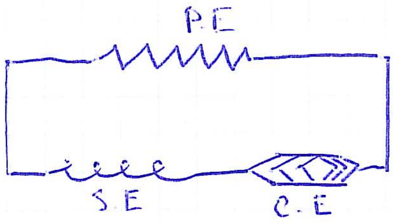
Problem 1 :

1) elastic modulus $E = \dfrac{\sigma_1 - \sigma_0}{\varepsilon_1 - \varepsilon_0} = 17\ GPa$.

$(\sigma = E\,\varepsilon)$

2) Hill's three element model :



P.E : ~~pass~~ parallel element → (carrying passive force)

C.E : contractile element

S.E : serie element

(C.E and S.E) → (active force)

Problem 2 :

1) $Q = \displaystyle\int_0^{d/2} v_z(r)\, 2\pi r\, dr$

$$Q = \frac{2\pi \Delta P}{4\eta L}\left[\left(\frac{d}{2}\right)^2 \frac{r^2}{2} - \frac{r^4}{4}\right]_0^{d/2} = \frac{2\pi\Delta P}{4\eta L}\left[\frac{1}{2}\left(\frac{d}{2}\right)^4 - \frac{1}{4}\left(\frac{d}{2}\right)^4\right]$$

$$Q = \frac{\pi \Delta P}{8\eta L}\left(\frac{d}{2}\right)^4 = \frac{\pi \Delta P d^4}{128\,\eta L}$$

2) $v_z(r=0) = \dfrac{\Delta P d^2}{16\,\eta L} = v_0$

$$\frac{Q}{v_0} = \frac{\pi d^2}{8} = \frac{1}{2}\,\pi\left(\frac{d}{2}\right)^2 = \frac{1}{2}\,A_{ves}$$

A_{ves} is the area of the blood vessel.

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3) $\tau_{rz} = 0 + 2\eta \frac{1}{2}\left(v_{z,r} + \cancel{v_{r,z}} \right)$ $\quad 0$

$= \eta \dfrac{\partial v_z}{\partial r}$ $\quad \Rightarrow F =$

4) F at $\dfrac{d}{2}$?

$$F = -A \, \tau_{rz}\Big|_{r=d/2} = -A \, \eta \, \frac{\partial v_z}{\partial r}\Big|_{r=\frac{d}{2}}$$

$$F = \cancel{-A} + 2\pi r L \, \eta \, \frac{\Delta P}{4\eta L} \left(+2r \right) \Big|_{r=\frac{d}{2}}$$

at the wall $: F = \Delta P \, \pi \left(\dfrac{d}{2}\right)^2$

5) equilibrium :

The net force on the vessel is due to the viscous force and the pressure differential at the ends :

$$P_1 \, \pi \left(\frac{d}{2}\right)^2 - P_2 \left(\pi \, \frac{d^2}{2} \right) - F = 0$$

$$F = \Delta P \, \pi \, \frac{d^2}{2}$$

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problem 3 :

1) $\cancel{\frac{\sigma_{\theta\theta}}{r_i} = \frac{p_i}{h} \quad \sigma_{\theta\theta} = r_i \frac{p_i}{h}}$

$$\frac{\sigma_{\theta\theta}}{r_i + \frac{h}{2}} = \frac{p_i}{h} \qquad r_i >> h \implies r_i + \frac{h}{2} \approx r_i$$

$$\boxed{\sigma_{\theta\theta} = p_i \frac{r_i}{h}}$$

2) $\lambda_z = 1 \implies \lambda_r = \frac{1}{\lambda_\theta}$

$$h = \lambda_r H = \boxed{\frac{1}{\lambda_\theta} H}$$

$$r_i = \boxed{\lambda_\theta R_i}$$

3) $\sigma_{\theta\theta} = p_i \frac{\lambda_\theta^2 R_i}{H} \implies p_i = \sigma_{\theta\theta} \frac{H}{\lambda_\theta^2 R_i}$

4) $\sigma = 2 f(I_1) \mathbb{B} + q \mathbb{1}$

5) $\sigma_{rr} = 0 \implies q = -2 f(I_1) \lambda_r^2$

$$q = -2 f(I_1) \frac{1}{\lambda_\theta^2}$$

6) there are equal to zero

7) eq(8) becomes $\frac{\partial \sigma_{rr}}{\partial r} + \frac{\sigma_{rr} - \sigma_{\theta\theta}}{r} = 0$.

8) $-\frac{\partial \sigma_{rr}}{\partial r} = \frac{\sigma_{rr} - \sigma_{\theta\theta}}{r}$

$$\int_{r_i}^{r_o} -\frac{\partial \sigma_{rr}}{\partial r} dr = \int_{r_i}^{r_o} \frac{\sigma_{rr} - \sigma_{\theta\theta}}{r} dr.$$

$$-\left[\sigma_{rr}\right]_{r_i}^{r_o} = \int_{r_i}^{r_o} \frac{\sigma_{rr} - \sigma_{\theta\theta}}{r} dr.$$

$$+\left[0 + p_i\right] = \int_{r_i}^{r_o} \frac{\sigma_{rr} - \sigma_{\theta\theta}}{r} dr$$