```
> restart;with(Riemann):with(TensorPack): with(Canon):CDF(0): CDS(index):
```

**Chapter XX Tensor analysis using indices - Senovilla et al. - Shearfree for acceleration parallel to vorticity if $\sigma_{a\,b}=0 \Rightarrow \omega\Theta=0$**

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**eq65**

```
> read "EFE" : read "SFE" :read "fids" :read "Seneqs80" :
```

proof of eq65:
slight variation from original

We commence with eqs62, 63 and 64

```
> eq[62] : T(%);
```

$$P^{a}{}_{b}\,dotdu^{b} = -\frac{1}{6}\,\frac{\left(6\,\Psi^{2}\,\mu\,p'' + 6\,\Psi^{2}\,p\,p'' - 6\,\Psi^{2}\,p^{2} + 2\,\Psi^{2}\,p' - 18\,p^{3}\right) du^{a}\,\theta}{\Psi^{2}\,p'} + \frac{3}{2}\,\frac{p'\,\Psi^{;d}\,\omega^{a}{}_{d}}{\Psi} \tag{1.1}$$

```
> eq[63] : T(%);
```

$$P^{a}{}_{b}\,ddu^{b} = \left(\left(p' - \frac{2}{3}\right)\theta + \frac{dotPsi}{\Psi}\right) du^{a} \tag{1.2}$$

```
> eq[64] := omega[a, b]·Psi[-B] = 0 : T(%);
```

$$\omega^{a\,b}\,\Psi_{;b} = 0 \tag{1.3}$$

proof: eq64 follows directly from eqs 62 and 63, taking into account the orthogonality of du[a] and omega[a,b]

```
>
> temp := rhs(eq[63]) = op(1, rhs(eq[62])) : T(%);
```

$$\left(\left(p' - \frac{2}{3}\right)\theta + \frac{dotPsi}{\Psi}\right) du^{a} = -\frac{1}{6}\,\frac{\left(6\,\Psi^{2}\,\mu\,p'' + 6\,\Psi^{2}\,p\,p'' - 6\,\Psi^{2}\,p^{2} + 2\,\Psi^{2}\,p' - 18\,p^{3}\right) du^{a}\,\theta}{\Psi^{2}\,p'} \tag{1.4}$$

```
> temp1 := temp / du[a] : T(%);
```

$$\left(p' - \frac{2}{3}\right)\theta + \frac{dotPsi}{\Psi} = -\frac{1}{6}\,\frac{\left(6\,\Psi^{2}\,\mu\,p'' + 6\,\Psi^{2}\,p\,p'' - 6\,\Psi^{2}\,p^{2} + 2\,\Psi^{2}\,p' - 18\,p^{3}\right)\theta}{\Psi^{2}\,p'} \tag{1.5}$$

```
> temp2 := collect(expand(isolate(temp1, dotPsi)), [Psi, theta]) : T(%);
```

(1.6)

$$dotPsi = \left( -\frac{p''\mu}{p'} - \frac{p''p}{p'} + \frac{1}{3} \right) \theta \Psi + \frac{3 p^2 \theta}{\Psi} \tag{1.6}$$

```
> eq[65] := temp2 : T(%);
```

$$dotPsi = \left( -\frac{p''\mu}{p'} - \frac{p''p}{p'} + \frac{1}{3} \right) \theta \Psi + \frac{3 p^2 \theta}{\Psi} \tag{1.7}$$

```
> convert(temp2, string) : T(%)
```

"dotPsi = (-1/`p'`*`p"`*mu-1/`p'`*`p"`*p+1/3)*theta*Psi+3/Psi*`p'`^2*theta" (1.8)

```
> eq[65]
      := parse("dotPsi = (-1/`p'`*`p"`*mu-1/`p'`*`p"`*p+3*`p'`/Psi^2*`p'`+1/3)*Psi*theta") :
    T(%);
```

$$dotPsi = \left( -\frac{p''\mu}{p'} - \frac{p''p}{p'} + \frac{3 p^2}{\Psi^2} + \frac{1}{3} \right) \Psi \theta \tag{1.9}$$

```
>
>
>
```

wich is eq65