2019년 국가직 9급 응용역학 해설(나형)

1. ④번

④ 포아송비는 축하중이 작용하는 부재의 축방향 변형률(ϵ_v)에 대한 횡방향 변형률(ϵ_h)의 비(ϵ_h/ϵ_v)이다.

2. ③번

평행축정리 이용

- $I_{임의축2} = I_{임의축1} + 면적 \times \{(축거리_2)^2 - (축거리_1)^2\}$

$\therefore I_{X2} = I_{X1} + A \times \{(2d)^2 - (d)^2\} = I_{X1} + 3Ad^2$

3. ③번

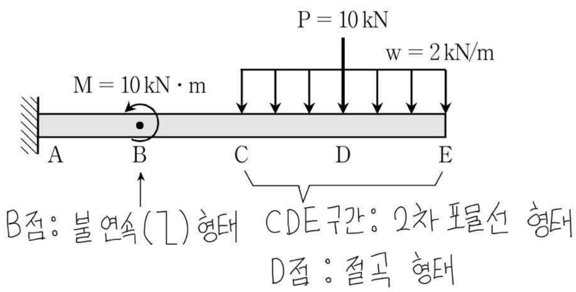
- $\sum M_C = 0,\ \circlearrowright +;\ R_A(16) - \left(\frac{1}{2} \times 3 \times 4\right)\left(3 \times \frac{2}{3} + 7\right) - 5(6) = 0$

$$R_A = \frac{21}{4}[\mathrm{kN}]$$

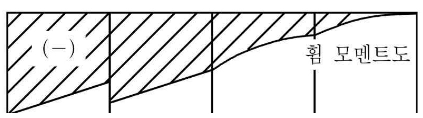
- $\sum V = 0,\ \uparrow +;\ R_A + R_B - \left(\frac{1}{2} \times 3 \times 4\right) - 5 = 0$이므로 $R_A + R_B = 11$이다.

$$R_B = 11 - \frac{21}{4} = \frac{23}{4}[\mathrm{kN}]$$

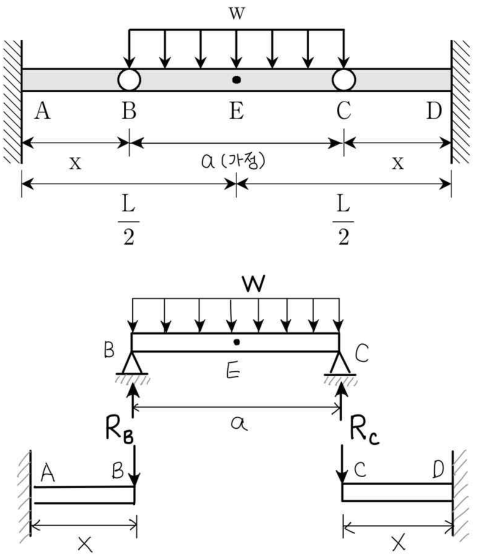
4. ①번



①



5. ①번



- $M_E = \dfrac{wa^2}{8}$
- $M_A = R_B \times x = \dfrac{wa}{2} \times x = \dfrac{wax}{2}$
- $M_E\left(= \dfrac{wa^2}{8}\right) = M_A\left(= \dfrac{wax}{2}\right),\ a = 4x$
- $L_{AB} + L_{BEC} + L_{CD} = L$이므로 $6x = L$이다.

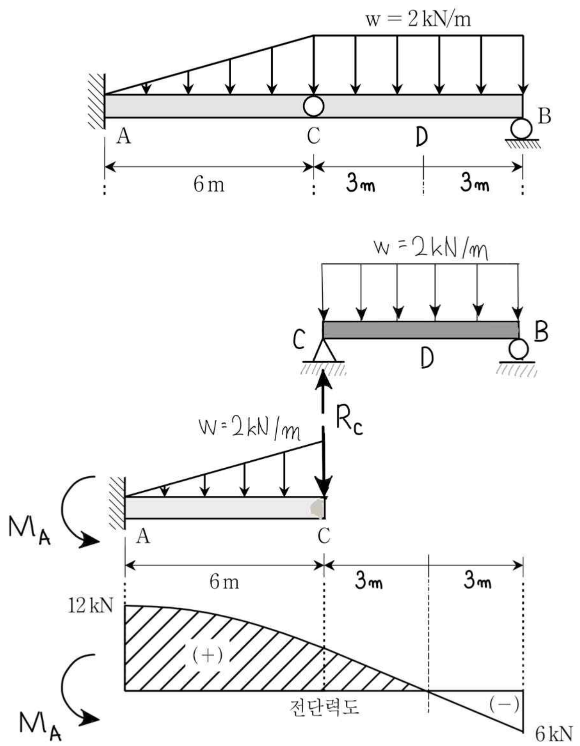
$\therefore x = \dfrac{L}{6}$

6. ②번

- $\sum M_A = 0,\ \curvearrowright\!+;\ 10(6) - R_B(10) = 0,\ R_B = 6[\mathrm{kN}](\uparrow)$
- $P \le f \cdot R_B$이므로 $P_{\max} = f \cdot R_B$이다.

$\therefore P_{\max} = 0.3 \times 6 = 1.8[\mathrm{kN}]$

7. ④번



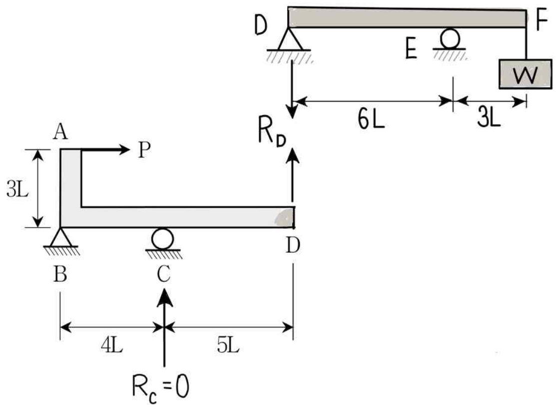
- $R_C = \dfrac{w \times L_{BC}}{2} = \dfrac{2 \times 6}{2} = 6[\mathrm{kN}]$
- $M_A = \left(\dfrac{1}{2} \times 6 \times 2\right)\left(6 \times \dfrac{2}{3}\right) + 6(6)$

  $= 60[\mathrm{kN \cdot m}]$
- 전단력도의 누적면적은 휨모멘트의 크기와 같다.
- (좌측) $M_D = -M_A + A_{AD} = -60 + A_{AD}$
- (우측) $M_D = -A_{BD}$

  $= -\left(\dfrac{-1}{2} \times 3 \times 6\right) = 9[\mathrm{kN \cdot m}]$
- (좌측) $M_D(= -60 + A_{AD})$ = 우측 $M_D(= 9)$

$\therefore A_{AD} = 9 + 60 = 69[\mathrm{kN \cdot m}]$

8. ①번



• $(DEF)\ \Sigma M_E=0$, ↻+

$W(3L)-R_D(6L)=0$, $R_D=\dfrac{W}{2}$

• $(ABCD)\ \Sigma M_B=0$, ↻+

$P(3L)-\dfrac{W}{2}(9L)=0$, $2P=3W$

$\therefore \dfrac{P}{W}=\dfrac{3}{2}$

9. ②번

• $P_1=\dfrac{\pi^2 EI_z}{(L_{e1})^2}=\dfrac{\pi^2\left(\dfrac{L^2}{\pi^2}\right)(\pi)}{\left(\dfrac{L}{2}\right)^2}=4\pi$

• $P_2=\dfrac{\pi^2 EI_x}{(L_{e2})^2}=\dfrac{\pi^2\left(\dfrac{L^2}{\pi^2}\right)(20\pi)}{(L)^2}=20\pi$

$\therefore P=[P_1,\ P_2]_{\min}=4\pi$

10. ②번

중첩공식 이용

• $\delta_B=\dfrac{PL^3}{3EI}=\dfrac{PL^3}{3E\left(\dfrac{bh^3}{12}\right)}$ 이므로 $\delta_B\propto\dfrac{1}{h^3}$ 이다.

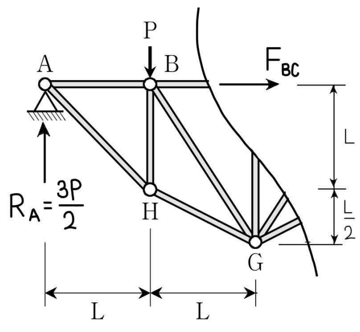
• $\dfrac{1}{b^3}:8[\text{mm}]=\dfrac{1}{\text{h}^3}:27[\text{mm}]$ 이므로 $\dfrac{27}{b^3}=\dfrac{8}{h^3}$ 이다.

• $27h^3=8b^3$ 이므로 $3h=2b$ 이다.

$\therefore h=\dfrac{2}{3}b$

11. ④번

단면법 이용



• $R_A=\dfrac{P+P+P}{2}=\dfrac{3P}{2}$

• $\Sigma M_G=0$, ↻+

$\dfrac{3P}{2}(2L)-P(L)+F_{BC}\left(\dfrac{3L}{2}\right)=0$

$\therefore F_{BC}=-\dfrac{4}{3}P$ (압축)

12. ①번

- $\sigma_{\max} = \sigma_{고정단} = \dfrac{W}{A} + \dfrac{W_{자중}}{A}$

$\therefore \sigma_{\max} = \dfrac{W}{\left(\dfrac{\pi d^2}{4}\right)} + \dfrac{\gamma AL}{A} = \dfrac{4W}{\pi d^2} + \gamma L$

13. ③번

$R_B = \dfrac{w(\ell + a)}{6} = \dfrac{P \times (3L + L)}{6} = \dfrac{2}{3}PL$

14. ②번

변위일치법 이용

$\sigma = E\left\{\alpha(\Delta T) - \dfrac{\delta}{L}\right\}$

$= (2 \times 10^6) \times \left\{(1 \times 10^{-5})(20) - \dfrac{1}{(10 \times 10^3)}\right\} = 200[\mathrm{kPa}]$

15. ①번

- $w = \gamma A = \gamma bh, \quad M = \dfrac{wL^2}{8} = \dfrac{\gamma bhL^2}{8}$
- $\sigma_A = \dfrac{M_{\max}}{Z} = \dfrac{\left(\dfrac{\gamma bhL^2}{8}\right)}{\left(\dfrac{bh^2}{6}\right)} = \dfrac{3\gamma L^2}{4h}$

∴휨 응력값은 폭 b의 영향을 받지 않는다.

16. ③번

변위일치법 이용

- $\delta(=5\mathrm{mm}) = \delta_1 + \delta_2$

$= \dfrac{RL_1}{E_1A} + \dfrac{RL_2}{E_2A} = \dfrac{RL_1}{E_1A} + \dfrac{RL_2}{(3E_1)A}$, 여기서 $E_2 = 3E_1$

- $\delta_1 : \delta_2 = \dfrac{RL_1}{E_1A} : \dfrac{RL_2}{(3E_1)A} = L_1 : \dfrac{L_2}{3}$

$= 1{,}505 : \dfrac{1{,}500}{3} = 1{,}505 : 500$

∴양쪽에 2배를 해주면 $\delta_1 : \delta_2 = 3{,}010 : 1{,}000$

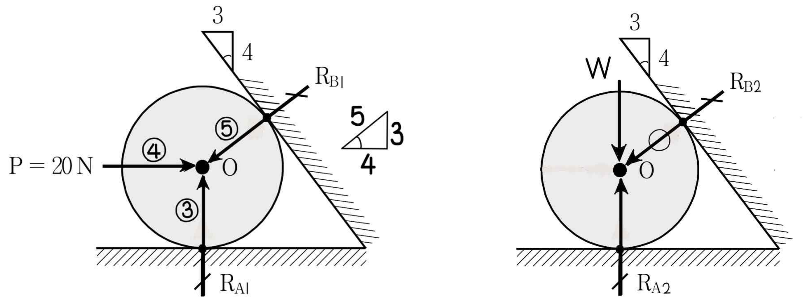
17. ②번

암기해야 할 단일구간해석 이용

$$M_B = \frac{3PL}{16} + \frac{wL^2}{8} = \frac{3\times6\times8}{16} + \frac{2\times8^2}{8} = 25[\text{kN}\cdot\text{m}]$$

18. ③번

시력도 이용



- $R_{A1} = 20 \times \frac{3}{4} = 15[\text{N}]$
- $R_{A2} = W = mg = 1 \times 10 = 10[\text{kg}\cdot\text{m/s}^2] = 10[\text{N}]$

$\therefore R_A = R_{A1} + R_{A2} = 15 + 10 = 25[\text{N}]$

19. ②번

변위일치법 이용

- $\frac{RL}{EA_1} + \frac{RL}{EA_2} = \alpha(\Delta T)(2L)$, $R = \frac{2\alpha(\Delta T)E(A_1A_2)}{(A_1 + A_2)}$

$\therefore R = \frac{2(1\times10^{-5})(10)(210)(1{,}000\times500)}{(1{,}000+500)} = 14.0[\text{kN}]$ (압축)

20. ①번

$$\tau_{\max} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + (\tau_{xy})^2}$$

$$= \sqrt{\left(\frac{36-0}{2}\right)^2 + (-24)^2} = 30[\text{MPa}]$$