```
> restart;with(linalg):with(LinearAlgebra):alias(w=w(z),phi=phi(z),
  sigma=sigma(z)):
> d:=-1;C:=1;
```

$$d := -1$$
$$C := 1 \tag{1}$$

```
> P3:=diff(w,z,z)-(diff(w,z)^2/w-diff(w,z)/z+(A*w^2+B)/z+C*w^3+d/w)
  ;
```

$$P3 := \frac{\partial^2}{\partial z^2}\, w - \frac{\left(\frac{\partial}{\partial z}\, w\right)^2}{w} + \frac{\frac{\partial}{\partial z}\, w}{z} - \frac{A\, w^2 + B}{z} - w^3 + \frac{1}{w} \tag{2}$$

```
> n:=1;epsilon[1]:=-1;epsilon[2]:=-1;
```

$$n := 1$$
$$\varepsilon_1 := -1$$
$$\varepsilon_2 := -1 \tag{3}$$

```
> K:=(n)->(ToeplitzMatrix(p,n)):
> U1:=seq(p[d+1]=psi[nu-n+d],d=0..2*n+1):U2:=seq(p[d+1]=psi[nu-n+
  d+1-epsilon[1]],d=0..2*n+1):
> Y:=seq(psi[nu-n+d]=psi(nu-n+d),d=0..2*n):
> psi:=(nu)->z^(epsilon[1]*nu)*(BesselJ(nu,sqrt(epsilon[1]*epsilon
  [2])*z)+0*BesselY(nu,sqrt(epsilon[1]*epsilon[2])*z)):
> subs(U1,K(n+1));subs(U2,K(n));
```

$$\begin{bmatrix} \Psi_{\nu} & \Psi_{\nu-1} \\ \Psi_{\nu+1} & \Psi_{\nu} \end{bmatrix}$$
$$\begin{bmatrix} \Psi_{\nu+1} \end{bmatrix} \tag{4}$$

```
> K1:=det(subs(U1,Y,K(n+1))):K2:=det(subs(U2,Y,K(n))):
> w:=convert(epsilon[1]*((1-n)/z-diff(ln(K1/K2),z)),parfrac,bessel)
  :
> A:=2*(nu+epsilon[1]*n);B:=epsilon[2]*2*(n-epsilon[1]*nu+1);
```

$$A := 2\,\nu - 2$$
$$B := -2\,\nu - 4 \tag{5}$$

```
> simplify(expand(P3));
```

$$0 \tag{6}$$