2015년 지방직 9급 응용역학 해설 (A형) 이 학 민

1. ③ 번

$$V = A \times x_c \times \theta = \left(\frac{1}{2} \times R \times H\right) \times \frac{R}{3} \times 2\pi = \frac{\pi R^2 H}{3}$$

2. ① 번

$$M = P \times y = (\wp \times A) \times y$$

$$= (2.5 \times (2 \times 1)) \times \left(6 + \frac{1}{2}\right) = 32.5\ [kN \cdot m]$$

3. ③ 번

I_C (정삼각형) > I_B (정사각형) > I_A (원형)

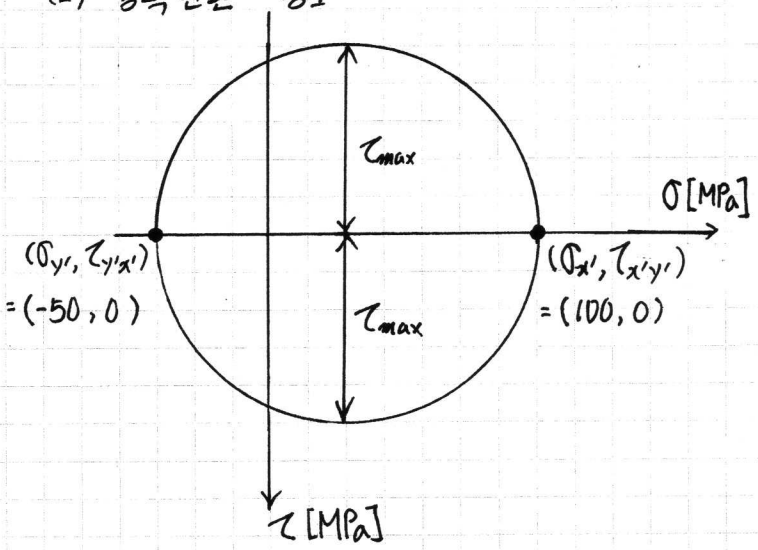
4. ④ 번

(1) 최기응력 좌표

$(\sigma_{x'}, \tau_{x'y'}) = (100, 0)$

$(\sigma_{y'}, \tau_{y'x'}) = (-50, 0)$

(2) 응력변환 경로



$$\therefore \tau_{max} = \left|\frac{\sigma_{x'} - \sigma_{y'}}{2}\right| = \left|\frac{(100) - (-50)}{2}\right| = 75.0\ [MPa]$$

5. ③번

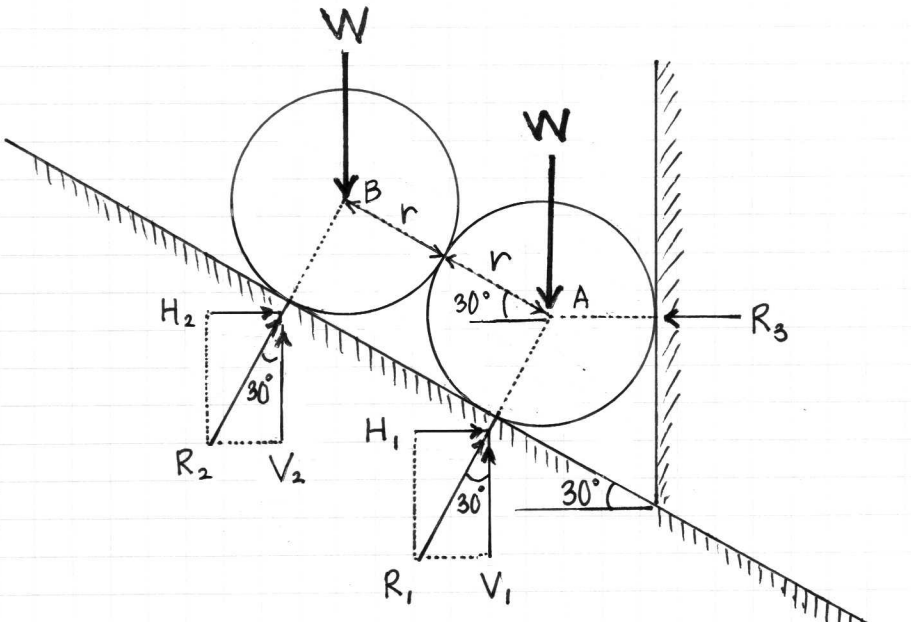
① $\sigma = \frac{F}{A} = \frac{P}{\left(\frac{\pi d^2}{4}\right)} = \frac{4P}{\pi d^2} = \frac{4 \times (15 \times 10^3)}{3 \times 10^2} = 200 [MPa]$

② $\delta = \frac{FL}{EA} = \sigma \times \frac{L}{E} = 200 \times \frac{1.0}{200} = 1 [mm]$

③ $\epsilon_x = \frac{\sigma}{E} = \frac{200}{(200 \times 10^3)} = 1.0 \times 10^{-3}$

④ $\Delta d = \epsilon_y \times d = (-\nu \epsilon_x) \times d = (-0.3 \times (1.0 \times 10^{-3})) \times 10 = -0.003 [mm]$

6. ③번



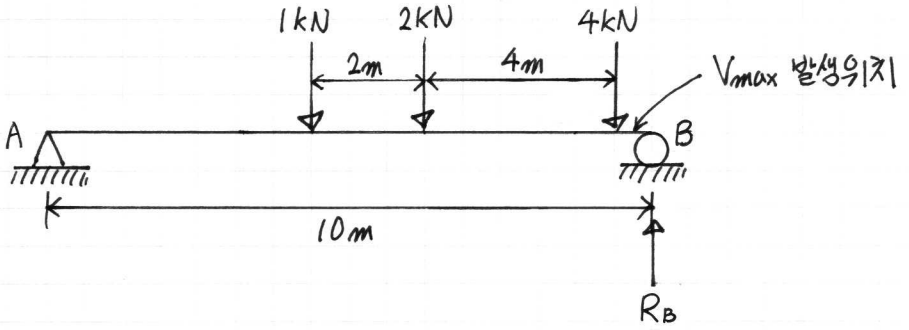
$\Sigma M_A = 0, \circlearrowleft +; \; R_2 (2r) - W (2r \cos 30°) = 0, \quad R_2 = W \cos 30° = \frac{\sqrt{3}}{2} W$

$\Sigma V = 0, \uparrow +; \; V_1 + V_2 - W - W = 0$, (여기서 $V_2 = R_c \cos 30° = \frac{3}{4} W$)

$V_1 + \frac{3}{4} W - W - W = 0, \quad V_1 = \frac{5}{4} W$

$\therefore R = R_1 = \frac{V_1}{\cos 30°} = \frac{\left(\frac{5W}{4}\right)}{\left(\frac{\sqrt{3}}{2}\right)} = \frac{5\sqrt{3}}{6} W$

7. ① 번

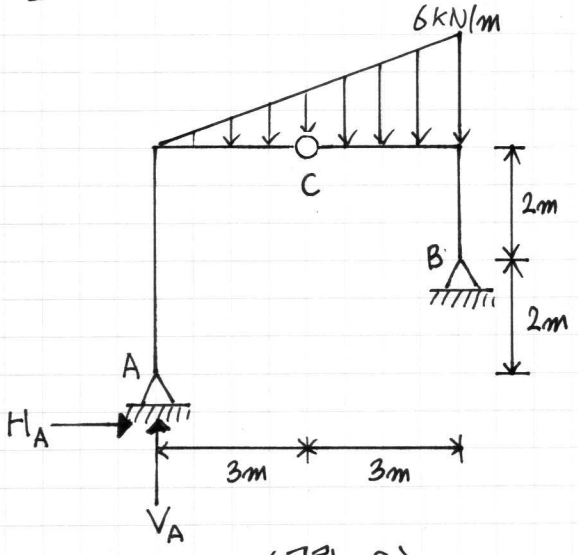


* 절대최대 전단력은 이동하중 4kN이 B점 바로 왼쪽을 지날 때 4kN과 B점 사이에서 발생한다.

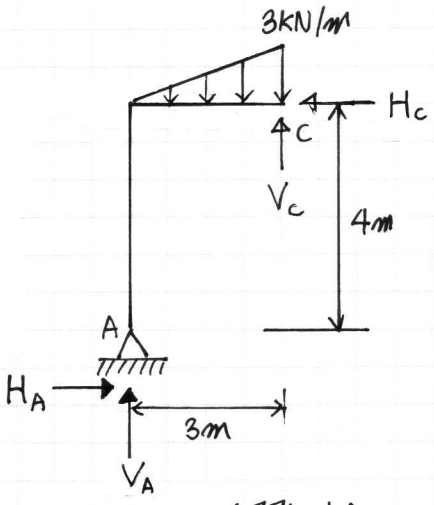
* $\Sigma M_A = 0, (+\circlearrowright);\ 1(4)+2(6)+4(10)-R_B(10)=0, \quad R_B = 5.6\,[kN]$

∴ 절대최대 $V_{max} = R_B = 5.6\,[kN]$

8. ② 번



<그림 a>



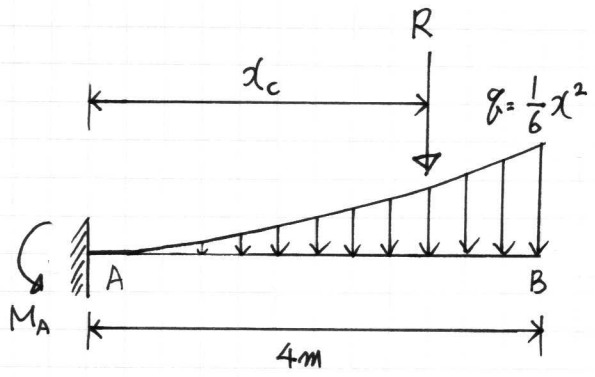
<그림 b>

<그림 a>에서 $\Sigma M_B = 0, (+\circlearrowright);\ V_A(6) - H_A(2) - \frac{1}{2}(6)(6)\times\frac{6}{3} = 0$ ——(1)

<그림 b>에서 $\Sigma M_C = 0, (+\circlearrowright);\ V_A(3) - H_A(4) - \frac{1}{2}(3)(3)\times\frac{3}{3} = 0$ ——(2)

from (1)(2) $H_A = 4.5\,[kN]$, $V_A = 7.5\,[kN]$

9. ③번



- $R = A(\text{면적}) = \frac{bh}{n+1}$

$$= \frac{4 \times \frac{x^2}{6}}{2+1} = \frac{2x^2}{9} = \frac{2\times 4^2}{9} = \frac{32}{9}\,[kN]$$

- $x_c = \frac{n+1}{n+2} b = \frac{2+1}{2+2} \times 4 = 3[m]$

$\therefore M_A = R \times x_c = \frac{32}{9} \times 3 = \frac{32}{3}\,[kN\cdot m]$

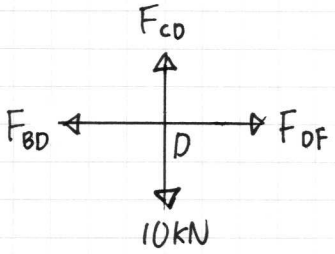
10. ③번

*모터넬 이용

$$\delta_c = \frac{P}{K_b + K_s} = \frac{P}{\frac{48EI}{L^3} + K} = \frac{10}{\frac{48\times(1{,}000/16)}{10^3} + 1} = 2.5[mm]$$

11. ④번

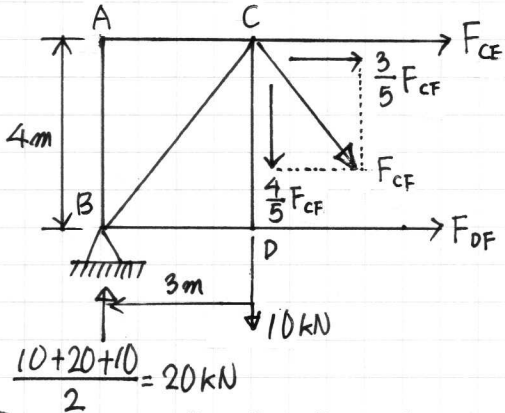
(1) F_{CD} 산정 (절점법 이용)



$\Sigma V = 0$, $\uparrow +$; $F_{CD} - 10 = 0$

$\therefore F_{CD} = 10.0\,[kN]$ (인장)

(2) F_{CF} 산정 (단면법 이용)



$\Sigma V = 0$, $\uparrow +$; $20 - 10 - \frac{4}{5}F_{CF} = 0$

$\therefore F_{CF} = 12.5\,[kN]$ (인장)

12. ② 번

$$\cdot \sigma_A = \sigma_C = \frac{P}{A}\left\{-1 + 3\times\frac{e}{(h/2)}\times\frac{(h/2)}{(h/2)}\right\}$$

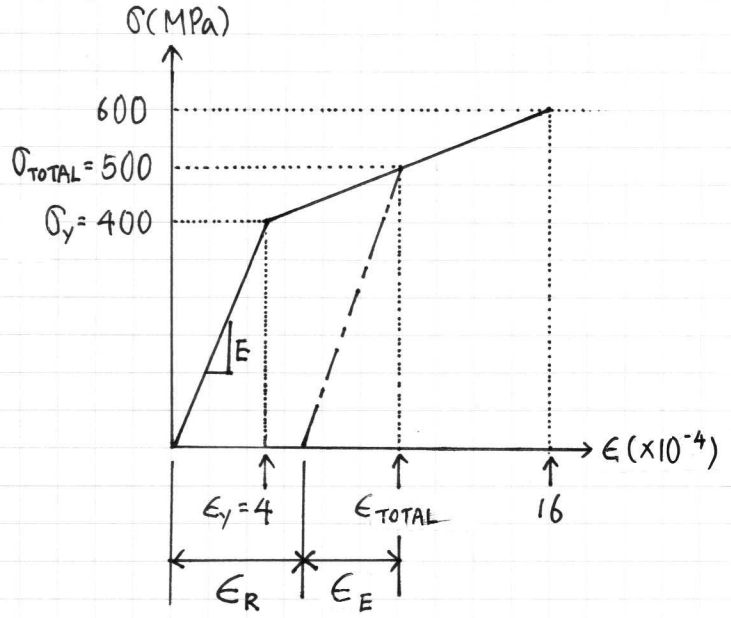
$$= \frac{(300\times10^3)}{200\times300}\times\left\{-1+3\times\left(\frac{40}{150}\right)\times\left(\frac{150}{150}\right)\right\} = -1\ [MPa]\ (압축)$$

$$\cdot \sigma_B = \sigma_D = \frac{P}{A}\left\{-1 - 3\times\frac{e}{(h/2)}\times\frac{(h/2)}{(h/2)}\right\}$$

$$= \frac{(300\times10^3)}{200\times300}\times\left\{-1-3\times\left(\frac{40}{150}\right)\times\left(\frac{150}{150}\right)\right\} = -9\ [MPa]\ (압축)$$

$$\therefore |\sigma_B = -9MPa| > 5MPa$$

13. ② 번



$$\cdot \epsilon_{TOTAL} = \frac{(4\times10^{-4})+(16\times10^{-4})}{2} = 10\times10^{-4}$$

$$\cdot E = \frac{\sigma_y}{\epsilon_y} = \frac{400}{(4\times10^{-4})} = 10^6\ [MPa]$$

$$\cdot \epsilon_E = \frac{\sigma_{TOTAL}}{E} = \frac{500}{10^6} = 5\times10^{-4}$$

$$\therefore \epsilon_R = \epsilon_{TOTAL} - \epsilon_E = 5\times10^{-4}$$

14. ② 번

$$M_{c,max} = \frac{W_L ab}{2} + \frac{P_L ab}{L}$$

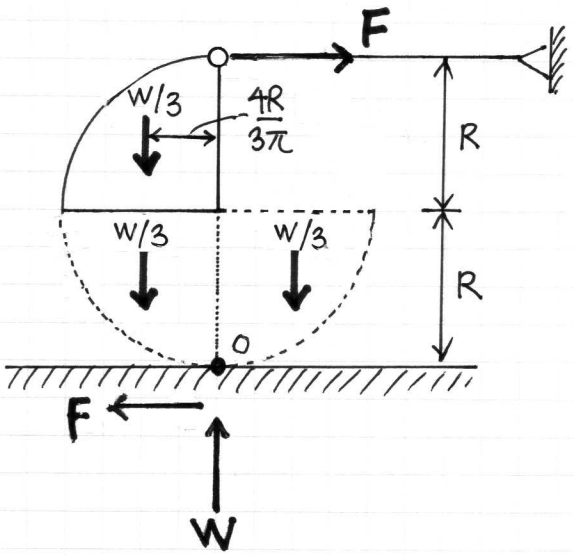
$$= \frac{4\times2\times8}{2} + \frac{10\times2\times8}{10} = 48\ [kN\cdot m]$$

15. ② 번

• $F_{mn} = -30[kN]$ (압축), $M_{mn} = 30 \times 0.1 - 3 \times 1 = 0\ [kN]$

$\therefore\ \sigma_A = \sigma_B = \dfrac{F_{mn}}{A} = \dfrac{(-30 \times 10^3)}{300 \times 200} = -0.5[MPa]$ (압축)

16. ④ 번



$\Sigma M_o = 0$, $\circlearrowright +$

$F(2R) - \dfrac{W}{3}\left(\dfrac{4R}{3\pi}\right) = 0$, (좌선부분은 상쇄)

$\therefore\ F = \dfrac{2W}{9\pi} = \dfrac{2}{9\pi} \times 12\pi = \dfrac{8}{3}$

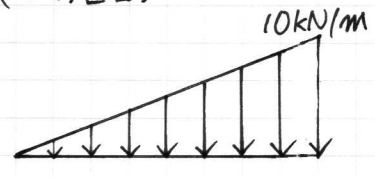
17. ② 번

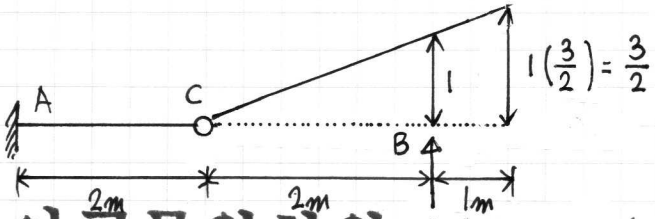
$\Sigma M_B = 0$, $\circlearrowright +$; $P(7) - 8 - (2.5 \times 4)\left(\dfrac{4}{2}\right) = 0$, $(\because M_B = 0)$

$\therefore\ P = 4\ [kN]$

18. ① 번

* 영향선 이용 (+ 직삼각형)





$R_B = \dfrac{hkl}{3} = \dfrac{\left(10 \times \frac{3}{2} \times 3\right)}{3}$

$= 15.0\ [kN]$

19. ① 번

* 보-내법 이용

- $k_{eq} = K + K = 2k = 2 \times \frac{EI}{2L^3} = \frac{EI}{L^3}$ ($\because$ 병렬구조)

- $\delta = \frac{UR}{K_b + K_s} = \frac{\left(\frac{5P}{16}\right)}{\left(\frac{3EI}{L^3}\right) + \left(\frac{EI}{L^3}\right)} = \frac{5PL^3}{64EI}$

20. ④ 번

- $\delta_A \left(= \frac{R_A}{K}\right) : \delta_B \left(= \frac{R_B}{K}\right) : \delta_C \left(= \frac{R_C}{K}\right) = \delta : 2\delta : 3\delta$ 이므로

$R_A : R_B : R_C = 1 : 2 : 3$ 이다.

- $R_A = \frac{1}{1+2+3} W = \frac{W}{6}$, $R_B = \frac{2}{1+2+3} W = \frac{2W}{6}$, $R_C = \frac{3}{1+2+3} W = \frac{3W}{6}$

- $\Sigma M_A = 0$, $\circlearrowleft +$: $W(d) - \frac{W}{6}(0) - \frac{2W}{6}(1) - \frac{3W}{6}(2) = 0$, $\therefore d = \frac{4}{3}$ [m]