7-29 corrected

(b) for Newtonian fluids, $n = 1$

$$\lim_{n \to 1} v_z/V = \lim_{n \to 1} \frac{\left((r/R)^{1-\frac{1}{n}} - 1 \right)}{\left(x^{1-\frac{1}{n}} - 1 \right)}$$

l'Hôpital's rule:

$$\lim_{n \to 1} v_z/V = \lim_{n \to 1} \frac{\frac{d}{dn}\left((r/R)^{1-\frac{1}{n}} - 1 \right)}{\frac{d}{dn}\left(x^{1-\frac{1}{n}} - 1 \right)}$$

Recall: $y = a^x$

$$\ln y = x \ln a$$

$$\frac{1}{y} \frac{dy}{dx} = \ln a$$

$$\frac{dy}{dx} = y \ln a = a^x \ln a$$

So:

$$y = r^{(1-\frac{1}{n})}$$

$$\ln y = (1-\tfrac{1}{n}) \ln r$$

$$\frac{1}{y}\frac{dy}{dn} = \ln r\,(-1)(-\tfrac{1}{n^2})$$

$$\boxed{\frac{dy}{dn} = (r)^{1-\frac{1}{n}} \ln r\,(\tfrac{1}{n^2})}$$

Also $z = x^{1-\frac{1}{n}}$

$$\ln z = (1-\tfrac{1}{n}) \ln x$$

$$\frac{1}{z}\frac{dz}{dn} = \ln x\,(\tfrac{1}{n^2})$$

$$\boxed{\frac{dz}{dn} = x^{1-\frac{1}{n}} \ln x\ \frac{1}{n^2}}$$

BACK TO l'Hopital:

$$\lim_{n\to 1} \frac{V_2}{V} = \lim_{n\to 1} \frac{(r)^{1-\frac{1}{n}} \ln r\ \frac{1}{n^2}}{x^{1-\frac{1}{n}} \ln x\ \frac{1}{n^2}} = \boxed{\frac{\ln r}{\ln x}}$$

Newtonian