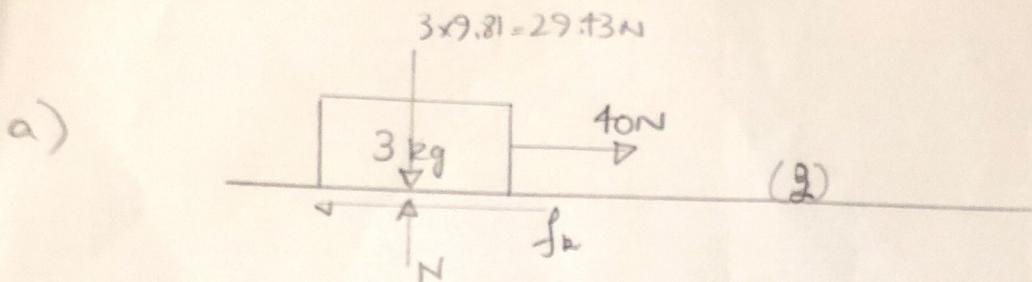


①

ENGG 102 SOLUTIONQuestion 1

$$f_R = \mu_R N$$

$$\sum F_y = 0 \quad N = 29.43 \text{ N}$$

$$f_R = 0.50 \times 29.43 = 14.715 \text{ N} \quad (5)$$

b) $\vec{W.D} = \vec{F} \cdot \vec{d}$ (6)

$$= 40 \cdot 2.5 \cos(0)$$

$$= 100 \text{ J}$$

c) $N = 29.43 \text{ N}$ (calculated above)
 $f_R = 14.715 \text{ N}$

$$W.D = 14.715 \cdot 2.5 (\cos 180)$$

$$= -36.7625 \text{ J} \quad (3)$$

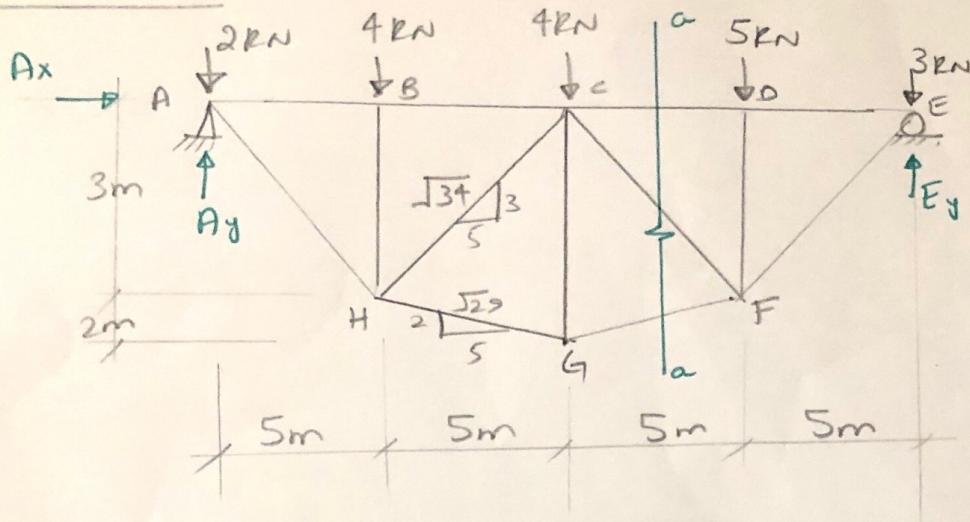
If 30 J went to the block, f_{block} gets = $36.7625 - 30 = 6.7625 \text{ J}$. (2)

d) $\Delta KE = 100 - 36.7625 = 63.2375 \text{ J}$ (3)

$$\frac{1}{2} m v_f^2 = 63.2375 \Rightarrow v_f = 6.49 \text{ m/s.} \quad (1)$$

Question 2

(2)



$$\sum F_x = 0$$

$$A_x = 0$$

$$\sum M_A = 0 \quad 4(5) + 4(10) + 5(15) + 3(20) = E_y(20)$$

$$E_y = 9.75 \text{ kN}$$

$$\sum F_y = 0$$

$$A_y + E_y = 18$$

$$A_y = 8.25 \text{ kN}$$

(5)

Section a-a

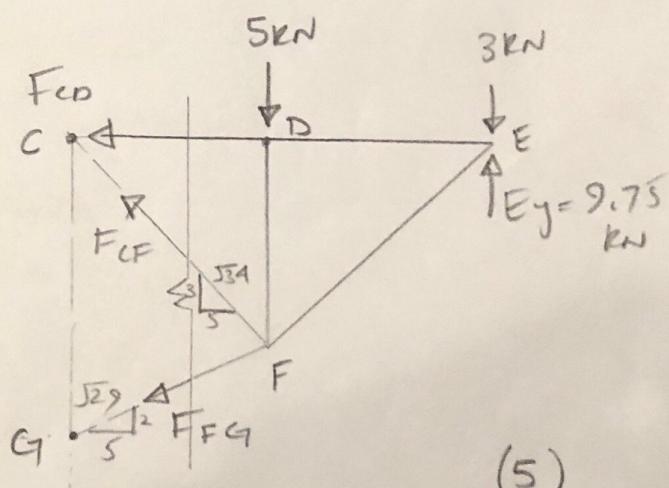
$$(\sum M_c = 0)$$

$$-F_{FG}(5)(\frac{5}{\sqrt{29}}) - 5(5)$$

$$-3(10) + 9.75(10) = 0$$

$$-F_{FG}(\frac{25}{\sqrt{29}}) - 25 - 30 + 97.5 = 0$$

$$F_{FG} = +9.155 (\tau) \text{ kN}$$



(5)

$$\left(\begin{array}{l} \sum M_F = 0 \\ + \end{array} \right) \quad (3)$$

$$F_{CD}(3) - 3(5) + 9.75(5) = 0 \quad (5)$$

$$F_{CD} = -11.25 \text{ kN} \quad (c)$$

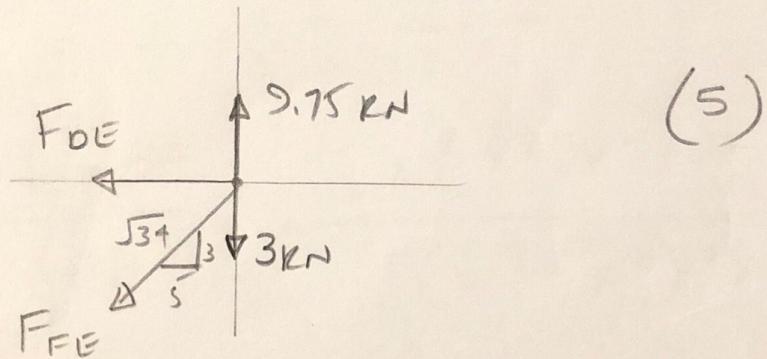
$$\sum F_y = 0 \quad (s)$$

$$-5 - 3 + 9.75 + F_{CF}\left(\frac{3}{\sqrt{34}}\right) - F_{FG}\left(\frac{2}{\sqrt{29}}\right) = 0$$

$$-5 - 3 + 9.75 + F_{CF}\left(\frac{3}{\sqrt{34}}\right) - 9.155\left(\frac{2}{\sqrt{29}}\right) = 0$$

$$F_{CF} = +3.207 \text{ kN} \quad (T)$$

Joint E



$$\sum F_y = 0 \quad -F_{FE}\left(\frac{3}{\sqrt{34}}\right) + 9.75 - 3 = 0$$

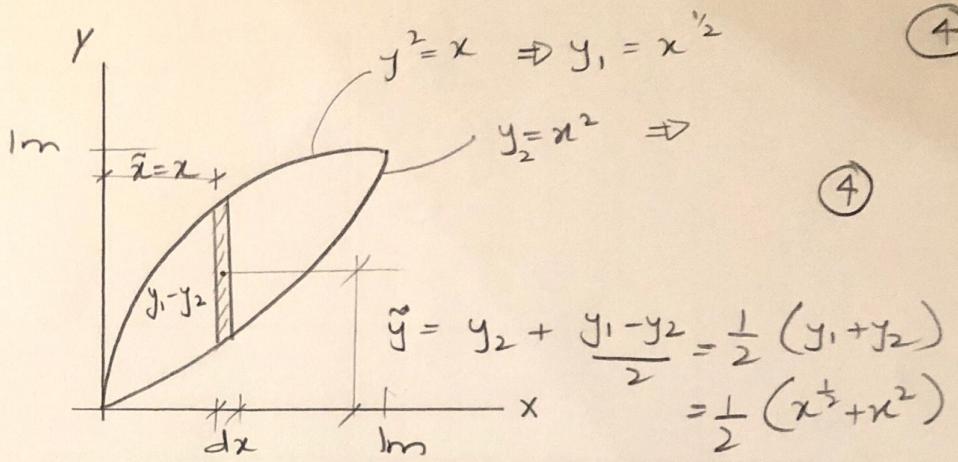
$$-F_{FE}\left(\frac{3}{\sqrt{34}}\right) = -6.75$$

$$F_{FE} = 13.12 \text{ kN} \quad (T)$$

$$\sum F_x = 0 \quad -F_{DE} - 13.12\left(\frac{5}{\sqrt{34}}\right) = 0$$

$$F_{DE} = -11.25 \text{ kN} \quad (c)$$

Q3



$$\text{Area} \Rightarrow dA = (y_1 - y_2)dx \quad ⑤$$

$$= (x^{1/2} - x^2)dx$$

$$\int_0^1 dA = \int_0^1 (x^{1/2} - x^2)dx$$

$$A = \left(\frac{2}{3}x^{3/2} - \frac{1}{3}x^3 \right) \Big|_0^1$$

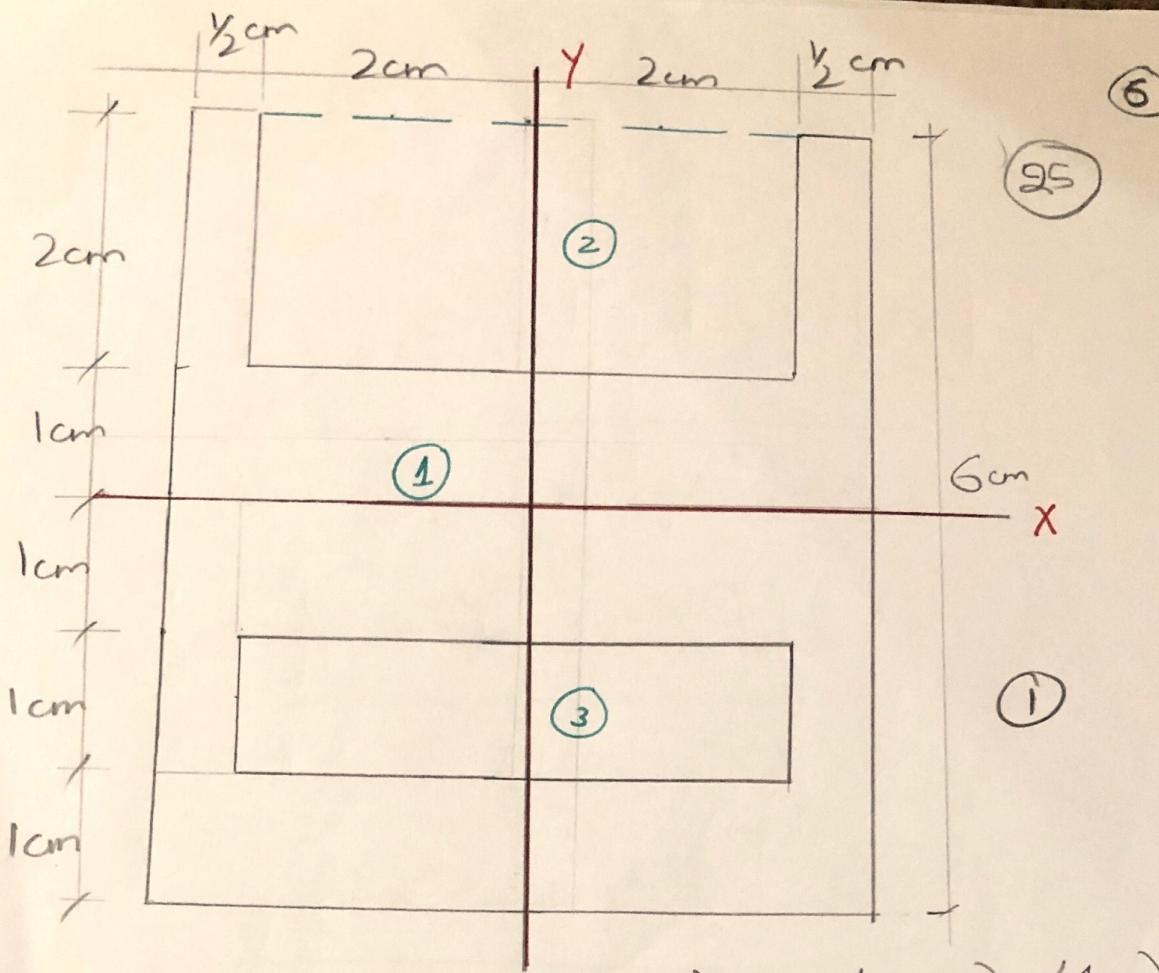
$$= \frac{2}{3} - \frac{1}{3} = \frac{1}{3} \text{ m}^2$$

$$\bar{x} = \frac{\int_A \tilde{x} dA}{\int_A dA} = \frac{\int_0^1 x(x^{1/2} - x^2)dx}{\int_0^1 (x^{1/2} - x^2)dx} \quad ⑧$$

$$= \frac{\left(\frac{2}{5}x^{5/2} - \frac{1}{4}x^4 \right) \Big|_0^1}{\frac{1}{3}} = \frac{\frac{2}{5} - \frac{1}{4}}{\frac{1}{3}}$$

$$= 3 \left(\frac{\frac{2}{5} - \frac{1}{4}}{\frac{1}{3}} \right) = \frac{3(3)}{20} = \frac{9}{20} \text{ m}$$

Q4



$$\text{Area} = A_1 - A_2 - A_3 = (5 \times 6) - (4 \times 2) - (4 \times 1)$$
$$= 18 \text{ cm}^2$$

$$I_y = I_{y1} - I_{y2} - I_{y3} \quad (8+8+8)$$
$$= \frac{6(5)^3}{12} - \frac{2(4)^3}{12} - \frac{1(4)^3}{12}$$
$$= 62.5 - 10\frac{2}{3} - 5\frac{1}{3}$$
$$= 46.5 \text{ cm}^4$$

