```
> restart;with(linalg):with(LinearAlgebra):alias(sigma=sigma(z),
  phi=phi(z)):
> S3:=(z*(diff(sigma, z, z))-(diff(sigma, z)))^2+4*(diff(sigma,z))
  ^2*(z*diff(sigma,z)-2*sigma)+4*z*theta[infinity]*diff(sigma,z)-
  z^2*(z*diff(sigma,z)-2*sigma+2*theta[0]);
```

$$S3 := \left(z\left(\frac{\partial^2}{\partial z^2}\,\sigma\right)-\left(\frac{\partial}{\partial z}\,\sigma\right)\right)^2+4\left(\frac{\partial}{\partial z}\,\sigma\right)^2\left(z\left(\frac{\partial}{\partial z}\,\sigma\right)-2\,\sigma\right)+4\,z\,\theta_\infty\left(\frac{\partial}{\partial z}\,\sigma\right) \quad (1)$$
$$-z^2\left(z\left(\frac{\partial}{\partial z}\,\sigma\right)-2\,\sigma+2\,\theta_0\right)$$

```
> F := collect(epsilon[1]*epsilon[2]/4*z^2+1/2*nu^2-epsilon[1]*n*
  nu-1/2*n*(n-2),[z,nu],factor);
```

$$F := \frac{1}{4}\,\varepsilon_1\,\varepsilon_2\,z^2+\frac{1}{2}\,\nu^2-\varepsilon_1\,n\,\nu-\frac{1}{2}\,n\,(n-2) \quad (2)$$

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

$$n := 2$$
$$\varepsilon_1 := 1$$
$$\varepsilon_2 := -1 \quad (3)$$

```
> psi:=(nu)->simplify(z^(epsilon[1]*nu)*(BesselJ(nu,sqrt(epsilon[1]
  *epsilon[2])*z)-0*BesselY(nu,sqrt(epsilon[1]*epsilon[2])*z)));
```

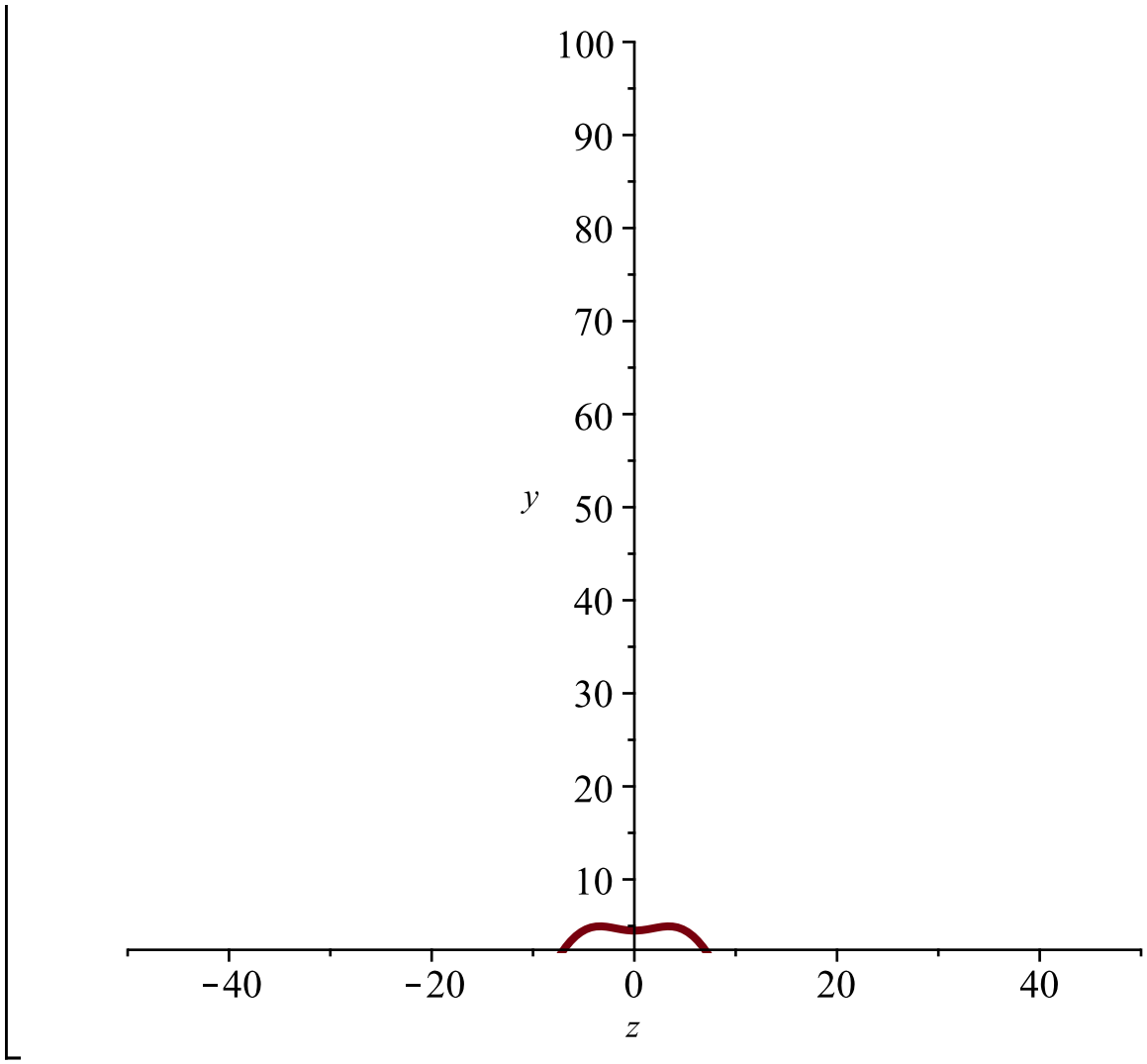
$$\psi := \nu \rightarrow simplify\left(z^{\varepsilon_1\,\nu}\left(\mathrm{BesselJ}\left(\nu,\sqrt{\varepsilon_1\,\varepsilon_2}\,z\right)-0\,\mathrm{BesselY}\left(\nu,\sqrt{\varepsilon_1\,\varepsilon_2}\,z\right)\right)\right) \quad (4)$$

```
> psi(nu):for k from 1 to n do;l[k]:=diff(%,z)*z;od:wronskian([psi
  (nu),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:=det(%):
> sigma:=simplify(F+z*diff(ln(tau),z)):theta[0]:=nu^2+n^2;theta
  [infinity]:=epsilon[1]*epsilon[2]*(nu^2-n^2);
```

$$\theta_0 := \nu^2+4$$
$$\theta_\infty := -\nu^2+4 \quad (5)$$

```
> #collect(expand(S3),[BesselJ,z],factor);
> nu:=-1;Digits:=100;plot(sigma,z=-50..50,y=3..100,thickness=3);
```

$$\nu := -1$$
$$Digits := 100$$


100
90
80
70
60
y
50
40
30
20
10
−40
−20
0
20
40
z