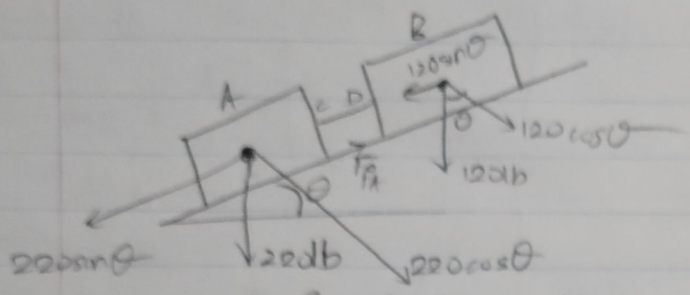
Question 1



Weight of crate A = 220lb

Weight of crate B = 120lb

Coefficient of static friction between A and plane $\mu_A = 0.25$

" " " " " B " " $\mu_B = 0.25$

ΣForce = 0

$\Rightarrow 220\sin\theta + 120\sin\theta - F_{fA} - F_{fB} = 0$

$\Rightarrow 220\sin\theta + 120\sin\theta = F_{fA} + F_{fB}$

$\Rightarrow 220\sin\theta + 120\sin\theta = \mu_A \times 220\cos\theta + \mu_B \times 120\cos\theta$

$\Rightarrow 340\sin\theta = 55\cos\theta + 30\cos\theta = 85\cos\theta$

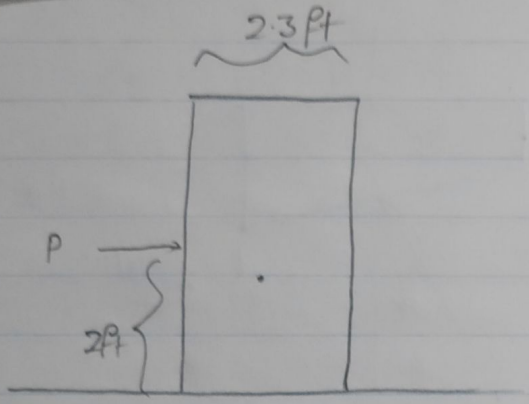
$\Rightarrow \theta = \tan^{-1}\left(\frac{85}{340}\right) = 14.03624347^\circ$

(Ans)

$F_{fA} = \mu_A \times$ Normal Force on crate A

$F_{fB} = \mu_B \times$ Normal Force on crate B

Question 2



230 kg

$\mu_s = 0.55$

$\Sigma F_y = 0$

$N = W$

$= 230\ lb$

$P = \mu_s \times N = 0.55 \times 230$

$= 126.5$

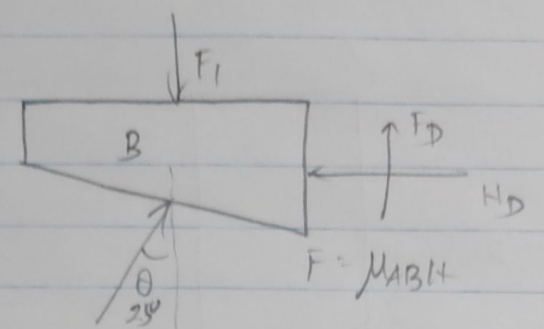
(Ans)

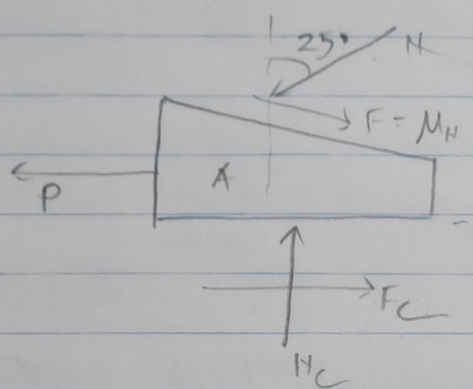
Problem 3

$F_1 = 2950$ lb

$\mu_{AC} = \mu_{BD} = 0.15$

$\mu_{AB} = 0.45$





$\Sigma F_x = 0$

$\Rightarrow F\cos 25° + H_C - N\sin 25 = 0$

$\Rightarrow \mu_{AB} N\cos 25 + H_D - N\sin 25 = 0$

$\Rightarrow 0.45 N\cos 25 - N\sin 25 + H_D = 0$

$\Rightarrow H_D = 0.014779757 5N$ ——— ①

$\Sigma F_y = 0$

$\Rightarrow F\sin 25 + N\cos 25 + F_D - F_1 = 0$

$\Rightarrow \mu_{AB} N\sin 25 + N\cos 25 + \mu_{BD} H_D - F_1 = 0$

$\Rightarrow 0.45 N\sin 25 + N\cos 25 + 0.15 H_D - 2950 = 0$

$\Rightarrow N = 2684.984009$

From ①,

$H_D = 39.68341408$ lb

$\Sigma F_x = 0$

$\Rightarrow F\cos 25 + F_c - P - N\sin 25 = 0$

$\Rightarrow M_{AB} N\cos 25 + M_{CA} H_c - P - N\sin 25 = 0$ ——— (II)

$\Sigma F_y = 0$

$\Rightarrow H_c - H\cos 25 - F\sin 25 = 0$

$\Rightarrow H_c = H\cos 25 + M_{AB} H\sin 25$

$\Rightarrow H_c = 2944.047488\,lb$ ——— (III)

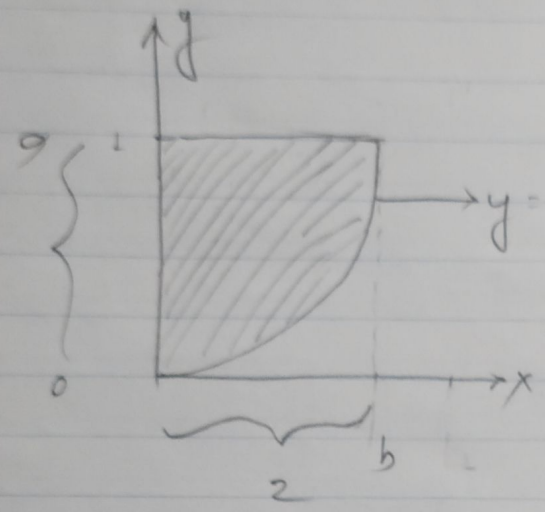
Putting (III) in (II),

$P = ((0.45 \times 2684.984000 \times \cos(25)) + (0.15 \times 2944.047488)$

$-(2684.984 \times \sin(17)))$

$= 401.9237091\,(Ans)$

Question 4



$y = \frac{9}{2^5} x^5 = \left(\frac{9}{32}\right) x^5$

$\therefore x = \sqrt[5]{\frac{32}{9} y}$

$dA = x\,dy$

$= \int_0^9 \left[\sqrt[5]{\frac{2^5}{9} y}\right] dy$

$= 15$

$$\tilde{x} = \frac{x}{2} = \frac{\sqrt[5]{\frac{2^5}{9}y}}{2}$$

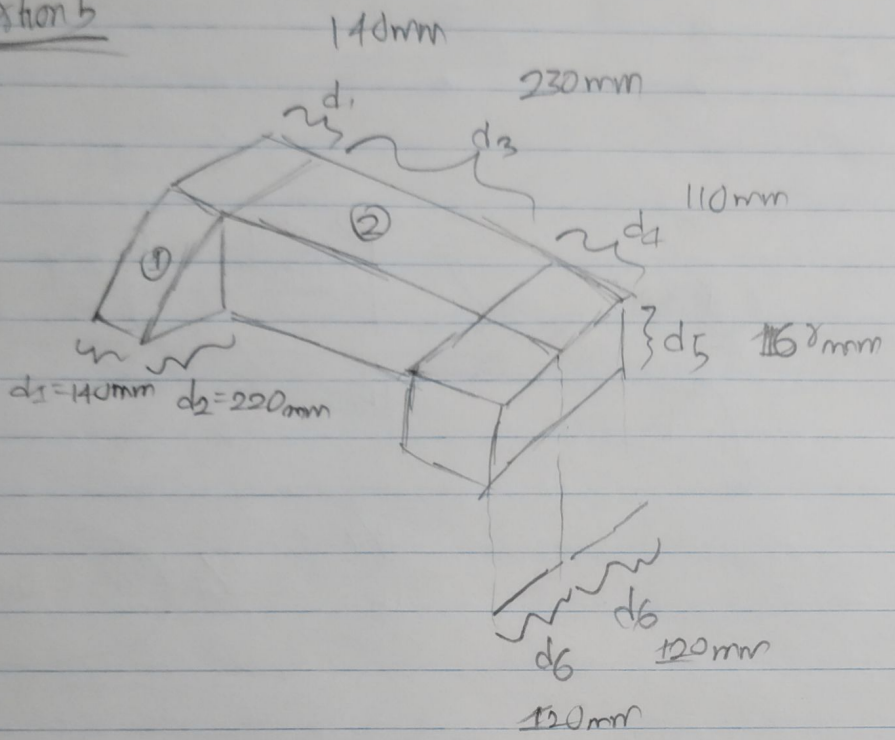
$$\bar{x} = \frac{\int_0^9 \tilde{x}\,dA}{\int_0^9 dA} = \frac{\int_0^9 \left[\frac{\sqrt[5]{\frac{2^5}{9}y}}{2} \times \sqrt[5]{\frac{2^5}{9}y}\right] dy}{15}$$

$$= \frac{80/7}{15} = 6/7 \Rightarrow \bar{x} = 0.857142 \text{ (Ans)}$$

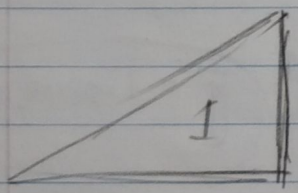
$$\bar{y} = \frac{\int_0^9 y\,dA}{\int_0^9 dA} = \frac{\int_0^9 y\left[\sqrt[5]{\frac{2^5}{9}y}\right] dy}{15}$$

$$= \frac{810/11}{15} = \frac{54}{11} \Rightarrow \bar{y} = 4.909091 \text{ (Ans)}$$

Question 5

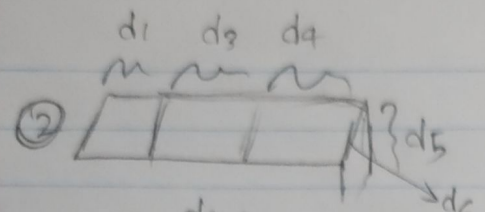


$$\rho = m/V \quad \therefore m = \rho V$$



$$\bar{x} = d_6 + \frac{1}{3} d_2 = \frac{580}{3}\ mm \qquad \bar{y} = \frac{d_1}{2} = 70\ mm \qquad \bar{z} = d_5/3 = 53.3333\ mm$$

$$m = \rho V = \left(\frac{1}{2} \cdot 154\right) \rho = 14640.00\ \rho$$



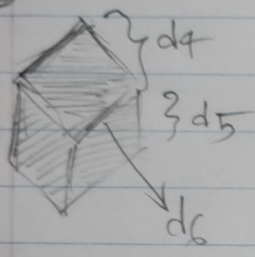
② $\bar{x} = \frac{d_6}{2} = 60\,mm$

$\bar{y} = \left(\frac{d_1+d_3+d_4}{2}\right) = 240\,mm$

$\bar{z} = \frac{d_5}{2} = 80\,mm$

$m = \rho V = \rho(lbh) = 9216000\,\rho$

③



$\bar{x} = d_6 + \frac{d_6}{2} = 180\,mm$

$\bar{y} = d_1 + d_3 + \frac{d_4}{2} = 425\,mm$

$\bar{z} = \frac{d_5}{2} = 80\,mm$

$m = \rho V = (lbh)\rho = 2112000\,\rho$

$$\tilde{x} = \frac{1464000\left(\frac{580}{3}\right) + 9216000(60) + 2112000(180)}{(1464000 + 9216000 + 2112000)}\rho$$

$$= 102.1964\,mm$$

$$\tilde{y} = \frac{\left[1464000(70) + 9216000(240) + 2112000(425)\right]\rho}{(1464000 + 9216000 + 2112000)\rho}$$

$$= 237.9582\,mm$$

$$\tilde{z} = \frac{1464000(53.333) + 9216000(80) + 2112000(80)}{(1464000 + 9216000 + 2112000)\rho}$$

$$= 75.23\,mm.$$