```
> restart:with(linalg):with(plots):with(PDEtools):with(plots):with
  (LinearAlgebra):with(linalg):alias(w=w(z),phi=phi(z),sigma=sigma
  (z)):
> P2:=diff(w,z,z)-(2*w^3+z*w+alpha);
```

$$P2 := \frac{\partial^2}{\partial z^2} w - 2 w^3 - z w - \alpha \tag{1}$$

```
> S2:=(diff(sigma,z,z))^2+4*diff(sigma,z)^3+2*diff(sigma,z)*(z*diff
  (sigma,z)-sigma)-1/4*(alpha+1/2)^2;
```

$$S2 := \left(\frac{\partial^2}{\partial z^2} \sigma \right)^2 + 4 \left(\frac{\partial}{\partial z} \sigma \right)^3 + 2 \left(\frac{\partial}{\partial z} \sigma \right) \left(z \left(\frac{\partial}{\partial z} \sigma \right) - \sigma \right) - \frac{1}{4} \left(\alpha + \frac{1}{2} \right)^2 \tag{2}$$

```
> alpha:=n+1/2;
```

$$\alpha := n + \frac{1}{2} \tag{3}$$

```
> w:=-(n+1/2)/z+B/z^2;
```

$$w := -\frac{n + \frac{1}{2}}{z} + \frac{B}{z^2} \tag{4}$$

```
> collect(expand(P2),z,factor);
```

$$-\frac{B}{z} + \frac{1}{4} \frac{(2n+3)(2n+1)(2n-1)}{z^3} - \frac{3}{2} \frac{B(2n+3)(2n-1)}{z^4} + \frac{3B^2(2n+1)}{z^5} - \frac{2B^3}{z^6} \tag{5}$$