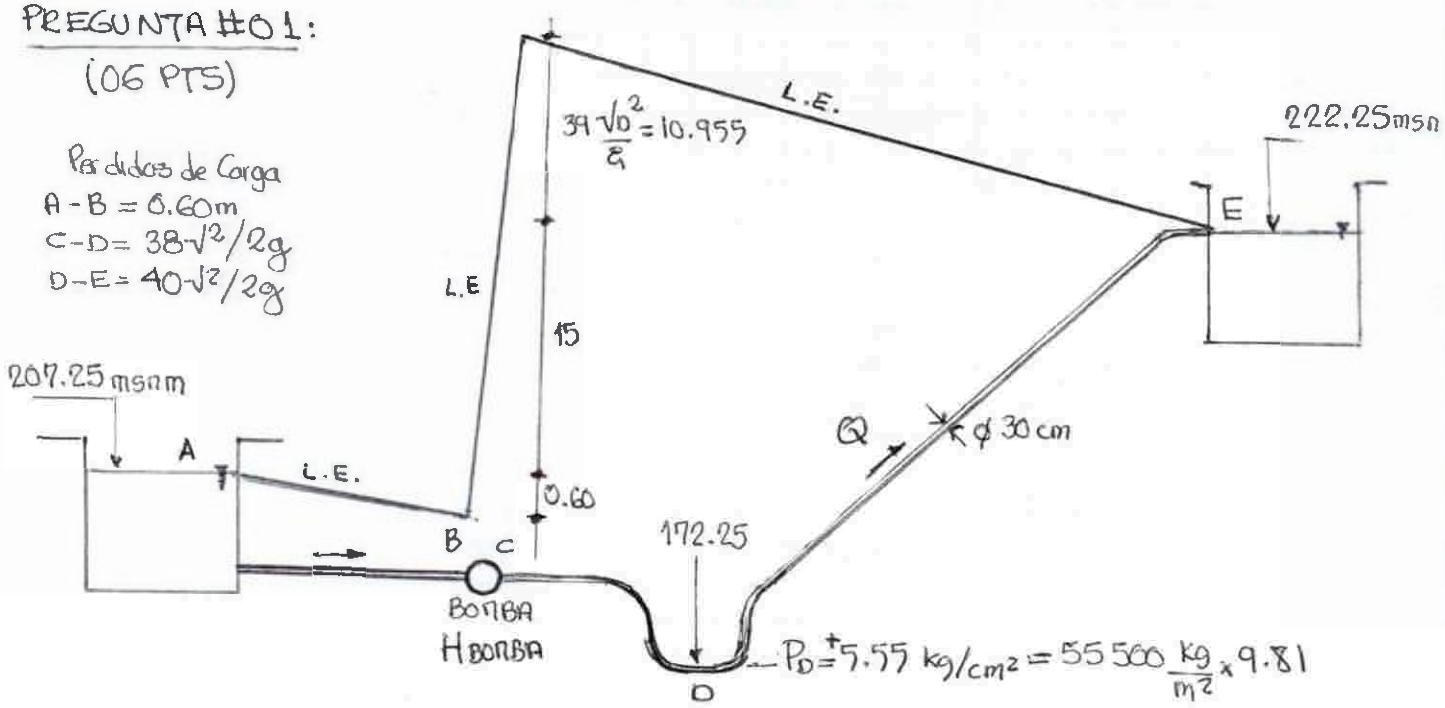
Solucionario: Mecanica de Fluidos I - Grupo C

PREGUNTA #01:

(06 PTS)

Perdidas de Carga
A - B = 0.60m
C - D = $38\frac{V^2}{2g}$
D - E = $40\frac{V^2}{2g}$



APLICAMOS ECUACION DE LA ENERGIA D - E (Para hallar V_D)

$$Z_D + \frac{P_D}{\gamma} + \frac{V_D^2}{2g} = Z_E + \frac{P_E}{\gamma}^{0} + \frac{V_E^2}{2g}^{0} + \sum_D^E hp$$

$$Z_D + \frac{P_D}{\gamma} + \frac{V_D^2}{2g} = Z_E + 40\frac{V_D^2}{2g}$$

$$\frac{V_D^2}{2g} - 40\frac{V_D^2}{2g} = Z_E - Z_D - \frac{P_D}{\gamma}$$

$$-39\frac{V_D^2}{2g} = 50 - \frac{P_D}{\gamma}$$

$$-39V_D^2 = 50 \times 2g - \frac{P_D}{\rho g} \times 2g$$

$$-V_D^2 = \frac{981 - 1088.91}{39}$$

$$V_D = \sqrt{2.767}$$

$$V_D = 1.66\ \frac{m}{sg}$$ ✓✓

$$\rightarrow Q = A \times V = \frac{\pi \times 0.30^2}{4} \times 1.66$$

$$Q = 0.117\ \frac{m^3}{sg} \times \frac{1000\ LT}{1\ m^3} \times \frac{60\ sg}{1\ min}$$

$$\boxed{Q = 7020\ \frac{LT}{min}}$$ ✓✓

• Potencia de la Bomba

$$Pot = \gamma \times Q \times H_B$$

→ ECUACION DE A - E:

$$Z_A + \frac{P_A}{\gamma}^{0} + \frac{V_A^2}{2g}^{0} - \sum_A^B hp + H_B - \sum_C^D hp - \sum_D^E hp = Z_E + \frac{P_E}{\gamma}^{0} + \frac{V_E^2}{2g}^{0}$$

$$Z_A - \sum_A^B hp + H_B - \sum_C^D hp - \sum_D^E hp = Z_E$$

$$H_B = (Z_E - Z_A) + \sum_A^B hp + \sum_C^D hp + \sum_D^E hp$$

remplazando valores

$$H_B = 222.25 - 207.25 + 0.60 + \frac{38V_2^2}{2g} + \frac{40V^2}{2g}$$

$$H_B = 15.60 + 39\frac{V_D^2}{g}$$

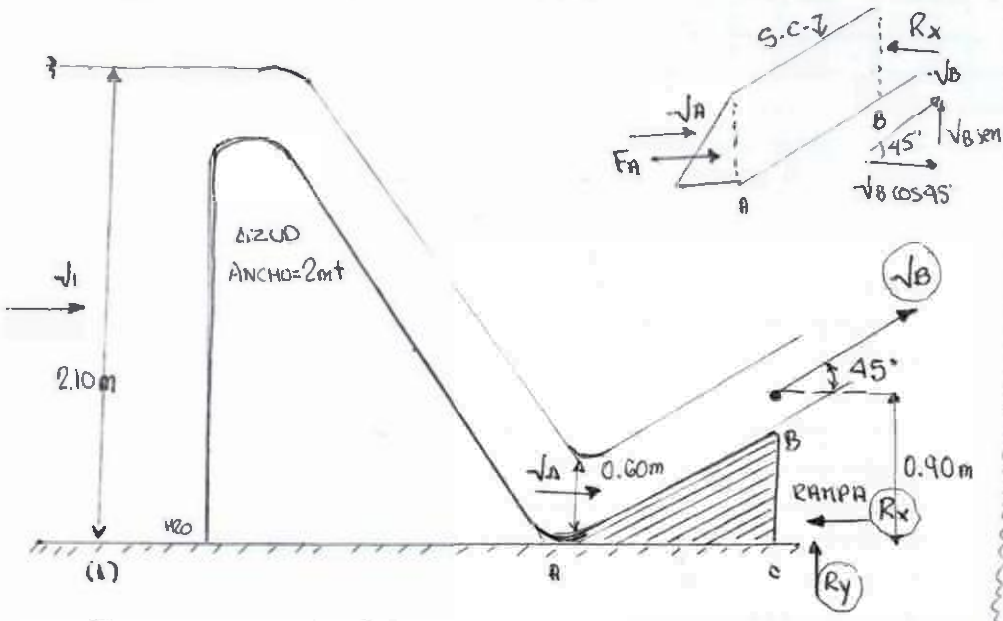
$$H_B = 26.555\ m$$ ✓✓

$$\rightarrow Pot_{BOMBA(KW)} = 9810\ \frac{N}{m^3} \times 0.117\ \frac{m^3}{sg} \times 26.555m$$

$$= 30479.03\ \frac{Nm}{sg}$$

$$\boxed{Pot_{BOMBA(KW)} = 30.479\ KWATT}$$

PREGUNTA #02
(07 PTS)



• → POR CANTIDAD DE MOVIMIENTO

$\Sigma F_x = \rho Q (V_{Bx} - V_{Ax})$

$F_R - R_x = \rho Q (V_B \cos 45° - V_A)$

DONDE:

$F_R = \frac{1}{2} \times 9810 \times 0.60^2 \times 2.00$

$F_R = 3531.6\,N$

→ $3531.6 - R_x = 1000 \times 6.804 \times (5.12 \times \frac{\sqrt{2}}{2} - 5.67)$

→ $R_x = 17477.17\,N$

$R_x = 1781.57\,KG$

$\Sigma F_y = \rho Q (V_{By} - V_{Ay})$

$R_y = \rho Q V_B \sin 45°$

$R_y = 1000 \times 6.804 \times 5.12 \times \frac{\sqrt{2}}{2}$

$R_y = 24633.11\,N$

$R_y = 2511.02\,KG$

• → Por ecuacion de la Continuidad en (1) y A:

$Q = A \cdot V \rightarrow A_1 V_1 = A_A \times V_A \rightarrow (2.10 \times 2.00) \times V_1 = (0.60 \times 2.00) \times V_A$

$V_A = \frac{4.20 V_1}{1.20}$

$V_A = 3.5 V_1 \quad \ldots (I)$

• → Por ecuacion de la Energia en (1) - A :

$\cancel{Z_A}^{0} + \frac{P_A}{\gamma} + \frac{V_A^2}{2g} = \cancel{Z_A}^{0} + \frac{P_A}{\gamma} + \frac{V_A^2}{2g} \rightarrow \frac{P_1}{\gamma} + \frac{V_1^2}{2g} = \frac{P_A}{\gamma} + \frac{V_A^2}{2g}$

$2.10 + \frac{V_1^2}{2g} = 0.60 + \frac{V_A^2}{2g}$

$\frac{V_A^2 - V_1^2}{2g} = 1.50 \rightarrow V_A^2 - V_1^2 = 29.43 \quad \ldots (II)$

→ (I) en (II) : $(3.5 V_1)^2 - V_1^2 = 29.43 \rightarrow 11.25 V_1^2 = 29.43$

$V_1^2 = 2.616$

$V_1 = 1.62\,m/sg \downarrow\downarrow \rightarrow V_A = 5.67\,m/sg \downarrow\downarrow$

→ DETERMINANDO EL CAUDAL: $Q = (2.10 \times 2.00) \times (1.62) \rightarrow Q = 6.804\,m^3/sg \downarrow\downarrow$

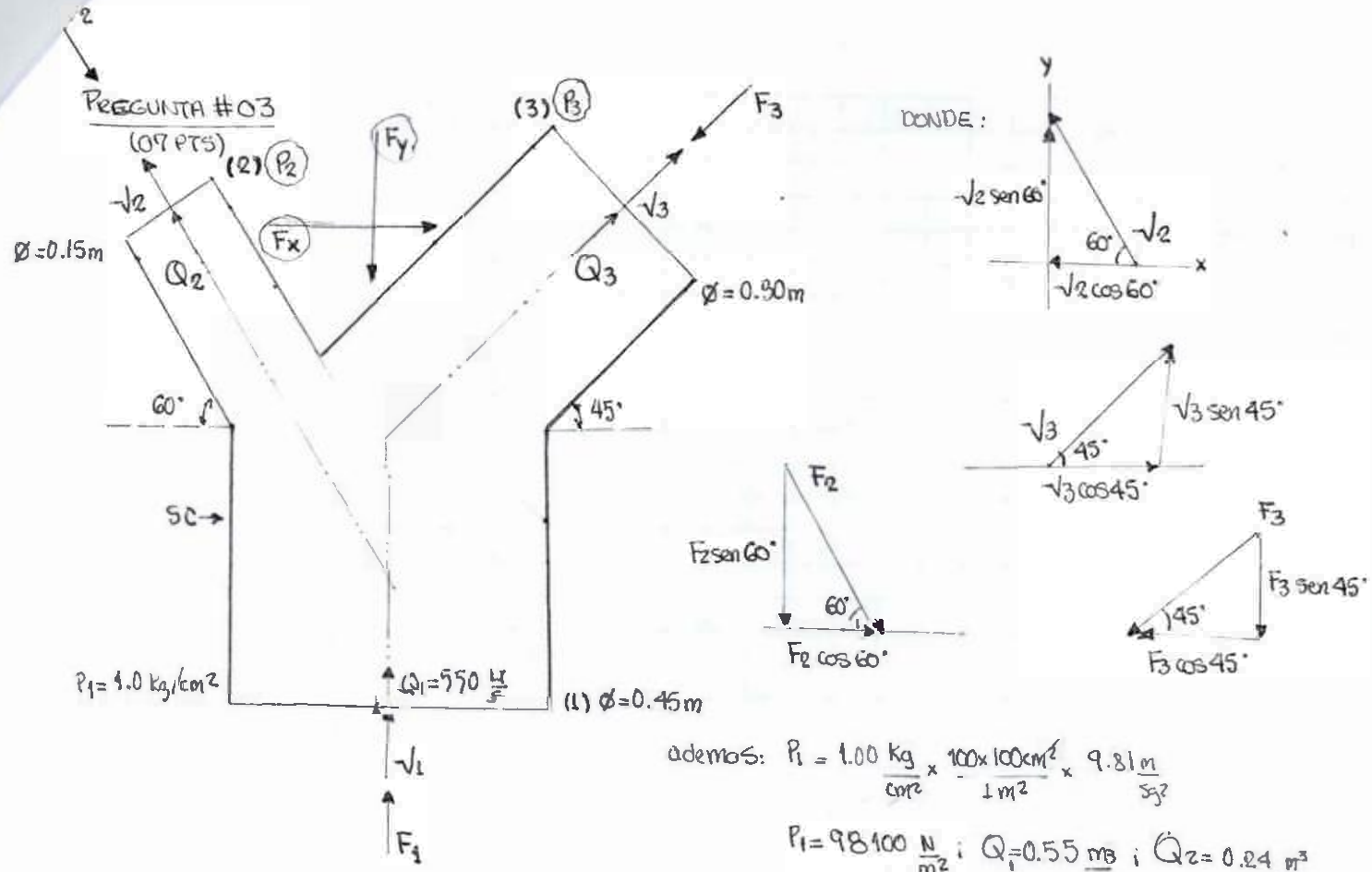
• → Por ecuacion de la Energia en A - B (para hallar la velocidad en B)

$\cancel{Z_A} + \frac{P_A}{\gamma} + \frac{V_A^2}{2g} = \cancel{Z_B} + \frac{P_B}{\gamma} + \frac{V_B^2}{2g}$

$\frac{P_A}{\gamma} + \frac{V_A^2}{2g} = \frac{P_B}{\gamma} + \frac{V_B^2}{2g}$

$0.60 + \frac{5.67^2}{2 \times 9.81} = 0.90 + \frac{V_B^2}{2g}$

$V_B = \sqrt{26.2908} \rightarrow V_B = 5.12\,m/sg$



DONDE:

además: $P_1 = 1.00 \frac{kg}{cm^2} \times \frac{100 \times 100 cm^2}{1 m^2} \times 9.81 \frac{m}{s^2}$

$P_1 = 98100 \frac{N}{m^2}$; $Q_1 = 0.55 \frac{m^3}{s}$; $Q_2 = 0.24 \frac{m^3}{s}$

- POR ECUACION DE LA CONTINUIDAD (PARA HALLAR VELOCIDADES Y CAUDALES)

$Q_1 = Q_2 + Q_3$ ..... (I)

$Q_1 = A_1 \times V_1 \rightarrow V_1 = \frac{Q_1}{A_1} = \frac{0.55}{(\frac{\pi \times 0.45^2}{4})}$

$V_1 = 3.458 \frac{m}{s}$ ↓↓

$Q_2 = A_2 \times V_2 \rightarrow V_2 = \frac{Q_2}{A_2} = \frac{0.24}{(\frac{\pi \times 0.15^2}{4})}$

$V_2 = 13.581 \frac{m}{s}$ ↓↓

→ en (I): $0.55 = 0.24 + Q_3$

$Q_3 = 0.31 \frac{m^3}{s} \rightarrow V_3 = \frac{0.31}{(\frac{\pi \times 0.30^2}{4})}$

$V_3 = 4.386 \frac{m}{s}$ ↓↓

- POR ECUACION DE LA ENERGIA EN 1-2: (PARA HALLAR LA PRESION)

$\cancel{Z_1}^{0} + \frac{P_1}{\gamma} + \frac{V_1^2}{2g} = \cancel{Z_2}^{0} + \frac{P_2}{\gamma} + \frac{V_2^2}{2g}$

$\frac{P_2}{\gamma} = \frac{P_1}{\gamma} + \frac{V_1^2}{2g} - \frac{V_2^2}{2g}$

$P_2 = P_1 + (\frac{V_1^2 - V_2^2}{2g}) \times \gamma$

→ $P_2 = 98100 + (\frac{3.458^2 - 13.5131^2}{2 \times 9.81}) \times 9810$

$P_2 = 11857.10 \frac{N}{m^2}$

- ECUACION ENERGIA 1-3:

$\cancel{Z_1}^{0} + \frac{P_1}{\gamma} + \frac{V_1^2}{2g} = \cancel{Z_3}^{0} + \frac{P_3}{\gamma} + \frac{V_3^2}{2g}$

$\frac{P_3}{\gamma} = \frac{P_1}{\gamma} + \frac{V_1^2}{2g} - \frac{V_3^2}{2g}$

$P_3 = P_1 + (\frac{V_1^2 - V_3^2}{2g}) \times \gamma$

→ $P_3 = 98100 + (\frac{3.458^2 - 4.386^2}{2 \times 9.81}) \times 9810$

$P_3 = 94460.38 \frac{N}{m^2}$

- ECUACION CANTIDAD DE MOVIMIENTO

$\Sigma F_x = CM_{2x} - CM_{1x}$

$F_x + F_2 \cos 60° - F_3 \cos 45° = (\rho Q_3 V_3 \cos 45° - \rho Q_2 V_2 \cos 60°) - (\cancel{\rho Q_1 V_{1x}}^{0})$

$F_x = F_3 \cos 45° - F_2 \cos 60° - \rho Q_2 V_2 \cos 60° + \rho Q_3 V_3 \cos 45°$

DONDE:

$F_2 = P_2 \times A_2 = 11857.10 \times (\frac{\pi \times 0.15^2}{4}) \rightarrow F_2 = 209.53 N$

$F_3 = P_3 \times A_3 = 94460.38 \times (\frac{\pi \times 0.30^2}{4}) \rightarrow F_3 = 6677.01 N$

$$\rightarrow F_x = 6677.01_x \frac{\sqrt{2}}{2} - 209.53_x \frac{1}{2} - 1000_x\ 0.24_x 13.581_x \frac{1}{2} + 1000_x 0.31_x 4.386_x \frac{\sqrt{2}}{2}$$

$$F_x = 4721.359 - 104.765 - 1629.72 + 808.459$$

$$\boxed{F_x = 3795.333\ N}$$

$$\rightarrow \Sigma F_y = C.M_{SALIDA} - C.M_{INGRESO}$$

$$F_1 - F_y - F_2 \operatorname{sen}60^\circ - F_3 \operatorname{sen}45^\circ = \rho Q_3 \sqrt{3} \operatorname{sen}45^\circ + \rho Q_2 \sqrt{2} \operatorname{sen}60^\circ - \rho Q_1 \sqrt{1}$$

DONDE: $F_1 = P_1 x A_1 = 98100_x (\pi x 0.45^2) \rightarrow F_1 = 15602.13\ N$

$$\rightarrow F_y = F_1 - F_2 \operatorname{sen}60^\circ - F_3 \operatorname{sen}45^\circ + \rho Q_1 \sqrt{1} - \rho Q_2 \sqrt{2} \operatorname{sen}60^\circ - \rho Q_3 \sqrt{3} \operatorname{sen}45^\circ$$

$$F_y = 15602.13 - 209.53_x \frac{\sqrt{3}}{2} - 6677.01_x \frac{\sqrt{2}}{2} + 1000_x 0.55_x 3.458 - 1000 x 0.24 x 13.581 x \frac{\sqrt{3}}{2} - 1000 x 0.31 x 4.386 x \frac{\sqrt{2}}{2}$$

$$F_y = 15602.13 - 181.46 - 4721.36 + 1901.90 - 2822.76 - 961.42$$

$$\boxed{F_y = 8817.03\ N}$$