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

$$n := 2$$

$$\varepsilon_1 := -1$$

$$\varepsilon_2 := 1 \tag{3}$$

```
> psi:=(nu)->simplify(z^(epsilon[1]*nu)*(BesselJ(nu,sqrt(epsilon[1]
  *epsilon[2])*z)-0*BesselY(nu,sqrt(epsilon[1]*epsilon[2])*z))):
> psi(nu):for k from 1 to n+1 do;l[k]:=diff(%,z)*z;od:wronskian(
  [psi(nu),seq(l[j],j=1..n)],z):for j from 1 to n+1 do;h[j]:=Row(%,
  1);row(%%,2):wronskian(%*z,z):od:<seq(h[j],j=1..n+1)>:tau[n+1]:=
  det(%):
> diff(psi(nu),z):for k from 1 to n do;l[k]:=diff(%,z)*z;
  od:wronskian([diff(psi(nu),z),seq(l[j],j=1..n-1)],z):for j from 1
  to n do;h[j]:=Row(%,1);row(%%,2):wronskian(%*z,z):od:<seq(h[j],j=
  1..n)>:tau[n]:=det(%):
> w:=convert(simplify(epsilon[1]*(n/z-diff(ln(tau[n+1]/tau[n]),z))
  ),parfrac,BesselJ(nu, z)):
> A:=2*(nu+epsilon[1]*n);B:=epsilon[2]*2*(n-epsilon[1]*nu+1);
```

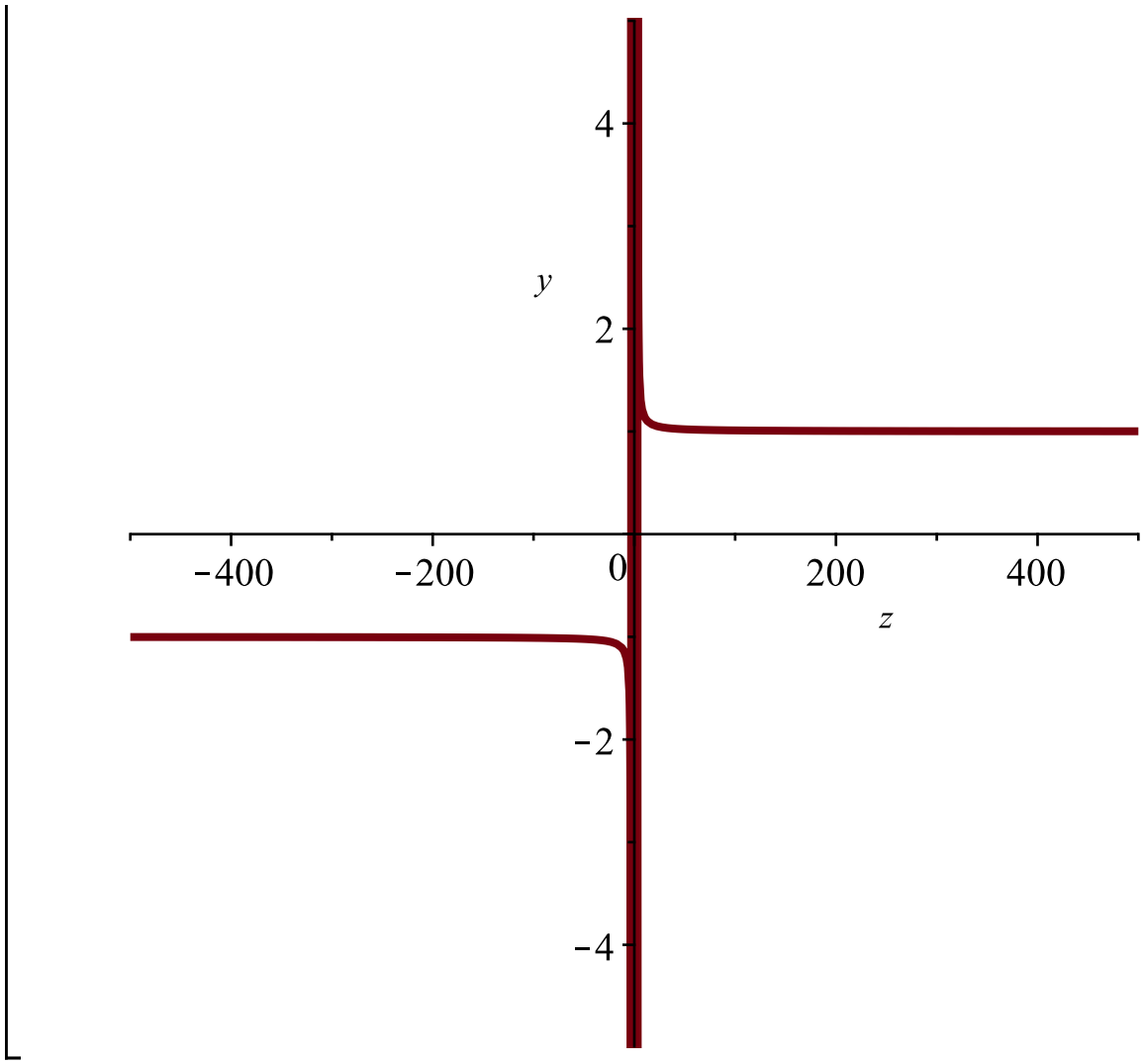
$$A := 2\nu - 4$$

$$B := 2\nu + 6 \tag{4}$$

```
> #simplify(expand(P3));
> nu:=-3/2;Digits:=100;plot(w,z=-500..500,y=-5..5,thickness=3);
```

$$\nu := -\frac{3}{2}$$

$$Digits := 100$$


4
y
2
-400
-200
0
200
400
z
-2
-4