100 學年四技二專第四次聯合模擬考試
土木與建築群　專業科目（一）　詳解

100-4-06-4

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
C	D	B	B	D	D	A	B	C	B	B	D	C	A	B	B	C	B	B	A
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
A	B	C	D	A	C	C	A	B	B	B	D	A	B	B	B	C	A	D	C

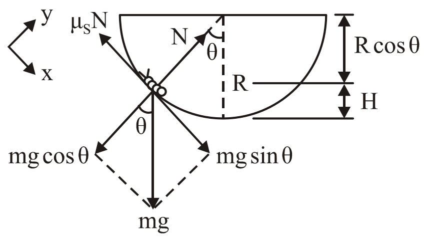
第一部份：工程力學

1. ①、⑤ $\begin{cases}\Sigma F = 0 \Rightarrow \text{不移動} \\ \Sigma M = 0 \Rightarrow \text{不轉動}\end{cases}$

② $\Sigma F \neq 0 \Rightarrow$ 會移動

③、④ $\begin{cases}\Sigma F = 0 \\ \Sigma M \neq 0\end{cases} \Rightarrow$ 會轉動，不會移動

2. 爬到最高處時，即恰要下滑時



重力下滑分力＝最大靜摩擦力

$\Sigma F_x = 0 \Rightarrow mg\sin\theta = F_{S(max)} = \mu_S N$

$\Sigma F_y = 0 \Rightarrow N = mg\cos\theta$

$\therefore mg\sin\theta = \mu_S N = \mu_S mg\cos\theta$

$mg\sin\theta = \sqrt{3}mg\cos\theta$

$\tan\theta = \sqrt{3}$，$\theta = 60°$

此時，$\dfrac{\text{下滑力}}{\text{正向力}} = \dfrac{mg\sin\theta}{mg\cos\theta} = \tan\theta = \sqrt{3}$

爬升最大高度 $H = R - R\cos\theta = R - R\cos 60° = \dfrac{R}{2}$

3. 設梯長為 L

以梯子與地面的接觸點 A 為支點

取 $\Sigma M_A = 0 \Rightarrow F_1 \times L\cos\theta = W \times X\sin\theta$

$F_1 = (\dfrac{W}{L}\tan\theta)X$

$\because$ W、L、θ 皆不變

$\therefore F_1 \propto X \Rightarrow$ 在上爬過程中，

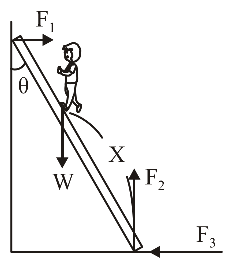
F_1 隨 X 增加而增加

$\Sigma F_y = 0 \Rightarrow F_2 = W$

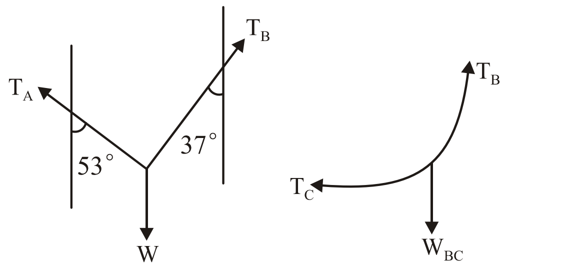
F_2 不變，不隨 X 而變化

$\Sigma F_x = 0 \Rightarrow F_3 = F_1$

在上爬過程中，隨 X 增加而增加



4. $\dfrac{T_A}{\sin 143°} = \dfrac{T_B}{\sin 127°} = \dfrac{W}{\sin 90°}$

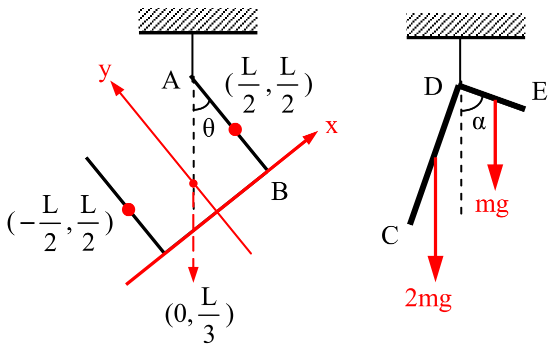


$\Rightarrow T_A = \dfrac{3}{5}W$，$T_B = \dfrac{4}{5}W \Rightarrow T_C = T_B\sin 37° = \dfrac{12}{25}W$

$W_{BC} = T_B\cos 37° = \dfrac{16}{25}W$

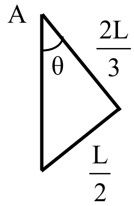
5. $L_{AC}：L_{BC} = (W - \dfrac{16}{25}W)：\dfrac{16}{25}W = 9：16$

6.



(1) 設 U 型邊長為 L

$\bar{y} = \dfrac{(L\times\frac{L}{2})+(L\times\frac{L}{2})}{3L} = \dfrac{L}{3}$，$\tan\theta = \dfrac{\frac{L}{2}}{\frac{2L}{3}} = \dfrac{3}{4}$



(2) 設 $\overline{CD}$ 邊長為 L，$\overline{DE} = \dfrac{L}{2}$

以 D 為支點，取 $\Sigma M_D = 0$

$\Rightarrow 2mg \times L\sin(90° - \alpha) = mg \times \dfrac{L}{2}\sin\alpha$

$2mg \times L\cos\alpha = mg \times \dfrac{L}{2}\sin\alpha$

$\tan\alpha = 4$，$\therefore \tan\theta \times \tan\alpha = \dfrac{3}{4} \times 4 = 3$

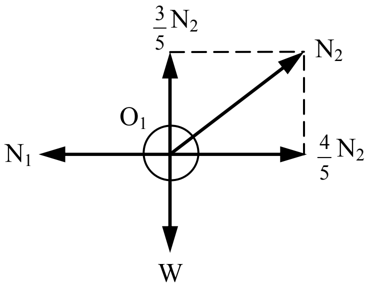
7. 取球 O_1 為自由體

假設鉛直光滑牆面對球 O_1 之接觸力為 N_1

半圓柱體 O_2 對球 O_1 之接觸力為 N_2

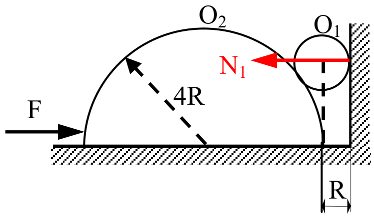
$\Sigma F_y = 0 \Rightarrow \frac{3}{5}N_2 = W \Rightarrow N_2 = \frac{5}{3}W$

$\Sigma F_x = 0 \Rightarrow \frac{4}{5}N_2 = N_1 \Rightarrow N_1 = \frac{4}{3}W$

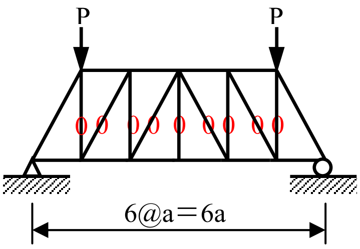


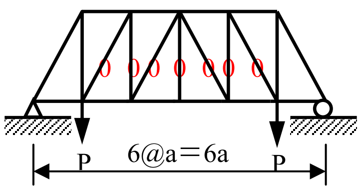
取整體爲自由體

$\Sigma F_x = 0 \Rightarrow F = N_1 = \frac{4}{3}W$



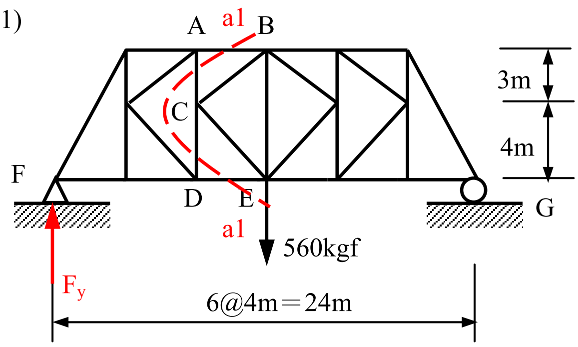
8.





如圖所示，$X = 9$，$Y = 7 \Rightarrow (X - Y) = 2$

9. (1)

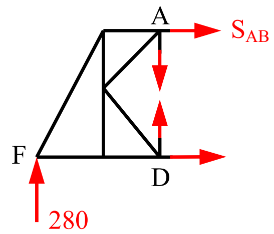


以 G 爲支點

取 $\Sigma M_G = 0 \Rightarrow F_y \times 24 = 560 \times 12$

$F_y = 280\ \text{kgf}(\uparrow)$

(2)



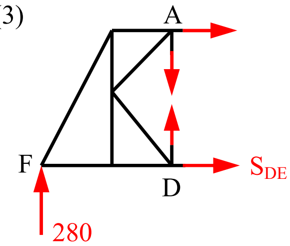
取切面 a1－a1 左部爲自由體圖

以 D 爲支點，取 $\Sigma M_D = 0$ (↻)

$\Rightarrow (S_{AB} \times 7) + (280 \times 8) = 0$

$\therefore S_{AB} = -320\ \text{kgf}(C)$

(3)



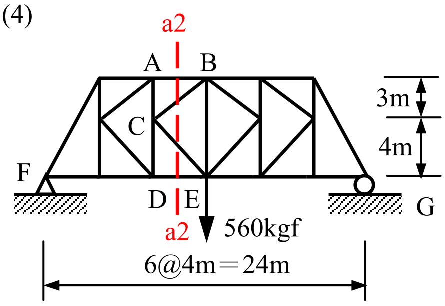
取切面 a1－a1 左部爲自由體圖

以 A 爲支點，取 $\Sigma M_A = 0$ (↻)

$\Rightarrow (-S_{DE} \times 7) + (280 \times 8) = 0$

$\therefore S_{DE} = +320\ \text{kgf}(T)$

(4)

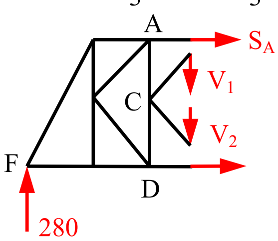


取切面 a2－a2 左部爲自由體圖

① $\Sigma F_y = 0\ (\uparrow) \Rightarrow V_1 + V_2 = 280$

$\frac{V_1}{V_2} = \frac{3}{4}$，$V_1 = \frac{3}{3+4} \times 280 = 120\ \text{kgf}$

② $S_{BC} = V_1 \times \frac{5}{3} = -120 \times \frac{5}{3} = -200\ \text{kgf}(C)$



10. (1) $\because \delta = \frac{PL}{AE} \Rightarrow L = \frac{\delta AE}{P}$

$\Rightarrow \frac{L_1}{L_2} = \frac{\delta_1}{\delta_2} \times \frac{A_1}{A_2} \times \frac{E_1}{E_2} \times \frac{P_2}{P_1} = \frac{2}{1} \times \frac{3}{1} \times \frac{1}{4} \times \frac{1}{1} = \frac{3}{2} = 1.5$

(2) $\because \delta_1 = \frac{PL_1}{A_1E_1} = \frac{PL_2}{A_2E_2} = 2\delta_2$

$\therefore \frac{PL_1}{3AE} = 2\times\frac{PL_2}{A(4E)} \Rightarrow L_1 : L_2 = 3 : 2$，即 $\frac{L_1}{L_2} = 1.5$

11. $\because E_V = \frac{E}{3(1-2\mu)} \Rightarrow \frac{5}{9}E = \frac{E}{3(1-2\mu)}$，$\therefore \mu = 0.2$

又 $\mu = \frac{bl}{D\delta} \Rightarrow 0.2 = \frac{b\times100}{5(0.2)} \Rightarrow \therefore b = 0.002\ cm$

12. $\because \delta = \alpha L\Delta T \Rightarrow \varepsilon = \frac{\delta}{L} = \alpha\Delta T$

$\therefore \sigma = E\varepsilon = E\alpha\Delta T = 600\times10^9\times15\times10^{-6}\times20$

$= 180\times10^6\ \frac{N}{mm^2} = 180\times10^6\ Pa = 180\ MPa$

13. $\because \sigma = E\alpha\Delta T$，又 E、α 皆不變

$\therefore \sigma \propto \Delta T \Rightarrow \sigma_2 = 2\sigma_1 = 360\ MPa$

14. $M_A : M_B : M_C = \frac{\omega L^2}{8} : \frac{\omega L^2}{2} : \frac{\omega L^2}{6} = 3 : 12 : 4$

15. (1) 設大的載重位於 A 點右側 xm，求反力 R_A

$\Sigma M_B = 0$ (↻)

$\Rightarrow (-R_A\times10) + 2000(10-x) + 1000(7-x) = 0$

$\Rightarrow R_A = 2700 - 300x$

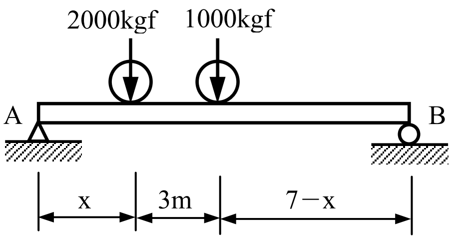
(2) 設距 A 點右側 xm 之彎矩函數為 M(x)

$\Rightarrow$ 令 $M'(x) = 0$ 即可求解

$\because M(x) = R_A\times x = (2700-300x)x = -300x^2 + 2700x$

$M'(x) = -600x + 2700 = 0 \Rightarrow x = 4.5\ m$

$M_{max} = -300(4.5)^2 + 2700(4.5) = 6075\ kgf\text{-}m$(↻)



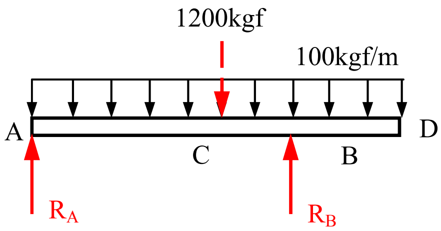
16. (1) 求 A、B 支承點反力

$\Sigma M_A = 0$ (↻) $\Rightarrow (1200\times6) - (R_B\times8) = 0$

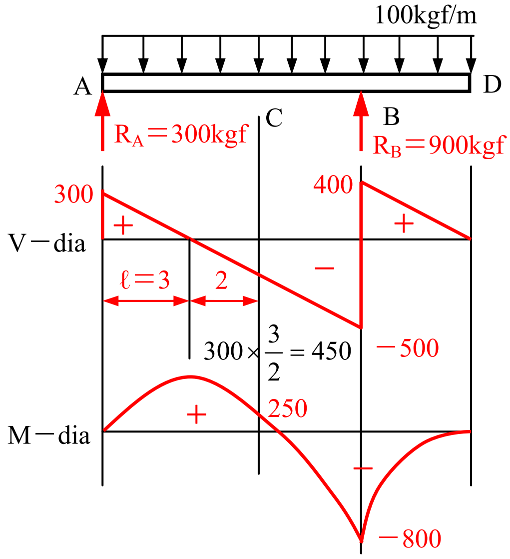
$\Rightarrow R_B = 900\ kgf$(↑)

$\Sigma F_y = 0$ (↑) $\Rightarrow R_A - 1200 + 900 = 0$

$\Rightarrow R_A = 300\ kgf$(↑)



(2) 繪出剪力圖(V-dia)及彎矩圖(M-dia)



$\Rightarrow \ell = \frac{3}{(3+5)}\times8 = 3\ m$

$\Rightarrow V_C = 300 - 100\times5 = -200\ kgf$

$\Rightarrow |M_{max}| = |M_B| = |-800| = 800$

$\Rightarrow |M_C| = |250| = 250 \Rightarrow \frac{|M_{max}|}{|M_C|} = \frac{800}{250} = \frac{16}{5}$

17. (1) 求 C 點剪力 $\Rightarrow V_C = 300 - 100\times5 = -200\ kgf$

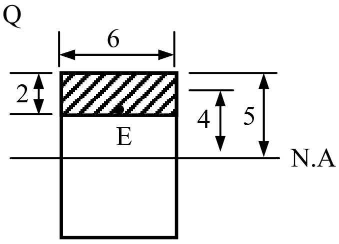
(2) 求慣性矩 I 及面積一次矩 Q

$I = \frac{bh^3}{12} = \frac{6\times10^3}{12} = 500\ cm^4$

$Q = (6\times2)\times4 = 48\ cm^3$

$\Rightarrow \tau_E = \frac{VQ}{Ib} = \frac{200\times48}{500\times6}$

$= 3.2\ kgf/cm^2$



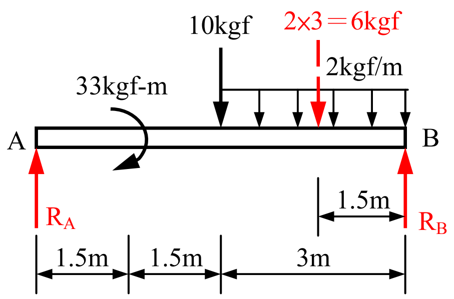
(單位：cm)

18. (1) 求 A、B 支承點反力

$\Sigma M_A = 0$ (↻) $\Rightarrow 33 + (10\times3) + (6\times4.5) - (R_B\times6) = 0$

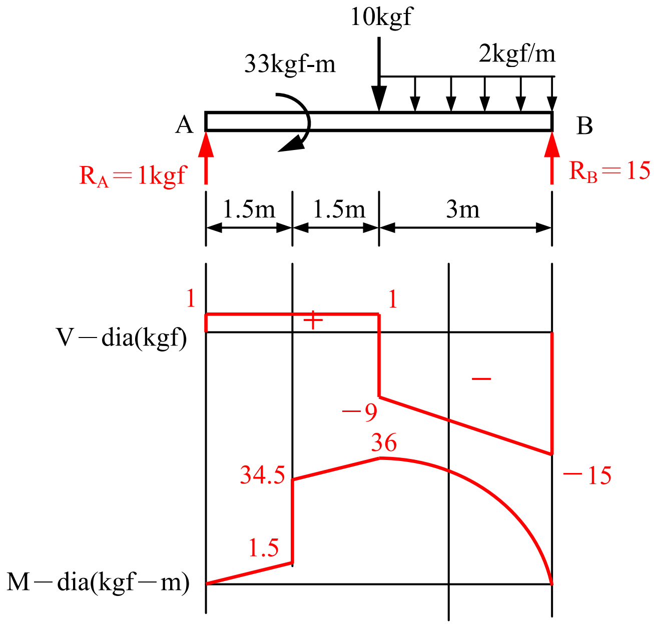
$\Rightarrow R_B = 15\ kgf$(↑)

$\Sigma F_y \Rightarrow R_A - 10 - 6 + 15 = 0 \Rightarrow R_A = 1\ kgf$(↑)



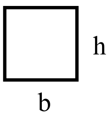
(2) 繪出剪力圖(V－dia)及彎矩圖(M－dia)

$\Rightarrow$ 由 M－dia 可知 M_{max} 發生在樑中點＝36 kgf-m



19. $\sigma = \dfrac{M_1 y}{I} = \dfrac{M_1 \times \frac{h}{2}}{\frac{bh^3}{12}} = \dfrac{6M_1}{bh^2}$

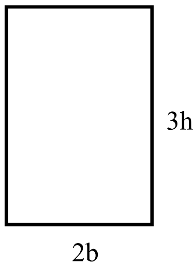
$\Rightarrow M_1 = \dfrac{bh^2\sigma}{6}$



$\sigma = \dfrac{M_2 y}{I} = \dfrac{M_2 \times \frac{3h}{2}}{\frac{54bh^3}{12}} = \dfrac{M_2}{3bh^2}$

$\Rightarrow M_2 = 3bh^2\sigma$

$\therefore \dfrac{M_2}{M_1} = \dfrac{3}{\frac{1}{6}} = 18$

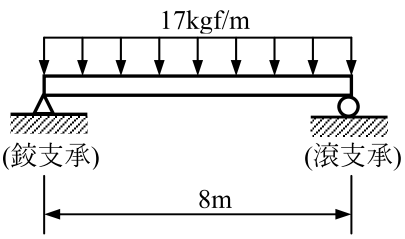


20. (1) $M_{max} = \dfrac{\omega\ell^2}{8} = \dfrac{17\times 8^2}{8} = 136\,\text{kgf-m}$

$I = \dfrac{2\times 5^3}{3} + \dfrac{6\times 3^3}{3} - 2\times\dfrac{2\times 1^3}{3} = 136\,\text{cm}^4$

(2) $\sigma_t = \dfrac{My_1}{I} = \dfrac{136\times 100\times 5}{136} = 500\,\text{kgf/cm}^2$

$\sigma_c = \sigma_c = \dfrac{My_2}{I} = \dfrac{136\times 100\times 3}{136} = 300\,\text{kgf/cm}^2$



第二部份：工程材料

24. 瀝青材料係屬於複雜之碳氫化合物

26. 每立方米水泥鬆單位重為 1500 kg，故 $\dfrac{1500}{50} = 30$ 包

33. 防鏽塗料

34. 高性能混凝土優異性質有高強度、高耐久性、高體積穩定性、高水密性等等

36. 玻璃受熱，由固態轉變成液態之溫度稱為軟化點

37. 針入度乃以 $\dfrac{1}{100}$ cm 為一單位，如今針入度為 120 表示貫入瀝青深度為 1.2 cm，又為 12 mm

39. 細度模數合乎規定者，篩分析不一定合格

40. 水泥細度單位通常以 cm^2/g 來表示