

P.590. P.412 J.

⑥

$$Q = 80 \sqrt{10 \times (0.1 + 0.004 + 0.608 + \frac{0.032}{B \rightarrow C} - \frac{0.004}{\text{회전}})}$$

$$= 94.6592 \text{ l/min}$$

B-C 구간 유량

④

$$Q = 80 \sqrt{10 \times (0.1 + \frac{0.004}{\text{회전}} + \frac{0.008 + 0.004}{D \rightarrow \text{회전}} - \frac{0.004}{C \rightarrow D \text{ 회전}})}$$

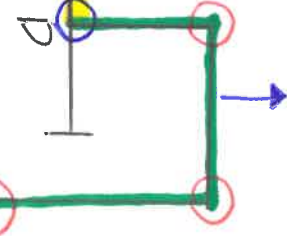
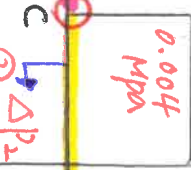
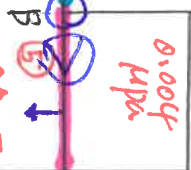
$$= 83.1384 \text{ l/min}$$

②

$$\Delta P_1 = \frac{6 \times 80^2 \times 10^4}{120^2 \times 28^5} \times \left(\frac{0.45}{\text{회전}} + \frac{1.8}{\text{회전}} + \frac{90.012}{25 \times 15A} \right)$$

$$= 0.0043 \text{ MPa}$$

$$= 0.004 \text{ MPa}$$



①

$$\Delta P_4 = \frac{6 \times (80 + 83.1384 + 94.6592)^2 \times 10^4}{120^2 \times 36^5}$$

$$\times \left(\frac{3.5}{\text{회전}} + \frac{1.8}{\text{회전}} + \frac{0.12}{\text{회전}} \right)$$

$$= 0.0295 \text{ MPa}$$

⑤

$$\Delta P_3 = \frac{6 \times (80 + 83.1384)^2 \times 10^4}{120^2 \times 28^5}$$

$$\times \left(\frac{3.5}{\text{회전}} + \frac{1.5}{\text{회전}} \right)$$

$$= 0.0332 \text{ MPa}$$

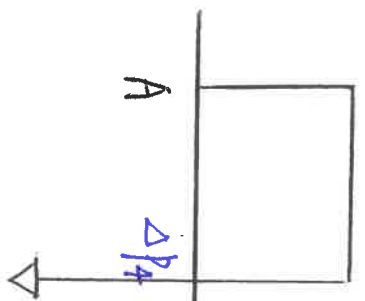
③

$$\Delta P_2 = \frac{6 \times 80^2 \times 10^4}{120^2 \times 28^5}$$

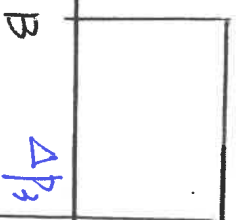
$$\times \left(\frac{3.5}{\text{회전}} + \frac{1.5}{\text{회전}} \right)$$

$$= 0.008 \text{ MPa}$$

$$Q = 80 \sqrt{10 \times 0.1} = 80 \text{ l/min}$$



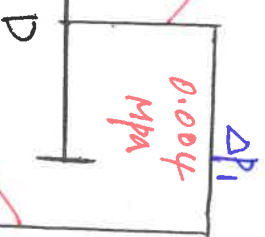
0.028 MPa



0.032 MPa



0.008 MPa



0.1m = 0.001 MPa

0.004 MPa

0.003 MPa

0.3m = 0.003 MPa

0.1m - 0.3m = -0.2m

-0.2m = -0.002 MPa

-0.002 MPa

수업

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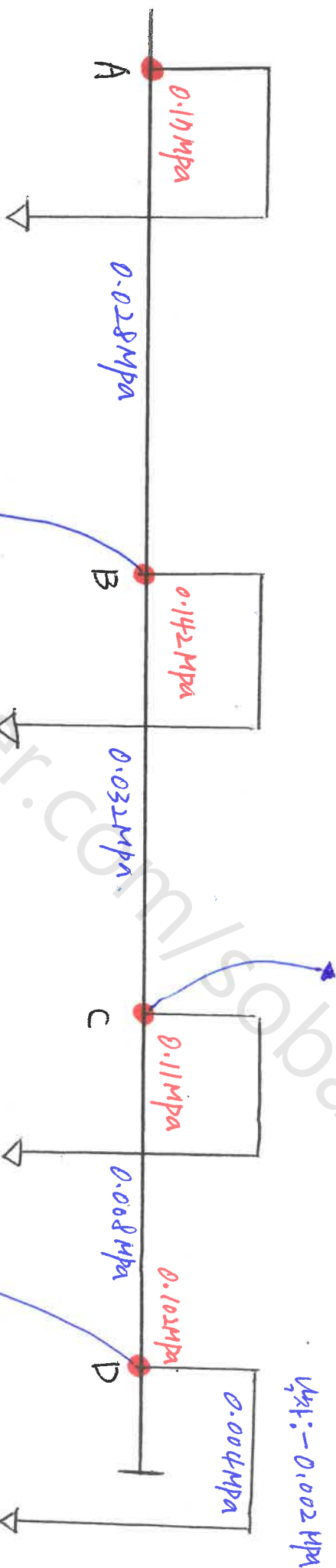
3)

④

$$A \text{ 장 응력} = B \text{ 장 응력} + A-B \text{ 장의 비례응력 } (\Delta P_4) \\ = 0.142 + 0.028 = \boxed{0.17 \text{ MPa}}$$

⑤

$$C \text{ 장 응력} = D \text{ 장 응력} + (-D-C \text{ 장의 비례응력 } (\Delta P_2)) \\ = 0.102 + 0.008 = \boxed{0.11 \text{ MPa}}$$



③

$$B \text{ 장 응력} = C \text{ 장 응력} + B-C \text{ 장의 비례응력 } (\Delta P_3) \\ = 0.11 + 0.032 = \boxed{0.142 \text{ MPa}}$$

①

$$D \text{ 장 응력} = \text{장 응력} + \text{비례응력} \\ = 0.1 + 0.004 + (-0.002) \\ = \boxed{0.102 \text{ MPa}}$$

4)



③

$$\text{③ 지점의 응력} = \frac{0.19}{0.004} - \frac{0.002}{0.004} = 0.168 \text{ MPa}$$

② 지점의 응력 =

$$\frac{0.19}{0.004} - \frac{0.002}{0.004} = 0.168 \text{ MPa}$$

②

$$\text{② 지점의 응력} = \frac{0.142}{0.004} - \frac{0.002}{0.004} = 0.14 \text{ MPa}$$

① 지점의 응력 =

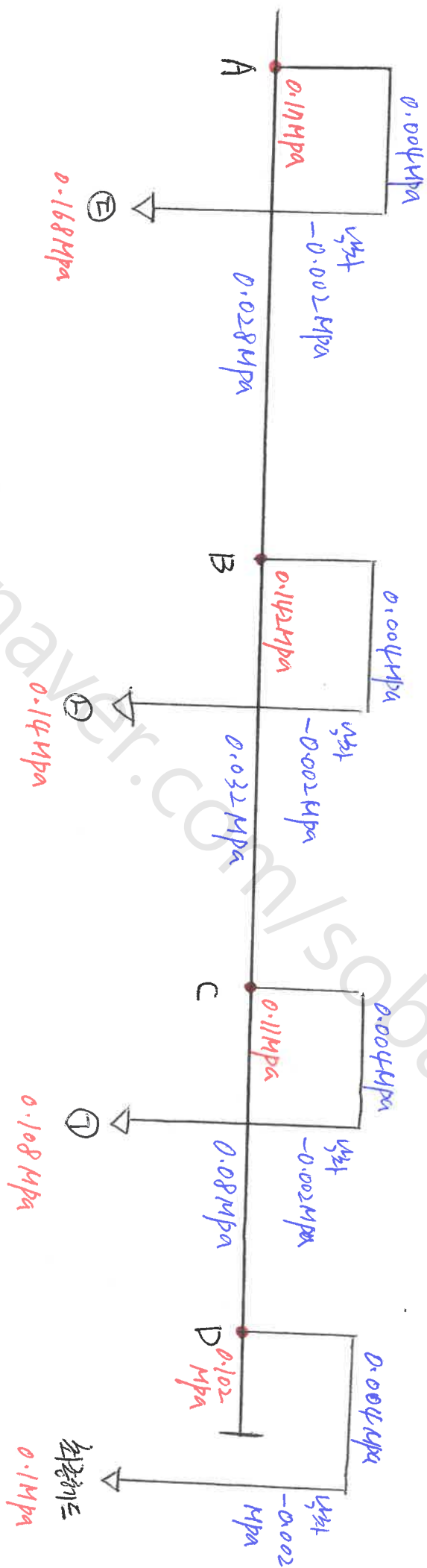
$$\frac{0.11}{0.004} - \frac{0.002}{0.004} = 0.108 \text{ MPa}$$

①

$$\text{① 지점의 응력} = \frac{0.102}{0.004} - \frac{0.002}{0.004} = 0.108 \text{ MPa}$$

① 지점의 응력 =

$$\frac{0.102}{0.004} - \frac{0.002}{0.004} = 0.108 \text{ MPa}$$



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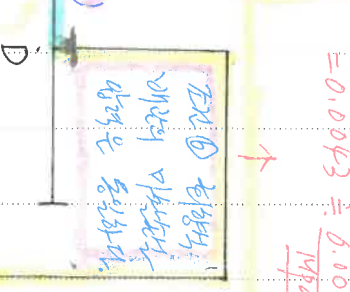
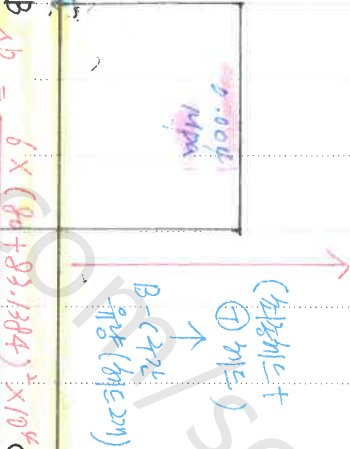
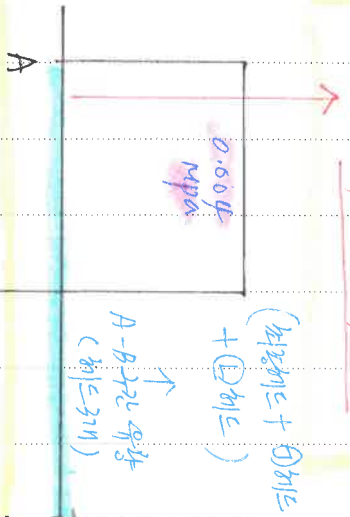
⑥

1) 각 구간별 유속의 차이를 알기 위하여 ?

$$Q = 80 \sqrt{10 \times (0.1 + 0.004 + 0.008)} \\ \text{A-B 구간} + \frac{0.032}{\text{B-C 구간}} = 94.6592 \text{ l/min}$$

$$Q = 80 \sqrt{10 \times (0.1 + 0.004 + 0.008 - 0.004)} \\ \text{B-C 구간} + \frac{0.032}{\text{C-D 구간}} = 83.1384 \text{ l/min}$$

$$\Delta P_1 = \frac{6 \times 80^2 \times 10^4}{120^2 \times 285} = 0.0043 \approx \frac{0.004}{\text{MPa}}$$



⑦

$$\Delta P_4 = \frac{6 \times (80 + 83.1384 + 94.6592)^2}{120^2 \times 365} = 0.0271 \approx 0.028 \text{ MPa}$$

$$\Delta P_3 = \frac{6 \times (80 + 83.1384)^2}{120^2 \times 285} = 0.0322 \approx 0.032 \text{ MPa}$$

$$\Delta P_2 = \frac{6 \times 80^2 \times 10^4}{120^2 \times 285} = 0.0043 \approx 0.008 \text{ MPa}$$

$$\Delta P_1 = \frac{6 \times 80^2 \times 10^4}{120^2 \times 285} = 0.0043 \approx 0.004 \text{ MPa}$$

$$Q = 80 \sqrt{10 \times (0.1 + 0.004 + 0.008)} = 94.6592 \text{ l/min}$$

$$Q = 80 \sqrt{10 \times (0.1 + 0.004 + 0.008 - 0.004)} = 83.1384 \text{ l/min}$$

$$Q = 80 \sqrt{10 \times (0.1 + 0.004 + 0.008 - 0.004 - 0.004)} = 71.7176 \text{ l/min}$$

$$Q = 80 \sqrt{10 \times (0.1 + 0.004 + 0.008 - 0.004 - 0.004 - 0.004)} = 60.2968 \text{ l/min}$$

$$Q = 80 \sqrt{10 \times 0.1} = 80 \text{ l/min}$$

1. 구간 ① 유속은 유량 계산 상대 (가장 작은 유속을 기준으로 풀이)

2. 구간 ② 계산유속은 유량 계산 상대 (가장 작은 유속을 기준으로 풀이)

$$\Delta P = \frac{6 \times Q^2 \times 10^4}{120^2 \times 285} \times L \text{ (구간 ①)}$$

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2) A점에서 최종 헤드까지의 총 손실압력

$$\Delta p_{1 \sim 4} = \Delta p_1 + \Delta p_2 + \Delta p_3 + \Delta p_4 + \text{낙하의 환산수두압력}$$

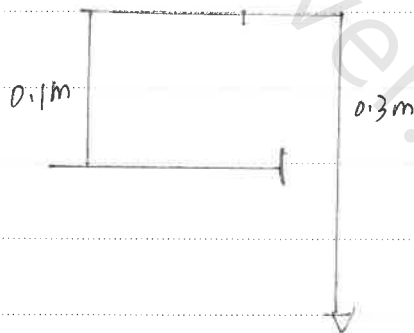
• $\Delta p_1 : \underline{0.004 \text{ MPa}}$

• $\Delta p_2 : \underline{0.008 \text{ MPa}}$

• $\Delta p_3 : \underline{0.032 \text{ MPa}}$

• $\Delta p_4 : \underline{0.028 \text{ MPa}}$

낙하의 환산수두압력



$$0.1\text{m} - 0.3\text{m} = -0.2\text{m}$$

$0.1\text{MPa} = 10\text{m}$ 를 환산하여 계산하면

$$-0.2\text{m} = \underline{-0.002 \text{ MPa}}$$

$$\therefore \Delta p_{1 \sim 4} = 0.004 + 0.008 + 0.032 + 0.028 + (-0.002)$$

$$= \underline{0.07 \text{ MPa}}$$

※ 95번 문제의 경우 조건 ⑧에서 배관내 낙하는 모두 무시하므로
낙하 - 0.002 MPa 은 적용하지 않는다.

3) D, C, B, A 정각에 압력 [MPa] ?

④

$$A \rightarrow B \text{ 압력} = B \rightarrow A \text{ 압력} + \Delta P_4 \quad (A \rightarrow B \text{ 구간})$$

$$= 0.142 + 0.028$$

$$= \underline{0.17 \text{ MPa}}$$

0.17 MPa

A

0.028 MPa

→

0.142 MPa

B

0.032 MPa

→

0.11 MPa

C

0.008 MPa

→

0.102 MPa

D

0.004 MPa

압력 = 0.002 MPa

③

$$C \rightarrow B \text{ 압력} = B \rightarrow C \text{ 압력} + \Delta P_3 \quad (C \rightarrow B \text{ 구간})$$

$$= 0.142 + 0.008$$

$$= \underline{0.11 \text{ MPa}}$$

②

$$B \rightarrow A \text{ 압력} = C \rightarrow B \text{ 압력} + \Delta P_2 \quad (B \rightarrow A \text{ 구간})$$

$$= 0.11 + 0.032$$

$$= \underline{0.142 \text{ MPa}}$$

①

$$D \rightarrow C \text{ 압력} =$$

외부에서 압력 P + ΔP_1 (외부에서 내부로 유입되는 압력)

+ 유체의 흐름에 따른 압력

$$= 0.1 + 0.004 + (-0.002)$$

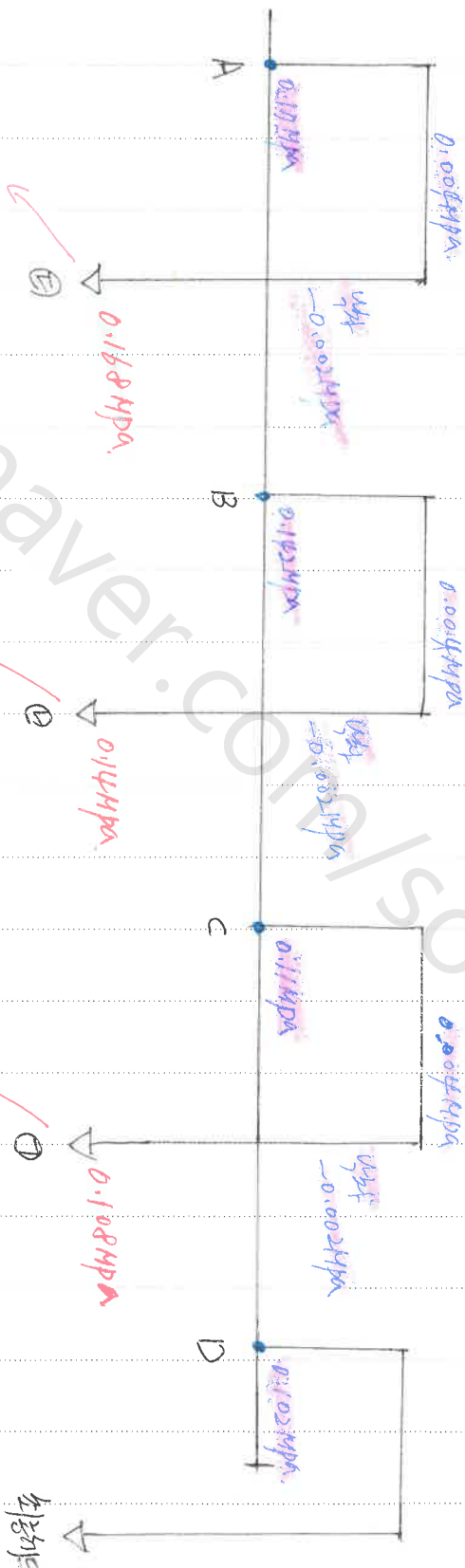
$$= \underline{0.102 \text{ MPa}}$$

PSH 유체 사용 X

0.1 MPa

→

4) ①, ②, ③ 지점에서의 휨모멘트 [MPa] ?



③

③ 지점 휨모멘트 =

A점에서의 - 좌측에서 우측으로의 휨모멘트

$$0.168 - 0.002 \times 0.004 = 0.168 \text{ MPa}$$

B점에서의 - 좌측에서 우측으로의 휨모멘트

$$0.14 - 0.002 \times 0.004 = 0.14 \text{ MPa}$$

②

② 지점 휨모멘트 =

B점에서의 - 좌측에서 우측으로의 휨모멘트

$$0.14 - 0.002 \times 0.004 = 0.14 \text{ MPa}$$

C점에서의 - 좌측에서 우측으로의 휨모멘트

$$0.108 - 0.002 \times 0.004 = 0.108 \text{ MPa}$$

①

① 지점 휨모멘트 =

C점에서의 - 좌측에서 우측으로의 휨모멘트

$$0.108 - 0.002 \times 0.004 = 0.108 \text{ MPa}$$

D점에서의 - 좌측에서 우측으로의 휨모멘트

$$0.102 - 0.002 \times 0.004 = 0.102 \text{ MPa}$$

