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> restart;with(linalg):with(LinearAlgebra):alias(sigma=sigma(z),
  phi=phi(z)):
> S3:=(z*(diff(sigma,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]);

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

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

$$F := \frac{1}{4} \epsilon_1 \epsilon_2 z^2 + \frac{1}{2} \nu^2 - \epsilon_1 n \nu + \frac{1}{2} n^2 \quad (2)$$

> n:=1;epsilon[1]:=1;epsilon[2]:=1;
  n:=1
  epsilon[1]:=1
  epsilon[2]:=1 \quad (3)
> K:=(n)->(ToeplitzMatrix(p,n)):
> U:=seq(p[d+1]=psi[nu-n+d+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)+BesselY(nu,sqrt(epsilon[1]*epsilon[2])*z)):
> subs(U,K(n));

$$\begin{bmatrix} \psi_{\nu} \end{bmatrix} \quad (4)$$

> tau:=det(subs(U,Y,K(n))):
> sigma:=simplify(F+z*diff(ln(tau),z)):theta[0]:=nu^2+n^2;theta
  [infinity]:=epsilon[1]*epsilon[2]*(nu^2-n^2);

$$\theta_0 := \nu^2 + 1$$


$$\theta_{\infty} := \nu^2 - 1 \quad (5)$$

> collect(expand(S3),[BesselJ,z],factor);
0 \quad (6)

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