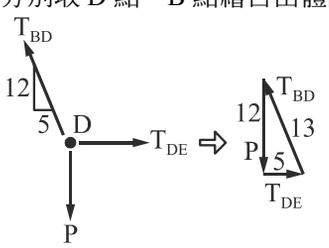
114 學年度四技二專第三次聯合模擬考試
土木與建築群　專業科目(一)　詳解

114-3-06-4

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

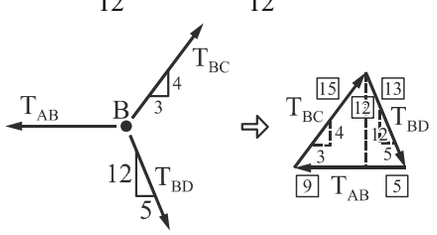
1. (A) 物體不受外力作用時，將呈現靜止狀態或等速直線運動
   (B) 人站立在往前行駛的公車內，突然間剎車時，人會往前傾，是因爲慣性作用
   (D) 物體作等速率圓周運動時，其合力狀態非爲零

2. 分別取 D 點、B 點繪自由體圖



$$\frac{T_{BD}}{13}=\frac{P}{12}=\frac{T_{DE}}{5}$$

$$\therefore T_{BD}=\frac{13}{12}P\ ,\ T_{DE}=\frac{5}{12}P$$



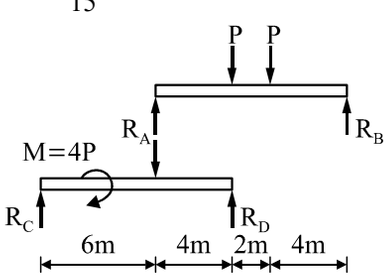
$$\frac{T_{BC}}{15}=\frac{T_{AB}}{14}=\frac{\cancel{T_{BD}}\frac{13}{12}P}{13}$$

$$\therefore T_{BC}=\frac{15}{12}P\ ,\ T_{AB}=\frac{14}{12}P$$

故 $T_{BC}=\frac{15}{12}P$ 爲繩索中受力最大者，$\frac{15}{12}P\le 20$

$$P\le\frac{12\times 20}{15}\ ,\ P_{max}=16\,\text{kgf}$$

3.



由上部圖得知 $R_A=R_B=P$

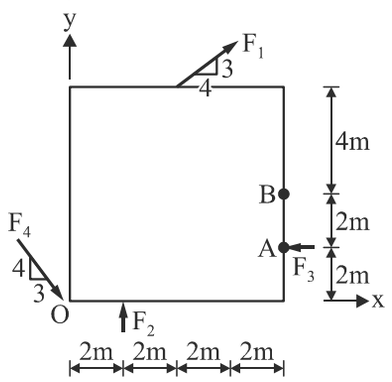
由下部圖分析 $+\circlearrowleft\Sigma M_C=0$

$4P+P\times 6-R_D\times 10=0$

$\therefore R_D=P(\uparrow)$

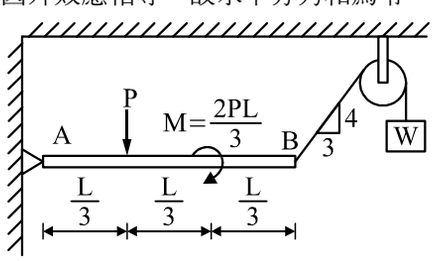
$+\uparrow\Sigma F_y=0\Rightarrow R_C=0$

4.

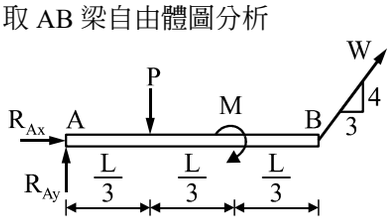


如題目所述，此力系的合力爲通過 A 點的垂直力，則合力對 A、B 點之力矩爲零，對 O 點之力矩不爲零；亦即四力對 A、B 點之力矩和爲零，對 O 點之力矩和不爲零。將四力轉換爲通過 O 點的單力及一力偶時，因外效應相等，故水平分力和爲零

5.



取 AB 梁自由體圖分析



$+\circlearrowleft\Sigma M_A=0$

$$P\times\frac{L}{3}+M-W\times\frac{4}{5}\times L=0$$

$$\therefore W=\frac{P\times\frac{L}{3}+\frac{2PL}{3}}{\frac{4}{5}L}=\frac{5}{4}P$$

6. $P=330\,\text{kgf}$

由 $(1,-1,0)\to(8,5,-6)$

方向 $\langle 8-1,5-(-1),-6-0\rangle=\langle 7,6,-6\rangle$

$Q = 260\ \text{kgf}$

由 $(0,1,-1) \to (4,13,2)$

方向 $\langle 4-0, 13-1, 2-(-1)\rangle = \langle 4,12,3\rangle$

$$\vec{P} = (P_x, P_y, P_z) = 330 \times \frac{\langle 7,6,-6\rangle}{\sqrt{7^2+6^2+(-6)^2}}$$

$$= (210, 180, -180)\ \text{kgf}$$

$$\vec{Q} = (Q_x, Q_y, Q_z) = 260 \times \frac{\langle 4,12,3\rangle}{\sqrt{4^2+12^2+3^2}}$$

$$= (80, 240, 60)\ \text{kgf}$$

合力 $\vec{P} + \vec{Q}$

$$= (210+80, 180+240, -180+60)$$

$$= (290, 420, -120)\ \text{kgf}$$

計算對 A 點 $(1,-1,1)$ 力矩

$\vec{r_P}$ 方向 $(1,-1,1) \to (1,-1,0)$

$$\Rightarrow \langle 1-1, -1-(-1), 0-1\rangle = \langle 0,0,-1\rangle$$

$$\vec{r_P} \times \vec{P} = \begin{vmatrix} i & j & k \\ 0 & 0 & -1 \\ 210 & 180 & -180 \end{vmatrix} = 180i - 210j$$

$\vec{r_Q}$ 方向 $(1,-1,1) \to (0,1,-1)$

$$\Rightarrow \langle 0-1, 1-(-1), -1-1\rangle = (-1,2,-2)$$

$$\vec{r_Q} \times \vec{Q} = \begin{vmatrix} i & j & k \\ -1 & 2 & -2 \\ 80 & 240 & 60 \end{vmatrix} = 600i - 100j - 400k$$

力矩和 $= (180+600, -210-100, -400)$

$$= (780, -310, -400)\ \text{kgf-m}$$

7. 合力爲一力偶

$+\circlearrowleft_x$ M_x $T_{AA'} \times 5 + T_{BB'} \times 10 = 1000\ \text{kgf-m}$

$+\circlearrowright_y$ M_y $-T_{AA'} \times 5 + 200 \times 5 = +750\ \text{kgf-m}$

合力偶 $= \sqrt{1000^2 + (+750)^2 + 0^2} = 1250\ \text{kgf-m}$

8. 計算反力

$+\circlearrowleft \Sigma M_e = 0$

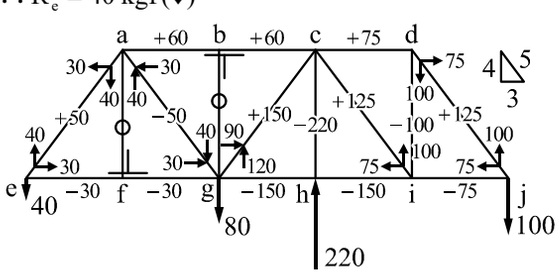
$80 \times 6 - R_h \times 9 + 100 \times 15 = 0$

$\therefore R_h = 220\ \text{kgf}(\uparrow)$

$+\uparrow \Sigma F_y = 0$

$R_e - 80 + R_h - 100 = 0$

$\therefore R_e = 40\ \text{kgf}(\downarrow)$



(1) 利用 T 型法則判斷零桿

得 S_{af} 及 S_{bg} 爲 0 kgf

(2) 自左側 e 點，計算各桿內力

取 e 點得 S_{ae} 爲 $+50$ kgf，$S_{ef} = S_{fg} = -30$ kgf

取 a 點得 S_{ag} 爲 -50 kgf，$S_{ab} = S_{bc} = +60$ kgf

取 g 點得 S_{cg} 爲 $+150$ kgf，$S_{gh} = S_{hi} = -150$ kgf

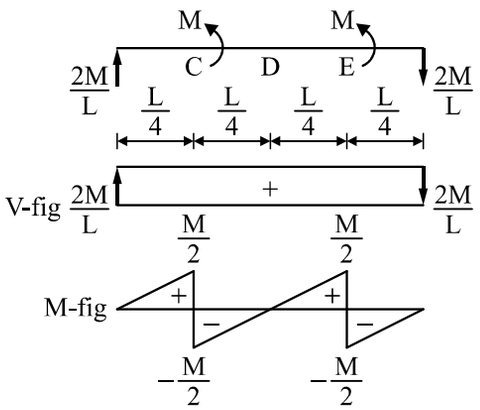
取 j 點得 S_{dj} 爲 $+125$ kgf，S_{ij} 爲 -75 kgf

取 d 點得 S_{di} 爲 -100 kgf，S_{cd} 爲 $+75$ kgf

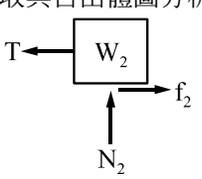
取 i 點得 S_{ci} 爲 $+125$ kgf

(3) 故零桿數有 2，拉力桿有 7，壓力桿有 8

9.



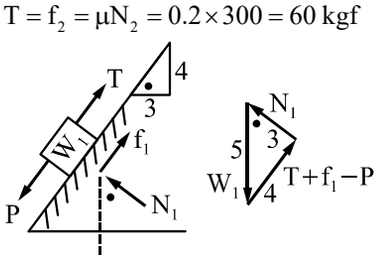
10. 取其自由體圖分析



$W_2 = 300\ \text{kgf}$

取平衡分析，得 $N_2 = 300\ \text{kgf}$

$T = f_2 = \mu N_2 = 0.2 \times 300 = 60\ \text{kgf}$



$W_1 = 80\ \text{kgf}$

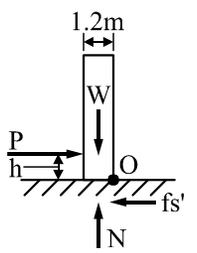
取平衡分析，$\dfrac{W_1}{5} = \dfrac{N_1}{3} = \dfrac{T + f_1 - P}{4}$

$\therefore N_1 = 48\ \text{kgf}$

$f_1 = \mu N_1 = 9.6\ \text{kgf} \Rightarrow T + f_1 - P = \dfrac{4}{5} W_1 = 64\ \text{kgf}$

$\therefore P = T + f_1 - 64 = 5.6\ \text{kgf}$

11. 摩擦係數 $\mu = \tan 30° = 0.577$



(1) 計算物體即將滑動時之 P 力

$N = W$

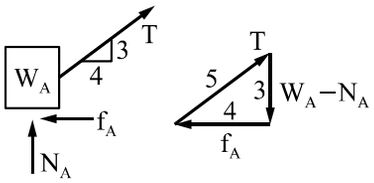
$P = fs' = \mu N = 0.577W$

(2) 利用力矩平衡計算 h 最大值

$\Sigma M_o = W \times \frac{1.2}{2} \geq P \times h$ ， ~~$W \times 0.6 \geq 0.577W \times h$~~

$h \leq 1.04$ ， $h_{max} = 1.04\ m$

12. 以物塊 A 爲自由體分析



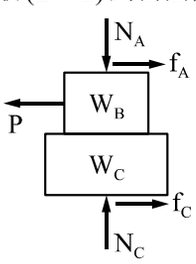
$\frac{T}{5} = \frac{W_A - N_A}{3} = \frac{f_A}{4}$ ； $f_A = 0.2N_A$

$\Rightarrow \frac{115 - N_A}{3} = \frac{0.2N_A}{4}$

$\therefore N_A = 100\ kgf$ ， $f_A = 20\ kgf$

(1) 如 (B＋C) 同時恰向左運動

取 (B＋C) 爲自由體分析如下

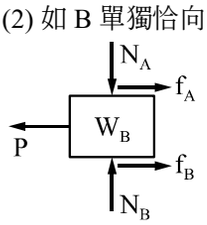


$N_C = N_A + W_B + W_C = 100 + 60 + 40 = 200\ kgf$

$f_C = 0.2N_C = 40\ kgf$

$\therefore P = f_A + f_C = 20 + 40 = 60\ kgf$

(2) 如 B 單獨恰向左運動，取 B 爲自由體分析



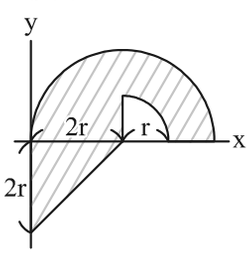
$N_B = N_A + W_B = 100 + 60 = 160\ kgf$

$f_B = 0.3N_B = 48\ kgf$

$\therefore P = f_A + f_B = 20 + 48 = 68\ kgf$

(3) 由(1)(2)知，P＝60 kgf 時， (B＋C) 兩物會一起向左移動，此時 P＝60 kgf 爲最小值

13.



① $\frac{1}{2}$ 大圓， $A_1 = \frac{(2r)^2\pi}{2} = 2r^2\pi$

重心座標 $(x_1, y_1) = (2r, \frac{4(2r)}{3\pi}) = (2r, \frac{8r}{3\pi})$

② $\frac{1}{4}$ 小圓， $A_2 = -\frac{r^2\pi}{4}$

重心座標 $(x_2, y_2) = (2r + \frac{4r}{3\pi}, \frac{4r}{3\pi})$

③三角形， $A_3 = \frac{2r \times 2r}{2} = 2r^2$

重心座標 $(x_3, y_3) = (\frac{0 + 2r + 0}{3}, \frac{0 + 0 - 2r}{3}) = (\frac{2r}{3}, \frac{-2r}{3})$

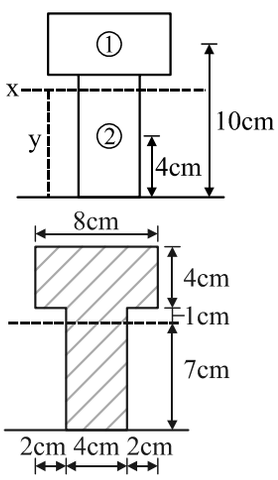
幾何圖形座標

$\bar{y} = \frac{A_1y_1 + A_2y_2 + A_3y_3}{A_1 + A_2 + A_3}$

$\bar{y} = \frac{2\pi r^2(\frac{8r}{3\pi}) + (-\frac{1}{4}\pi r^2) \times (\frac{4r}{3\pi}) + 2r^2 \times (-\frac{2}{3}r)}{2\pi r^2 + (-\frac{1}{4}\pi) r^2 + 2r^2}$

$= \frac{\frac{16}{3}r^3 - \frac{1}{3}r^3 - \frac{4}{3}r^3}{\frac{7}{4}\pi r^2 + 2r^2} = \frac{\frac{11}{3}r}{\frac{7\pi + 8}{4}} = \frac{44r}{3(7\pi + 8)}$

14.



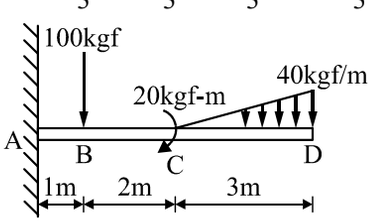
(1) 計算形心軸 x-x 與底軸距離

$y = \frac{8 \times 4 \times 10 + 8 \times 4 \times 4}{8 \times 4 \times 2} = 7\ cm$

(2) 計算慣性矩

$I_x = \frac{4 \times 7^3}{3} + \frac{8 \times 5^3}{3} - \frac{4 \times 1^3}{3} = 789\frac{1}{3}\ cm^4$

15.



計算 A 點支承反力

$+\uparrow \Sigma F_y = 0$

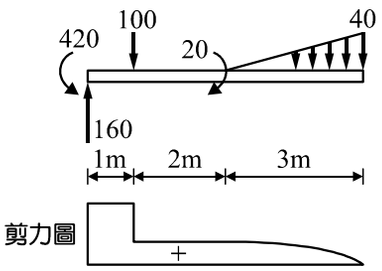
$R_{Ay} - 100 - \frac{40 \times 3}{2} = 0$

$\therefore R_{Ay} = 160\ kgf(\uparrow)$

$+\circlearrowright \Sigma M_A = 0$

$100 \times 1 + 20 + 60 \times 5 - M_A = 0$

$\therefore M_A = 420\ kgf\text{-}m\ (\circlearrowleft)$



16. 降伏強度 $\sigma_y=\dfrac{P}{A}=\dfrac{6000\ \text{kgf}}{4\times1.5\ \text{cm}^2}=1000\ \text{kgf/cm}^2$

容許強度 $\sigma_a=\dfrac{\sigma_y}{2}=500\ \text{kgf/cm}^2$

$\sigma_a=\dfrac{P_a}{10}\Rightarrow P_a=10\times\sigma_a=5000\ \text{kgf}$

17. $\sigma=E\cdot\varepsilon\Rightarrow\dfrac{7000}{2\times2}=E\cdot\dfrac{1}{200}\Rightarrow E=3.5\times10^5\ \text{kgf/cm}^2$

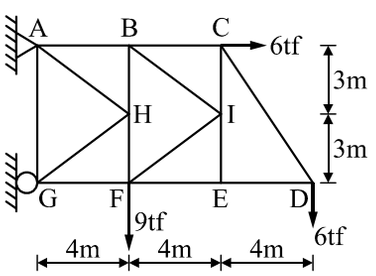
$\nu=\dfrac{\varepsilon_{側}}{\varepsilon_{軸}}=\dfrac{\frac{0.004}{2}}{\frac{1}{200}}=0.4$

$G=\dfrac{E}{2(1+\nu)}=\dfrac{3.5\times10^5}{2(1+0.4)}=1.25\times10^5\ \text{kgf/cm}^2$

18. $\tau=\dfrac{P}{A}\Rightarrow3\ \text{tf/cm}^2=\dfrac{P}{10\pi\times20\ \text{mm}^2}$

$P=\dfrac{3000\ \text{kgf}}{100\ \text{mm}^2}\times10\pi\times20\ \text{mm}^2=6000\pi\ \text{kgf}=6\pi\ \text{tf}$

19.



(1) 計算支承反力得

$+\circlearrowleft\Sigma M_A=0$

$9\times4+6\times12-R_G\times6=0$

$\therefore R_G=18\ \text{tf}(\rightarrow)$

$+\uparrow\Sigma F_y=0$

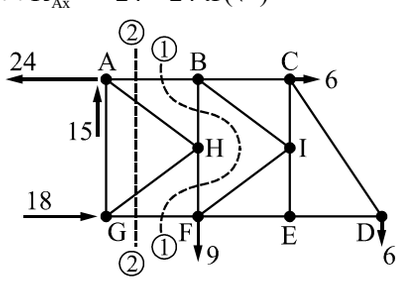
$R_{Ay}-9-6=0$

$\therefore R_{Ay}=15\ \text{tf}(\uparrow)$

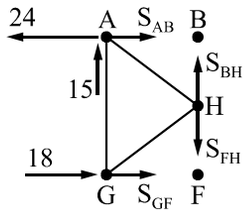
$\overset{+}{\rightarrow}\Sigma F_x=0$

$R_{Ax}+R_G+6=0$

$\therefore R_{Ax}=-24=24\ \text{tf}(\leftarrow)$



取①−①斷面左側自由體圖分析



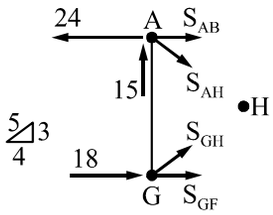
$+\circlearrowleft\Sigma M_B=0$，$15\times4-18\times6-S_{GF}\times6=0$

$\therefore S_{GF}=-8=8\ \text{tf}$ (壓)

$\overset{+}{\rightarrow}\Sigma F_x=0$，$18+S_{GF}+S_{AB}-24=0$

$\therefore S_{AB}=+14=14\ \text{tf}$ (拉)

取②−②斷面左側自由體圖分析



$+\circlearrowleft\Sigma M_A=0$，$-18\times6-S_{GF}\times6-S_{GH}\times\dfrac{4}{5}\times6=0$

$\therefore S_{GH}=-12.5=12.5\ \text{tf}$ (壓)

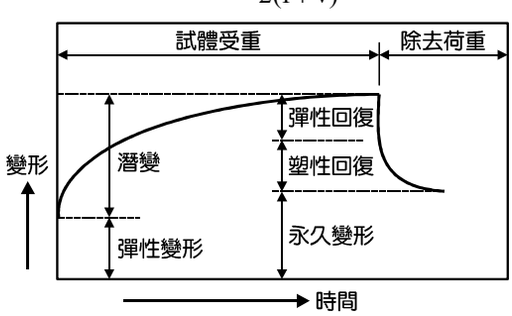
$+\uparrow\Sigma F_y=0$，$15+S_{GH}\times\dfrac{3}{5}-S_{AH}\times\dfrac{3}{5}=0$

$\therefore S_{AH}=12.5\ \text{tf}$ (拉)

20. $\sigma=E\cdot\varepsilon\Rightarrow\varepsilon=\dfrac{\sigma}{E}=\dfrac{\frac{210}{4}}{2.1\times10^6}=0.000025=2.5\times10^{-5}$

21. (D) 剪力彈性模數 $G=\dfrac{E}{2(1+\nu)}$

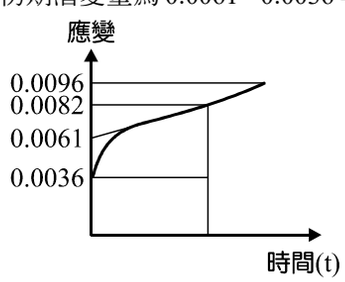
22.



理想潛變曲線如上圖，試樣受荷載後的初期應變值爲 0.0036，且依照下圖

材料直至破壞的總潛變量爲 $0.0096-0.0036=0.0060$

初期潛變量爲 $0.0061-0.0036=0.0025$



23. (B) 金屬疲勞破壞，是由表面破裂開始而發展至內部
(C) 疲勞破壞之反覆應力值小於彈性限度，且破壞前

沒有明顯之塑性變形
(D) 疲勞破壞爲材料在反覆交互應力下發生的非彈性(塑性)變形，不符合虎克定律定義材料彈性線性變形的關係

25. 水泥細度大者比重較大、水化速率較快、早期強度大，細度大者表示水泥粉末顆粒較細，則水化熱也較多

27. $W/C = 0.55 \Rightarrow \frac{W_W}{W_C} = 0.55 \rightarrow \frac{160}{W_C} = 0.55$，$W_C = 291\,kg$

$$r_x = \frac{W_x}{V_x} = \frac{607+644+788+160+291}{1} = 2490\ kgf/m^3$$

29. (C) 依據公共工程委員會第 03390 章混凝土養護第 3.1.3 點，混凝土表面若須接合新澆置之混凝土或塗裝其他面層，如油漆、瓷磚、防潮層、不透水層或屋頂隔熱層者，不得使用蠟、脂類或其他有害混凝土表面及強度之養護劑

30. (B) 石英岩的母岩爲砂岩
(C) 片麻岩的母岩爲花崗岩
(D) 黏板岩的母岩爲頁岩

31. $\frac{256\times100}{6+1}\times2\times102\% = 7461$ 塊

32. (B) 以銀作爲玻璃上的低輻射薄膜
(C) 對可見光有較高的穿透率
(D) 對不可見光如紅外線的反射率較高

35. $0.08\times0.03\times0.6\times20+0.05\times0.05\times0.2\times8 = 0.0328\ m^3$

$0.0328\times360 = 11.808$ 才

37. (A) 軟化點較高的瀝青溫度敏感性較小
(B) 瀝青的針入度越小軟化點越高
(C) 瀝青材料的防水性佳

38. 聚四氟乙烯(PTFE)俗稱鐵氟龍，其質地較軟，具有抗酸、抗鹼、抗各種有機溶劑之特性，幾乎不溶於所有的溶劑。半導體晶圓廠在製程中的蝕刻與清洗過程裡，會用到非常大量的腐蝕性化學品，例如硝酸、氫氟酸，這些化學品必須維持非常高的結晶度和純度，因任何微小的瑕疵都可能影響整個製程的良率，導致數千萬美元的損失。因此，從化學品的運輸到儲存過程，都需要確保極高的安全性與純度。然而，傳統的金屬槽車在運輸這類腐蝕性化學品時，容易因腐蝕作用釋放出金屬離子，進而污染化學品的純度。爲解決這個問題，半導體相關業者以聚四氟乙烯(PTFE)內襯槽車與運輸管道，這種槽車內襯具有極高的耐腐蝕性、化學穩定性及潔淨度，能確保化學品在運輸過程中的高純度不受損害

39. 濕潤狀態含水率 $= \frac{W_{Wet}-W_{OD}}{W_{OD}}\times100\%$

$$\Rightarrow 0.1 = \frac{100-W_{OD}}{W_{OD}} \rightarrow W_{OD} = 90.91\,kg$$

吸水率 $= \frac{W_{SSD}-W_{OD}}{W_{OD}}\times100\%$

$$\Rightarrow 0.04 = \frac{W_{SSD}-90.91}{90.91} \rightarrow W_{SSD} = 94.54\,kg$$

$W_W = W_{Wet} - W_{SSD}$

$= 100 - 94.54 = 5.46\ kg$

40. (C) 拌和水量過多，則水灰比增大，混凝土強度較差，足見拌和水影響混凝土強度