LAU School of Engineering	Course:	Statics – CIE 200 *Exam 3 (75 minutes)*
	Fall 2016 (6th December 2016)	
	Instructor:	Amer El-Souri
	Name:	
	ID:	

Problem I: *(25 %)*

The simple 2-D Truss shown in Figure **I** is statically determinate and in equilibrium.

i. Determine the force in members ***AB*** and ***BC*** using THE METHOD OF JOINTS.
ii. Determine the force in members ***BD*** and ***CE*** using THE METHOD OF SECTIONS.

(i) & (ii) are independant

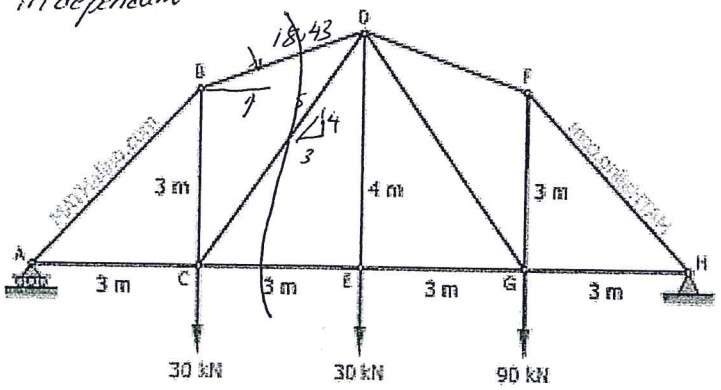


Figure I

Problem II: *(25 %)*

The frame shown in Figure **II** is composed of four members ***AC, CF, DF*** and ***BE***, connected by pins at ***B, C, E*** and ***F***.
Determine the external reactions at pins **A** and **D**, and the internal forces of the frame at points **B, C, E and F**. *Hint*: Members ***BE*** and ***CF*** are two-force elements.

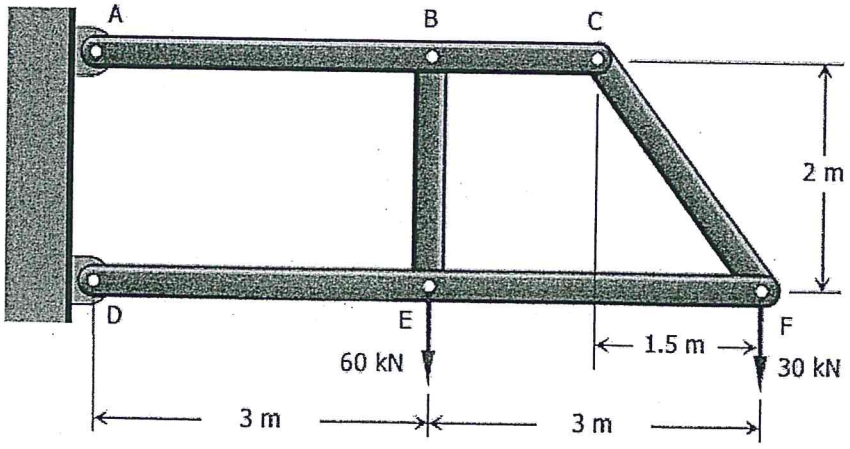
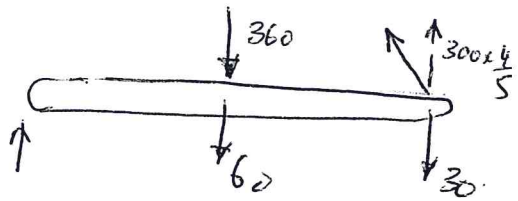


Figure II



Problem III: *(25 %)*

Beam ***ABCD-CE-BF*** shown in Figure **III** is statically determinate and in equilibrium. Assuming the beam has negligible thickness:

iii. Determine the reactions at the supports at ***A*** and ***D.*** (7 %)

iv. Determine the internal actions ***N, V & M*** forces at sections shown in Figure **III.** (18 %)

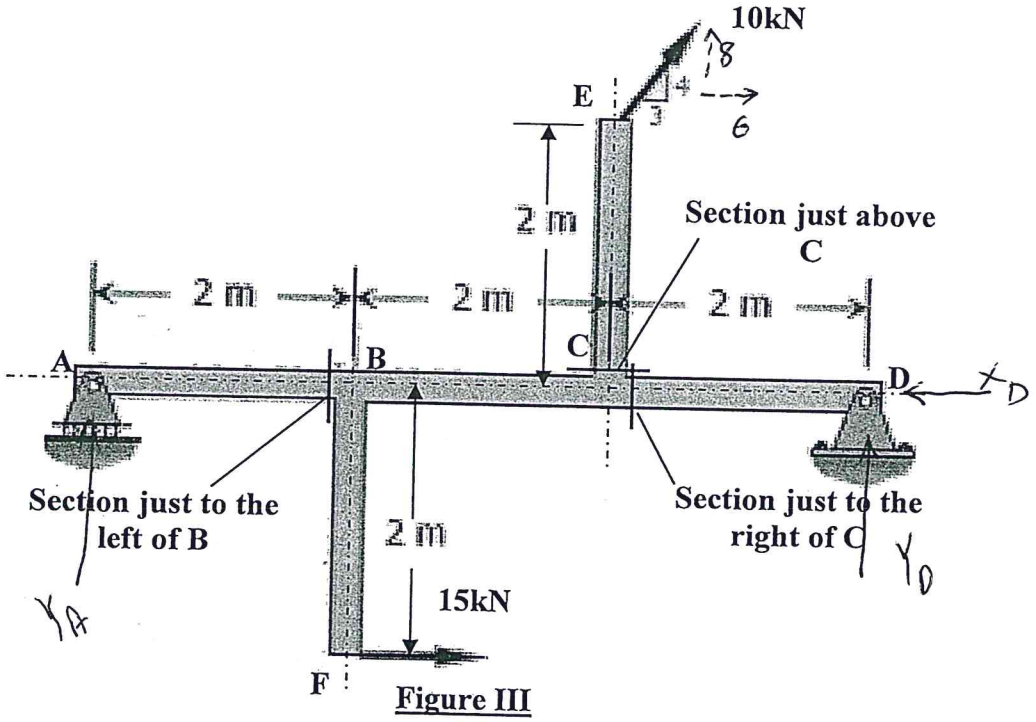


Figure III

Problem IV: *(35 %)*

Given is a statically determinate Beam ***ABC*** subjected to the applied loadings shown in Figure **IV.**

It is required to:

i. Determine the reactions at the supports at ***A*** and ***C.*** (7 %)

ii. Write down the equations of the shear force and bending moment for part ***AB*** of the beam. Use ***A*** as an origin. (10 %)

iii. Draw the shear force and bending moment diagrams for the whole beam using the method of Areas. Show all necessary features for the diagrams including the point of maximum moment. Note: The 20 kN.m moment is applied at point ***B***. (18 %)

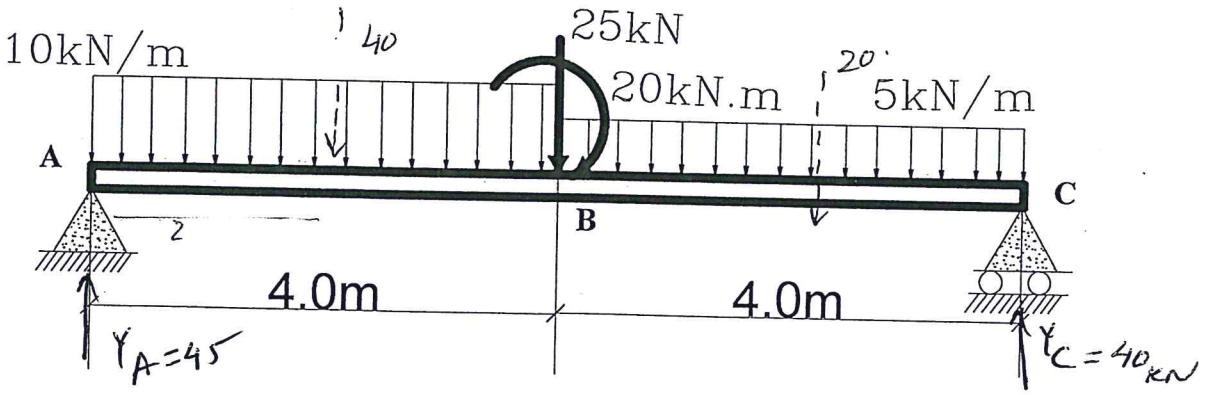


Figure IV

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EXAMINATION BOOKLET

Date: 6 / 12 / 2016
dd mm yyyy

Name: Amer Elsouri | ID. No.: Exam (3)

Subject: CIE 200 Exam (3) | Section: Solution.

Instructor: | Box No.: | Email:

CLOSED-BOOK

Question:	1	2	3	4	5	6	7	8	9	10	Total:

Grade:

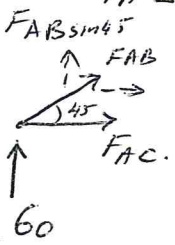
Problem (I)

(i) Reactions : $Y_A = R_A = ?$

$\circlearrowleft \Sigma M_H = 0 \quad +90(3) + 30(6) + 30(9) - Y_A(12) = 0$

$Y_A = 60\ kN \rightarrow Y_H = 150 - 60 = 90\ kN$

Joint A

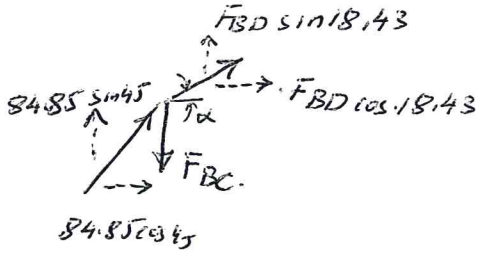


$+\uparrow \Sigma F_y = 0$

$F_{AB}\sin 45 + 60 = 0$

$F_{AB} = \frac{-60}{\sin 45} = -84.85\ kN\ (C)$

Joint B



$\alpha = \tan^{-1}\frac{1}{3} = 18.43$

$\rightarrow \Sigma F_x = 0$

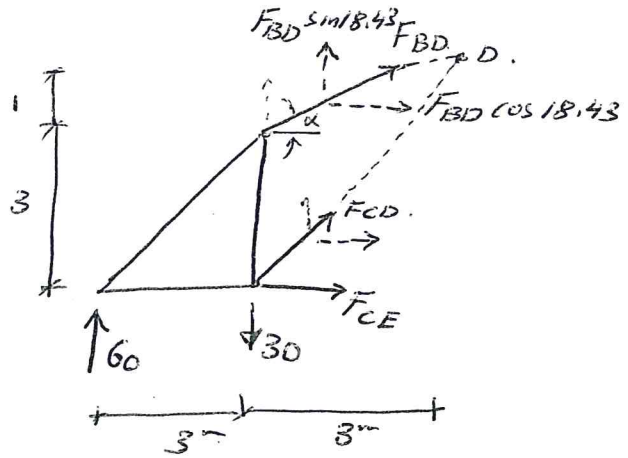
$84.85 \times \cos 45 + F_{BD}\cos 18.43 = 0$

$F_{BD} = -63.24\ kN\ (C)$

$+\uparrow \Sigma F_y = 0 \qquad 84.85\sin 45 + (-63.24)\sin 18.43 - F_{BC} = 0$

$F_{BC} = 40\ kN\ (T)$

(ii)



$\circlearrowleft \Sigma M_D = 0$

$-60(6) + 30(3) + F_{CE}(4) = 0$

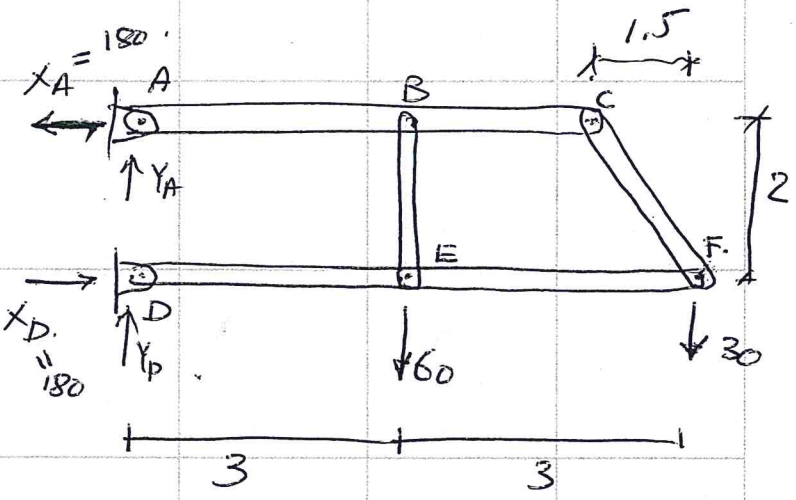
$F_{CE} = 67.5\ kN\ (T)$ ✓

$\circlearrowleft \Sigma M_C = 0$

$-F_{BD}\cos 18.43\,(3) - 60(3) = 0$

$F_{BD} = -63.24\ kN\ (C)$ ✓

Problem (II)



For the whole body

$\oplus \circlearrowleft \Sigma M_A = 0$

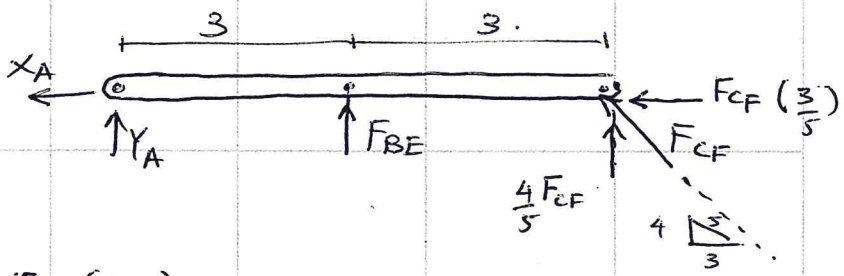
$-60(3) - 30(6) + X_D(2) = 0$

$X_D = 180_{kN}$

$\rightarrow \Sigma F_x = 0 \quad -X_A + X_D = 0$

$X_A = X_D = 180_{kN}$

SPLIT ABC



$\rightarrow \Sigma F_x = 0$

$-180 - F_{CF}\left(\frac{3}{5}\right) = 0.$

$F_{CF} = -5 \times \frac{180}{3} = -300_{kN}.$

$\oplus \circlearrowleft \Sigma M_A = 0.$

$F_{BE}(3) + F_{CF}\left(\frac{4}{5}\right)(4.5) = 0.$ ($F_{CF} = -300$)

$F_{BE} = +360\ kN.$

$+\uparrow \Sigma F_y = 0$

$Y_A + 360 + \frac{4}{5}F_{CF} = 0 \rightarrow Y_A = -120_{kN}.$ ($\frac{4}{5}F_{CF} = -300$)

Back To the whole System. F.B.D

$+\uparrow \Sigma F_y = 0 \quad -120 - 60 - 30 + Y_D = 0.$

$Y_D = 210_{kN}.$

Problem (III)

Reactions.

$\Sigma M\omega_A = 0$.

$Y_D(6) + 15(2) - 6(2) + 8(4) = 0$.

$Y_D = -8.33_{KN}$.

$\rightarrow \Sigma F_x = 0 \longrightarrow X_D = 6 + 15 = 21_{KN}$

$+\uparrow \Sigma F_y = 0$. $\quad 8 + 8.33 + Y_A = 0$.

$Y_A = +0.33_{KN}$.

Left of B

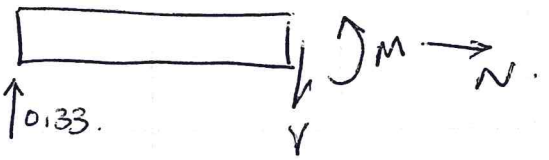
$\Sigma F_x = 0 \quad N_B = 0$.

$\Sigma F_y = 0$.

$0.33 - V = 0$

$V = 0.33$

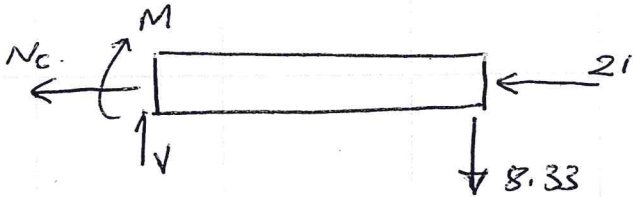
B^-



$\circlearrowright \Sigma M\omega_B = 0 \quad -0.33(2) + M = 0$.

$M = 0.66\,KNm$

To Right of C



$+\uparrow \Sigma F_y = 0$

$-8.33 + V = 0$.

$V = 8.33$.

$\rightarrow \Sigma F_x = 0 \quad -N_C - 21 = 0$

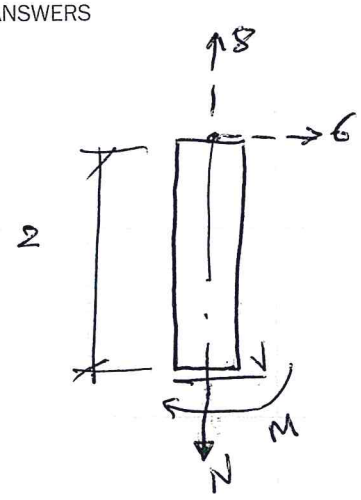
$N_C = -21_{KN}$

$\circlearrowright \Sigma M\omega_C = 0$

$-8.33(2) - M = 0$.

$M = -16.66_{KN}$

Just to above 'C'



$+\uparrow \Sigma F_y = 0$

$8 - N = 0$

$N = 8$ (T)

$\rightarrow \Sigma F_x = 0$

$6 - V = 0 \qquad V = 6.$

(+) $\Sigma M\,@\,C = 0$

$-6(2) - M = 0.$

$M = 12\ kNm$

Problem (IV)

(i) Reactions.

(+) $\Sigma M\,@\,A = 0.$

$Y_C(8) - 20(6) - 40(2) - 25(4) - 20 = 0.$

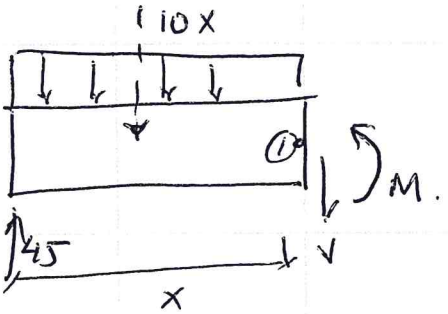
$Y_C = 40_{kN}$

$+\uparrow \Sigma F_y = 0$

$-40 - 20 - 25 + 40 + Y_A = 0.$

$Y_A = 45_{kN}.$

(ii)



$+\uparrow \Sigma F_y = 0$

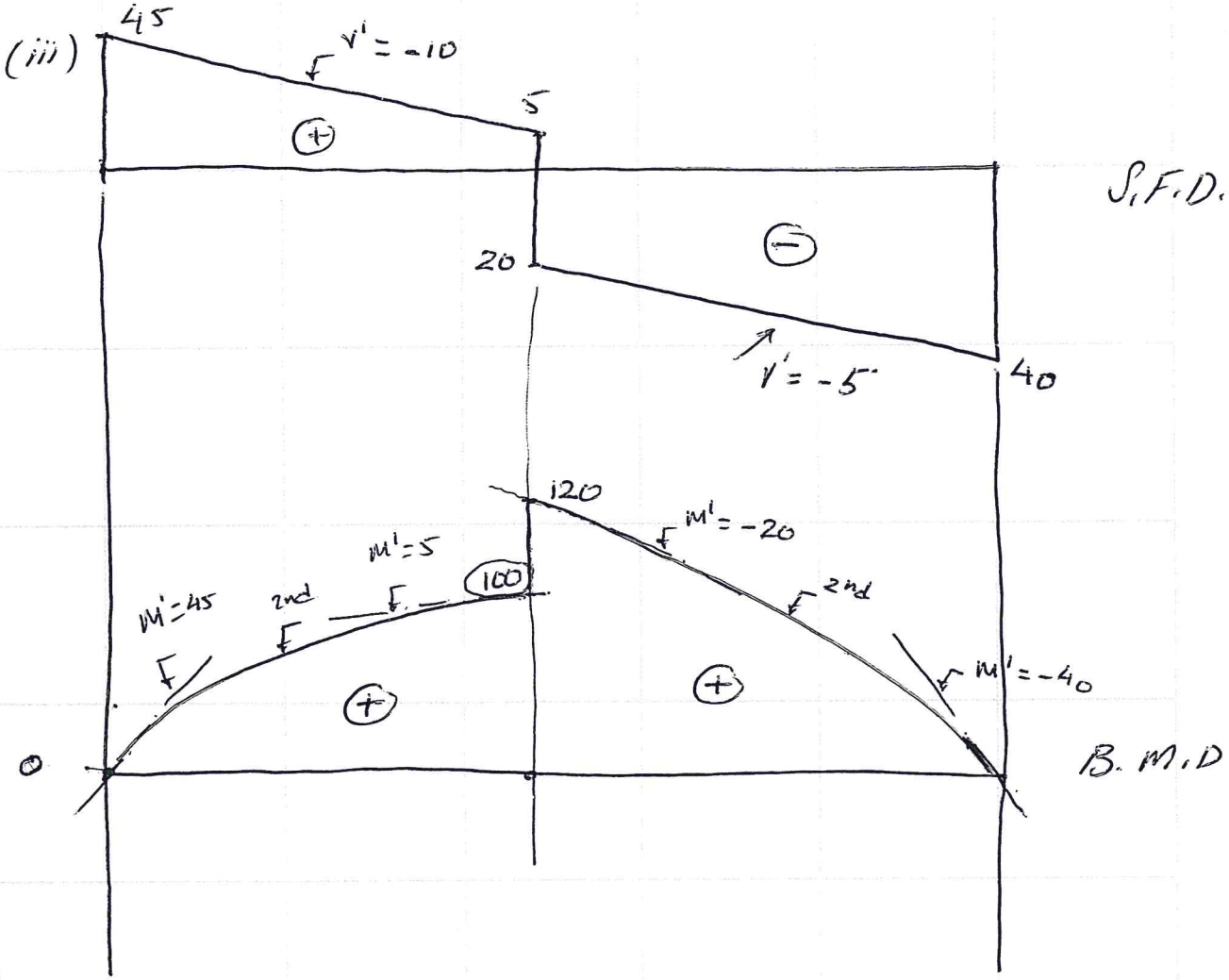
$45 - 10x - V = 0$

$V = -10x + 45 \quad -(1).$

(+) $\Sigma M\,@\,① = 0$

$-45(x) + 10x \cdot \frac{x}{2} + M = 0 \rightarrow M = -5x^2 + 45x \quad -(2)$

(iii)



$M_B = 5 \times 4$

$+ 40 \times \frac{4}{2} = 100$