frac{\partial^2}{\partial z^2} \sigma = -p \quad (5)$$

> solve({S1,S2},{q,p}) ;

$$\left\{ p = - \left( \frac{\partial^2}{\partial z^2} \sigma \right), q = - \left( \frac{\partial}{\partial z} \sigma \right) \right\} \quad (6)$$

> expand(sigma-subs(%,H)) ; expand(-%*2) ; sigma1-% ;

$$\sigma - \frac{1}{2} \left( \frac{\partial^2}{\partial z^2} \sigma \right)^2 - 2 \left( \frac{\partial}{\partial z} \sigma \right)^3 - z \left( \frac{\partial}{\partial z} \sigma \right)$$


$$\left( \frac{\partial^2}{\partial z^2} \sigma \right)^2 + 4 \left( \frac{\partial}{\partial z} \sigma \right)^3 + 2 z \left( \frac{\partial}{\partial z} \sigma \right) - 2 \sigma$$


$$0 \quad (7)$$


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