(3-71 Class

$$T_{shaft} = \dot{m} r V_{\theta,2} = \dot{m} r \frac{V}{2}\cos\theta = \dot{m} r \left[\frac{\dot{m}}{2\rho A}\right]\cos\theta = \frac{\dot{m}^2 r \cos\theta}{2\rho A}$$

$$\cos\theta = \frac{2\rho T_{shaft}(\pi D_n^2/4)}{\dot{m}^2 r} = \frac{2(1000)[15\times 0.08]\left[\pi (0.008)^2/4\right]}{(0.9)^2 (0.16)} \rightarrow \theta = 21.4^\circ$$

(3-73 Class

$$\dot{W}_{shaft} = U V_\theta \dot{m}$$

$$\vec{V}_1 = \vec{V}_{r,1} + \vec{U} \rightarrow V_{\theta,1} = V_1 \cos 30^\circ = 15\cos 30^\circ = 13 \text{ m/s}$$

$$\dot{m}_1 = \rho(\vec{V}\cdot n_1)A = \rho V \sin\theta (2\pi r_1 h_1) = (1000)\times 15 \sin 30 \left(2\pi (0.6)(0.3)\right) = 8482 \text{ kg/s}$$

$$U = r_1 \omega = 0.6\left[120 \times \frac{2\pi}{60}\right] = 7.54$$

$$\dot{W}_{shaft} = (7.54)(13)(8482) = 8.2\times 10^5 \text{ W}$$

(3-76 Class

$$\sum_{out}\left(\bar{u}^{\,0} + \frac{P}{\rho} + \frac{V^2}{2} + g\vec{z}^{\,0}\right)\dot{m} - \sum_{in}\left(\bar{u} + \frac{P}{\rho} + \frac{V^2}{2} + gz\right)\dot{m} = \dot{Q}_{net} + \dot{W}_{shaft}$$

$$\rightarrow \left(\frac{-20\times 10^3}{10^3} + \frac{2^2}{2} + 0\right)\dot{m} - \left(\frac{154\times 10^3}{10^3} + \frac{6^2}{2} + 10\times 1\right)\dot{m} = \dot{W}_{shaft}$$

$$\dot{m} = Q\rho = 0.2\times 1000 = 200 \text{ kg/s}$$

$$\rightarrow \dot{W}_{shaft} = 40000 = 40 \text{ kW} \qquad \leftarrow \text{4 ans}$$

سوال 3-80)

$$\frac{V_A^2}{2g} + Z_A = \frac{P_B}{\gamma} + \frac{V_B^2}{2g} + Z_B + h_L \rightarrow 0+0+10 = 0+0+0+h_L \rightarrow h_L = 10\,m$$

$$\frac{V_B^2}{2g} + Z_B + h_P = \frac{P_A}{\gamma} + \frac{V_A^2}{2g} + Z_A + h_P \rightarrow 0+0+0+h_P = 0+0+10+10 \rightarrow h_P = 20m$$

(۳-۸۶ حجم کنترل: سطح آزاد مخزن و مقطع A

$$\rightarrow \frac{P_1}{\gamma} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + Z_2 + h_L$$

$$\rightarrow 0+0+8 = 0+\frac{V_2^2}{2g} + 0 + 0.05\frac{V_1^2}{2g}$$

$$\rightarrow \frac{V_2^2}{2g} + 0.05\frac{V_1^2}{2g} = 8 \rightarrow \frac{81V_1^2}{2g} + 0.05\frac{V_1^2}{2g} = 8 \rightarrow V_1 = 1.3\,a$$

$$\rightarrow A_1V_1 = A_2V_2 \rightarrow \frac{\pi}{4}(100)^2 \times V_1 = \frac{\pi}{4}(50)^2 \times V_2$$

$$\rightarrow \frac{V_2}{V_1} = 9 \rightarrow V_2 = 9V_1$$

$$\rightarrow Q_{سیستم} = A_1V_1 = \frac{\pi}{4}(100\times10^{-3})^2 \times 1.3\,a = 23.8\,a\ L/s$$

نرینه ۳

جواب ۳-۱۹)

$Z_A = 0$ سطح آب $\quad V_A = 0 \rightarrow \frac{V_A^2}{2g} = 0 \quad Z_B = 2m \quad V_B = V_{لوله} \quad \frac{V_B^2}{2g} = \frac{V_{لوله}^2}{2g}$

$\Delta H_{AB} = L_{AB} \times .1.1 \frac{V^2}{2g}$

$P_B = 2 - 100 = -97 kP \quad \frac{P_B}{\gamma} = \frac{-97}{+9,11} = -9,8 m$

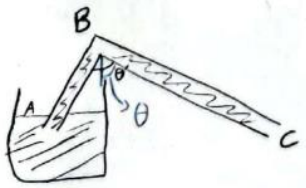
$\Delta H_{BC} = L_{BC} x$

$Z_C = 2 - 2.0 \cos\theta \quad \frac{P_C}{\gamma} = 0$

$Z_A + \frac{P_A}{\gamma} + \frac{V_A^2}{2g} = Z_B + \frac{P_B}{\gamma} + \Delta H_{AB} \rightarrow 0+0+0 = 2 - 9,8 + \frac{V_{لوله}^2}{2g} + 3 \times .1.1 \times \frac{V_{لوله}^2}{2g} \Rightarrow 7,8 = 1,03 \frac{V_{لوله}^2}{2g} \rightarrow \frac{V_{لوله}^2}{2g} = 7,5 m$

$Z_B = \frac{P_B}{\gamma} + \frac{V_B^2}{2g} = Z_C + \frac{P_C}{\gamma} + \frac{V_C^2}{2g} + \Delta H_{BC} \rightarrow 2 - 9,8 + \frac{V_{لوله}^2}{2g} = 2 - 2.0 \cos\theta + 0 + \frac{V_{لوله}^2}{2g} + 2.0 \times .1.1 \times \frac{V_{لوله}^2}{2g}$

$-7,8 = 2 - 2.0 \cos\theta + 2.0 \times .1.1 \times 7,5 \rightarrow \cos\theta = .1045 \rightarrow \theta = 55^\circ$



برای به دست آوردن θ چون θ، ۵۵ درجه است پس θ باید از ۵۵ بیشتر باشد پس θ میشود ۹۰ درجه گزینه ۴

سوال 3-92)

$\vec{V} = \frac{1}{A} \int_A V dA = \frac{1}{\pi r_0^2} \int_0^{r_0} kr (2\pi r dr) = \frac{2k}{r_0^2} \left| r^2 dr \right|_0^{r_0} = \frac{2}{3} kr_0$

$\alpha = \frac{1}{A} \int_A \left(\frac{V}{V}\right)^3 dA = \frac{1}{\pi r_0^2} \int_0^{r_0} \left[\frac{kr}{(2/3) kr_0}\right] (2\pi r dr) = \frac{27}{4 r_0^5} \int_0^{r_0} r^4 dr$

$= \frac{27}{4 r_0^5} \left| \frac{1}{5} r^5 \right|_0^{r_0} = \frac{27}{20}$

سوال 3-95)

$EGL = \frac{V^2}{2g} + \frac{P}{\gamma} + z \quad , \quad z = 30m \quad , \quad \text{افت بار انرژی} = 6$

$EGL = \frac{6}{30} = 0.2 \rightarrow$ گزینه (2)

۵-۵۲) گزینه ۳

گزینه ۱ ← لایه مرزی لزج است، رابطه برنولی برای نواحی غیرلزج نوشته می‌شود. ۱۲

گزینه ۲ ← جریان نباید چرخشی باشد. ۸۱

گزینه ۳ ← در تمام میدان جریان می‌توان نوشت.

۵-۵۹) فشار وارده بر پایه پل برابر با P_{stag} ← $P_{stag} = P + \frac{\rho V^2}{2}$

گزینه ۴

سوال 5-63)

$$Q = \int_A V\,dA = \int_{1.9}^{2.1} \sqrt{2gh}\,(b\,dh) = b\sqrt{2g}\int_{1.9}^{2.1} \sqrt{h}\,dh = \frac{2}{3}\sqrt{2g}\,h^{3/2}\Big|_{1.9}^{2.1}$$

$$= \frac{2}{3}(0.4)\sqrt{2(9.81)}\left[(2.1)^{3/2} - (1.9)^{3/2}\right] = 0.50108\ m^3/s$$

$$Q_m = V_2 A = \sqrt{2gh}\,(bd) = \sqrt{2(9.81)(2)}\left[(0.4)(0.2)\right] = 0.50113\ m^3/s$$

سوال 5-68)

$$Q_A = Q_B \rightarrow V_A A_A = V_B A_B \rightarrow \sqrt{2gh_A}\,\frac{\pi}{4}d_A^2 = \sqrt{2gh_B}\,\frac{\pi}{4}d_B^2$$

$$h_A = \left(\frac{d_B}{d_A}\right)^4 h_B = \left(\frac{0.5}{0.4}\right)^4 \times 2 = 4.88 \simeq 4.9\,m$$

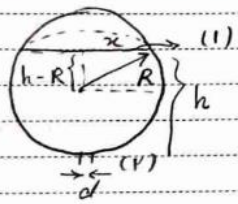
سوال 5-72

$$\frac{P_2}{\gamma} + \frac{v_2^2}{2g} + z_2 = \frac{P_3}{\gamma} + \frac{v_3^2}{2g} + z_3$$

$$\frac{P_2}{\gamma} + \frac{v^2}{2g} + [H + (2m)] = 0 + \frac{v^2}{2g} + 0 \qquad P_2 = -\gamma (H+2)$$

$$(1770 - 101300)\text{pa} = -(9810)(H+2) \qquad H = 8{,}15\text{m}$$

۷۷-۵) جریان شبه پایدار



$$\rightarrow A_1 v_1 = A_2 v_2$$

$$\rightarrow x = \sqrt{R^2 - (h-R)^2} = \sqrt{R^2 - (R^2 - 2hR + h^2)} = \sqrt{2hR - h^2}$$

$$\rightarrow \pi (x)^2 \times \left(\frac{-dh}{dt}\right) = \frac{\pi}{4} d^2 \times \sqrt{2gh}$$

$$\rightarrow \frac{-dh}{dt} = \frac{d^2}{4} \times \frac{\sqrt{2gh}}{x^2} = \frac{d^2}{4} \times \frac{\sqrt{2gh}}{2hR - h^2}$$

$$\rightarrow \frac{dh}{dt} = -1{,}11 \frac{d^2 \sqrt{h}}{2hR - h^2}$$