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> restart;with(linalg):with(LinearAlgebra):alias(phi=phi(zeta),u=u(zeta),phi[nu]=phi[nu](zeta)):
> P3:=(diff(u,zeta))/zeta+diff(u,zeta,zeta)-(diff(u,zeta))^2/u-(1/2)*alpha*u^2/zeta^2-(1/2)*beta/zeta-Gamma*u^3/zeta^2-delta/u;
```

$$P3 := \frac{\frac{\partial}{\partial \zeta} u}{\zeta} + \frac{\partial^2}{\partial \zeta^2} u - \frac{\left(\frac{\partial}{\partial \zeta} u\right)^2}{u} - \frac{1}{2} \frac{\alpha u^2}{\zeta^2} - \frac{1}{2} \frac{\beta}{\zeta} - \frac{\Gamma u^3}{\zeta^2} - \frac{\delta}{u} \quad (1)$$

```
> Gamma:=1;delta:=-1;
```

$$\Gamma := 1$$

$$\delta := -1$$

(2)

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

$$n := 2$$

$$\epsilon_1 := 1$$

$$\epsilon_2 := -1$$

(3)

```
> phi:=for k from 1 to n+1 do;l[k]:=diff(%,zeta)*zeta;od:wronskian([phi,seq(l[j],j=1..n)],zeta):for j from 1 to n+1 do;h[j]:=Row(%,1);row(%%,2):wronskian(%*zeta,zeta):od:<seq(h[j],j=1..n+1)>:T:=det(%):
```

```
> sqrt(zeta)*diff(phi,zeta):for k from 1 to n do;l[k]:=diff(%,zeta)*zeta;od:wronskian([sqrt(zeta)*diff(phi,zeta),seq(l[j],j=1..n-1)],zeta):for j from 1 to n do;h[j]:=Row(%,1);row(%%,2):wronskian(%*zeta,zeta):od:<seq(h[j],j=1..n)>:B:=det(%):
```

```
> phi:=sqrt(zeta)^(epsilon[1]*nu)*(BesselJ(nu,2*sqrt(epsilon[1]*epsilon[2]*zeta))+0*BesselY(nu,2*sqrt(epsilon[1]*epsilon[2]*zeta)));
```

$$\phi := \left(\sqrt{\zeta}\right)^v \text{BesselJ}\left(v, 2\sqrt{-\zeta}\right) \quad (4)$$

```
> u:=1/2*simplify(epsilon[1]*n-2*zeta*epsilon[1]*diff(ln(T/B),zeta)):
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```
> alpha:=2*epsilon[1]*(epsilon[1]*nu+n);beta:=2*epsilon[2]*(1-epsilon[1]*nu+n);
```

$$\alpha := 2v + 4$$

$$\beta := 2v - 6$$

(5)

```
> simplify(numer(P3));
```

$$0$$

(6)