

```
> restart;with(PDEtools):alias(w=w(z),u=u(Zeta));
```

w, u

(1)

```
> ODE1:=diff(w, z, z)-(diff(w, z))^2/w+(diff(w, z))/z-(A*w^2+B)/z-C*w^3-d/w;
```

$$ODE1 := \frac{\partial^2}{\partial z^2} w - \frac{\left(\frac{\partial}{\partial z} w\right)^2}{w} + \frac{\frac{\partial}{\partial z} w}{z} - \frac{A w^2 + B}{z} - C w^3 - \frac{d}{w}$$

(2)

```
> tr:={w=(Zeta)^(-1/2)*u,z=2*sqrt(Zeta)};
```

$$tr := \left\{ z = 2\sqrt{\zeta}, w = \frac{u}{\sqrt{\zeta}} \right\}$$

(3)

```
> 4*expand(dchange(tr,ODE1)/4/sqrt(Zeta))=0;
```

$$\frac{\frac{\partial}{\partial \zeta} u}{\zeta} + \frac{\partial^2}{\partial \zeta^2} u - \frac{\left(\frac{\partial}{\partial \zeta} u\right)^2}{u} - \frac{1}{2} \frac{A u^2}{\zeta^2} - \frac{1}{2} \frac{B}{\zeta} - \frac{C u^3}{\zeta^2} - \frac{d}{u} = 0$$

(4)

```
> subs(C=1,d=-1,%);
```

$$\frac{\frac{\partial}{\partial \zeta} u}{\zeta} + \frac{\partial^2}{\partial \zeta^2} u - \frac{\left(\frac{\partial}{\partial \zeta} u\right)^2}{u} - \frac{1}{2} \frac{A u^2}{\zeta^2} - \frac{1}{2} \frac{B}{\zeta} - \frac{u^3}{\zeta^2} + \frac{1}{u} = 0$$

(5)

```
> ODE2:=diff(u, Zeta, Zeta) - ( -(diff(u, Zeta))/Zeta+1/(2*Zeta)+
(diff(u, Zeta))^2/u+(1/2)*nu*u^2/Zeta^2-(1/2)*nu/Zeta+(1/4)*C*
u^3/Zeta^2-1/(4*u));
```

$$ODE2 := \frac{\partial^2}{\partial \zeta^2} u + \frac{\frac{\partial}{\partial \zeta} u}{\zeta} - \frac{1}{2\zeta} - \frac{\left(\frac{\partial}{\partial \zeta} u\right)^2}{u} - \frac{1}{2} \frac{v u^2}{\zeta^2} + \frac{1}{2} \frac{v}{\zeta} - \frac{1}{4} \frac{C u^3}{\zeta^2} + \frac{1}{4u}$$

(6)

```
> n:=0;A:=2*(nu+n);B:=2*(1-nu+n);C:=1;d:=-1;
```

$n := 0$

$A := 2v$

$B := 2 - 2v$

$C := 1$

$d := -1$

(7)

```
> U1:=-simplify(diff(ln(z^nu*(BesselJ(nu,z)+BesselY(nu,z))),z));
```

$$U1 := - \frac{2v \text{BesselJ}(v, z) + 2v \text{BesselY}(v, z) - \text{BesselJ}(v+1, z)z - \text{BesselY}(v+1, z)z}{z(\text{BesselJ}(v, z) + \text{BesselY}(v, z))}$$

(8)

```
> U2:=-simplify(expand((Zeta)*simplify(diff(ln(sqrt(Zeta)^nu*
(BesselJ(nu,sqrt(Zeta))+BesselY(nu,sqrt(Zeta))),Zeta))))*2;
```

$$U2 := \frac{1}{\text{BesselJ}(v, \sqrt{\zeta}) + \text{BesselY}(v, \sqrt{\zeta})} \left(\text{BesselJ}(v+1, \sqrt{\zeta}) \sqrt{\zeta} + \text{BesselY}(v+1, \sqrt{\zeta}) \sqrt{\zeta} - 2v \text{BesselJ}(v, \sqrt{\zeta}) - 2 \text{BesselY}(v, \sqrt{\zeta}) v \right)$$

(9)

```
> simplify(expand(subs(w=U1,ODE1)));
```

0

(10)

```
> simplify(expand(subs(u=U2,ODE2)));
```

L

0

(11)