Chapter 14

Q1

$d_1 : 7\ mm$ for the Large artery

$d_2 : ?!$

$$V_1 A_1 = V_2 A_2$$

from the q ~~eq 2V1~~ $V_2 = 2V_1$

$$\Rightarrow \quad \cancel{V_1} A_1 = 2\cancel{V_1} A_2$$

$$\cancel{\pi} r_1^2 = 2 \cancel{\pi} r_2^2$$

$$\frac{1}{2} \cdot \left(\frac{7}{2}\right)^2 = r_2^2$$

$$\sqrt{\frac{49}{8}} = r_2 \qquad r_2 = \frac{7}{\sqrt{4}}$$

$$= 2.475\ mm$$

$$\boxed{\text{Diameter} = 4.949\ mm}$$

Q2

the diameter of a blood vessel narrows by 70%

@ by what factor does the blood velocity increase

$$V_1 A_1 = V_2 A_2$$

→ let A_1, V_1 for the original shape

→ V_2, A_2 after the presence of a plaque on the Blood vessel walls

$$A_2 = 0.70 A_1$$

$$\therefore V_1 \cancel{A_1} = V_2 (0.70) \cancel{A_1}$$

$$V_2 = \frac{\cancel{0.8} V_1}{0.\cancel{70}} = 1.4 V_1$$

(b) if $V_1 = 0.15\ m.s^{-1}$ and systolic pressure $= 130mmHg$

what is the blood pressure in the narrowed vein?!

$$P_1 + \rho g h_1 + \frac{1}{2}\rho V_1^2 = P_2 + \rho g h_2 + \frac{1}{2}\rho V_2^2$$

$1mmHg \longrightarrow 133.3\ pa$

$130\ mmH \xleftarrow{\alpha} X$

$$X = 130 * 133.3$$

$$\boxed{P_1 = 17.3 * 10^3\ pa}$$

$$17.3 * 10^3 + \frac{1}{2}(1060)(0.15)^2$$
$$= P_2 + \frac{1}{2}(1060)\left[1.4 * (0.15)\right]^2$$

$$\boxed{P_2 = 119\ mmHg}$$

Q3

$V_1 = 10\ m/s$

$P_1 = 90\ Kpa$

$P_2 = ?!$ if $r_2 = 2r_1$

$h_1 = h_2$

$$P_1 + \frac{1}{2}\rho V_1^2 = P_2 + \frac{1}{2}\rho V_2^2$$

$$V_2 A_2 = V_1 A_1$$

$$V_2 (\pi r_2^2) = V_1 \pi r_1^2$$

$$V_2 ((2\cancel{r_1})^2) = V_1 \cancel{r_1^2}$$

$$\boxed{V_2 = \frac{V_1}{4}}$$

$$90 * 10^3 + \frac{1}{2}(1000)(10)^2 = P_2 + \frac{1}{2}(1000)\left(\frac{10}{4}\right)^2$$

$$\boxed{P_2 = 137\ KPa}$$

Q5

at what rate ?!

$$\frac{\Delta P}{\Delta h} = ?!$$

$\rightarrow$ if $V_1 = V_2$ = Constant

Solution

$$P_1 + \frac{1}{2}\cancel{\rho} V_1^2 + \rho g h_1 = P_2 + \frac{1}{2}\cancel{\rho} V_2^2 + \rho g h_2$$

$$P_2 - P_1 = \rho g \left[h_2 - h_1\right]$$

$$\frac{\Delta P}{\Delta h} = \rho g$$

$$= 1000 * 9.8$$

$$\boxed{\frac{\Delta P}{\Delta h} = 9800 \ \frac{Pa}{m}}$$

14.6

$v_2 = 7\ m/s$ fluid coming out

(a) How far below the surface of the fluid was the hole punched.

$$P_1 + \frac{1}{2}\rho v_1^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2$$

$v_1 = 0$ $\quad \therefore P_1 = P_2 = 1atm$

$h_2 = 0$

$$\cancel{\rho} g h_1 = \frac{1}{2}\cancel{\rho} v_2^2$$

$$h_1 = \frac{v_2^2}{2g} = \frac{49}{2 \times 9.8} = 2.45\ m$$

(b) if the volume flow rate coming out of the tank $= 0.5\ L/m$ what $r_2 = \#$

$$F_2 = \frac{\Delta V}{\Delta t} = \frac{A \Delta L}{\Delta t} = \boxed{A_2 v_2 = \frac{dV}{dt}}$$

$$\therefore A_2 = \frac{dV}{dt} / v_2$$

$$A_2 = \frac{dV/dt}{v_2}$$

$$\frac{dV}{dt} = 0.5 \text{ liter/min} = \frac{0.5}{60} \, m^3/s$$

$$A_2 = \frac{\frac{0.5}{60}}{7} = 0.0012 \, m^2 = 12 \, cm^2$$

the radius $\Rightarrow$ $A = \pi r^2$

$$r = \sqrt{\frac{A}{\pi}} = \sqrt{\frac{12}{\pi}}$$

$$\boxed{r = 1.95 \, cm}$$