

2-6-2012 (το ερώτημα Α είναι όπως στην
άσκηση 18/06/2015)

①

B $Q_3 = 100 \text{ m}^3/\text{h}$

Bernoulli $\Delta \rightarrow H$

$$H_{0\Delta} - J_3 Q_3^2 = H_{atm} + 0 + 30$$

$$H_{0\Delta}' = 30 + J_3 Q_3^2$$

$$H_{0\Delta}' = 30 + 1.0 \times 10^{-4} \times 100^2$$

$H_{0\Delta}' = 31 \text{ m SY}$

Bernoulli $\Delta \rightarrow Z$

$$H_{0\Delta} - J_2 Q_2^2 = H_{atm} + 0 + 20$$

$$H_{0\Delta}' - 20 = J_2 Q_2^2$$

$$Q_2 = \sqrt{\frac{H_{0\Delta}' - 20}{J_2}} = \sqrt{\frac{(31 - 20)}{(2 \times 10^{-4})}}$$

$Q_2 = 234.52 \text{ m}^3/\text{h}$

Bernoulli $\Delta \rightarrow \ominus$

$Q_4 = Q_2 \Rightarrow Q_4 = 234.52 \text{ m}^3/\text{h}$

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Κόμβος Δ : $Q_1 = Q_2 + Q_3 + Q_4$

$$Q_1 = (234.52 + 100 + 234.52) \text{ m}^3/\text{h}$$

$$Q_1 = 569.04 \text{ m}^3/\text{h}$$

Αντλία Α

$$Q_A = Q_1 = 569.04 \text{ m}^3/\text{h} \quad \frac{\chi_{\text{απ/κμ}}}{\text{Αντλ. Α}} \quad \begin{matrix} H_A = 19.5 \text{ mΣΥ} \\ \eta_A = 75.5\% \end{matrix}$$

$$N_A = \frac{\gamma Q_A H_A}{\eta_A 3600} \Rightarrow N_A = 40.05 \text{ kW}$$

Αντλίες Β, Γ

$$Q_B = Q_r = \frac{Q_1}{2} = 284.52 \text{ m}^3/\text{h} \quad \frac{\chi_{\text{απ/κμ}}}{\text{Αντλ. Β \& Γ}} \quad \begin{matrix} H_B = 19.5 \text{ mΣΥ} \\ \eta_B = 75.5\% \end{matrix}$$

$$N_B = \frac{\gamma Q_B H_B}{\eta_B 3600} \Rightarrow N_B = 20.025 \text{ kW}$$

Αντλία Γ : όμοια με την Β

$$(H_{AB\Gamma} = H_A + H_{B\Gamma}, (H_{B\Gamma} = H_B = H_r) \Rightarrow H_{AB\Gamma} = 39 \text{ mΣΥ})$$

Bernoulli (1) $\rightarrow$ Δ

$$H_{\text{ατμ}} + 0 + 10 - J_1 Q_1^2 + H_{AB\Gamma} - J_k Q_1^2 = H_{\text{οδ}}$$

$$10 + H_{AB\Gamma} - H_{\text{οδ}}' - J_1 Q_1^2 = J_k Q_1^2$$

$$J_k = \frac{10 + H_{AB\Gamma} - H_{\text{οδ}}'}{Q_1^2} - J_1$$

$$J_k = \frac{10 + 39 - 31}{(569.04)^2} - 0.2 \times 10^{-4}$$

$$J_k = 3.56 \times 10^{-5}$$

$$\boxed{\Gamma} \quad \boxed{Q_3 = 0}$$

Bernoulli: $\Delta \rightarrow H$

$$H_{0\Delta} - J_3 Q_3^2 = H_{atm} + 0 + 30$$

$$H_{0\Delta}' = 30 + J_3 Q_3^2$$

$$\boxed{H_{0\Delta}' = 30 \text{ mSY}}$$

Bernoulli: $\Delta \rightarrow Z$

$$H_{0\Delta} - J_2 Q_2^2 = H_{atm} + 0 + 20$$

$$H_{0\Delta}' - 20 = J_2 Q_2^2$$

$$Q_2 = \sqrt{\frac{H_{0\Delta}' - 20}{J_2}} = \sqrt{\frac{(30 - 20)}{(2 \times 10^{-4})}}$$

$$\boxed{Q_2 = 223.6 \text{ m}^3/\text{h}}$$

Bernoulli: $\Delta \rightarrow \odot$

$$Q_4 = Q_2 \Rightarrow \boxed{Q_4 = 223.6 \text{ m}^3/\text{h}}$$

Kombos $\Delta: Q_1 = Q_2 + Q_3 + Q_4$

$$Q_1 = (223.6 + 0 + 223.6) \text{ m}^3/\text{h}$$

$$Q_1 = 447.2 \text{ m}^3/\text{h}$$

Bernoulli: $E \rightarrow \Delta$

$$H_{atm} + 0 + 10 - J_1 Q_1^2 + H_A - J_K Q_1^2 = H_{0\Delta}$$

$$H_A = H_{0\Delta} - 10 + (J_1 + J_K) Q_1^2$$

$$H_A = 30 - 10 + (0.2 \times 10^{-4} + 3.56 \times 10^{-5}) (447.2)^2$$

$$H_A = 31.12 \text{ m} \Sigma Y$$

Avrdia A

$$Q_N = Q_1 = 447.2 \text{ m}^3/\text{h}$$

$$H_N = H_A = 31.12 \text{ m} \Sigma Y$$

$$\left. \begin{array}{l} H = \lambda Q^2 \\ (Q_N, H_N) \end{array} \right\} \lambda = \frac{H_N}{Q_N^2} = \frac{31.12}{447.2^2} \Rightarrow \lambda = 1.56 \times 10^{-4}$$

$$H = 1.56 \times 10^{-4} Q^2$$

Парабола

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Q	H
0	0
200	6.24
447.2	31.12
600	56.16
800	99.84

Το σημείο τομής της παραβολής με την χαρτί της αντλίας Α στις παλίες στροφές μου δίνει το παλίο αντίστοιχο Ση.

$$Q_n = 370 \text{ m}^3/\text{h}$$

$$H_n = 21.3 \text{ mΣΥ}$$

$$\eta_n = 65\%$$

$$\frac{V_N}{V_n} = \frac{Q_N}{Q_n} \Rightarrow V_N = V_n \frac{Q_N}{Q_n} = (1500 \text{ rpm}) \frac{447.2}{370}$$

$$V_N = 1813 \text{ rpm}$$

$$\eta_N = \eta_n = 65\%$$

$$N_A = \frac{\rho Q_N H_N}{\eta_N \cdot 3600} = \frac{1000 \times 9.81 \times 447.2 \times 31.12}{0.65 \times 3600}$$

$$N_A = 58344 \text{ W}$$

$$N_A = 58.344 \text{ kW}$$