Name in Arabic :	**Lecture time :**
Student Number:	

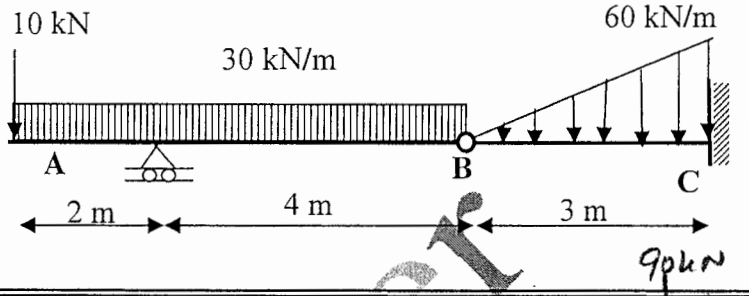
KING SAUD UNIVERSITY	**STRUCTURAL ANALYSIS : CE 361**
COLLEGE OF ENGINEERING	**SECOND SEMESTER, 1428/1429 H**
CIVIL ENGINEERING DEPARTMENT	**TIME : 90 min**

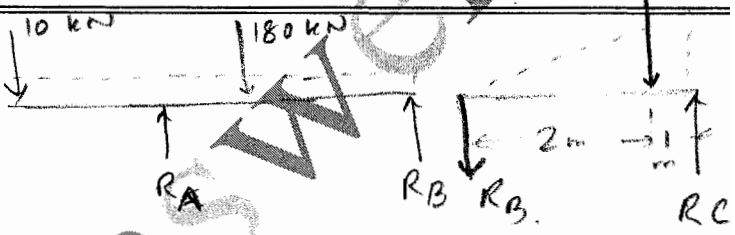
SECOND MID TERM EXAM

Problem 1: (12 points)

For the shown loaded beam it is required to;

1- Determine the reactions at supports
2- Draw S.F.D and B.M.D showing all necessary values and tangents on the diagrams with a reasonable scale.





$(+\circlearrowleft \Sigma M_B = 0:$

$10(6) + 180(3) - R_A(4) = 0$

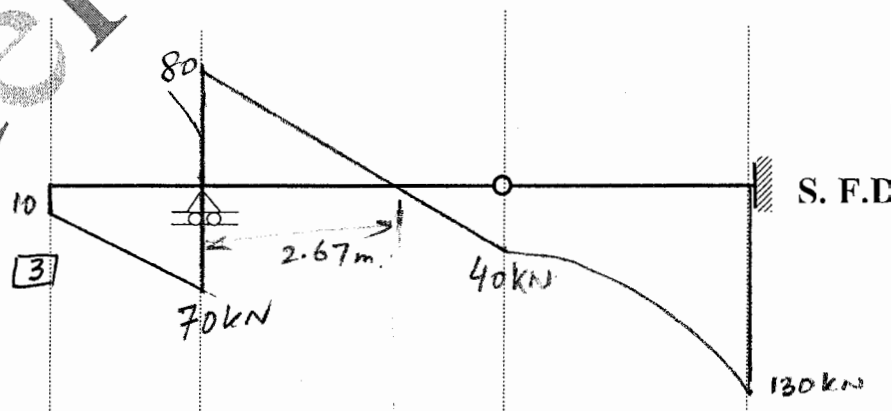
$R_A = 150\ kN$

$R_B = 40\ kN$

$R_C = 130\ kN$ [2]

$M_c + 90(1) + 40(3) = 0$

$M_c = 210\ kNm$ [1]

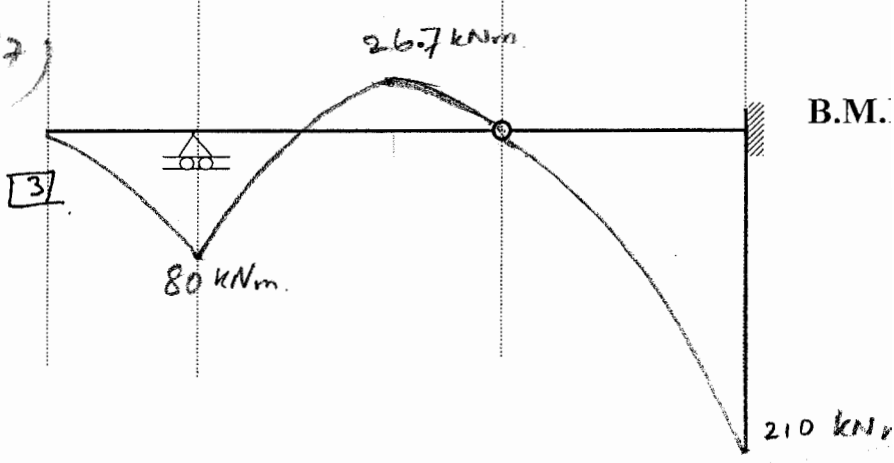


M_{max}

$= 10(4.67) + \left(\frac{80 \times 4.67 \times 4.67}{2}\right) - 150(2.67)$

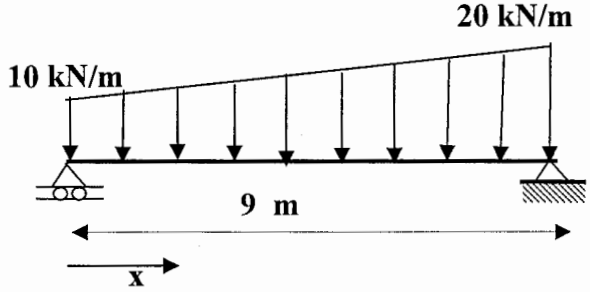
$= 26.67$

$= 26.7\ kNm$ [1]



Name in Arabic :	Lecture time :
Student Number:	

Problem 2: (8 points)



For the shown loaded beam, it is required to;

1- Write the shear force equation in terms of x
2- Write the bending moment equation in terms of x
3- Determine the maximum value of bending moment.

Show all necessary values and tangents on diagrams

Reactions.

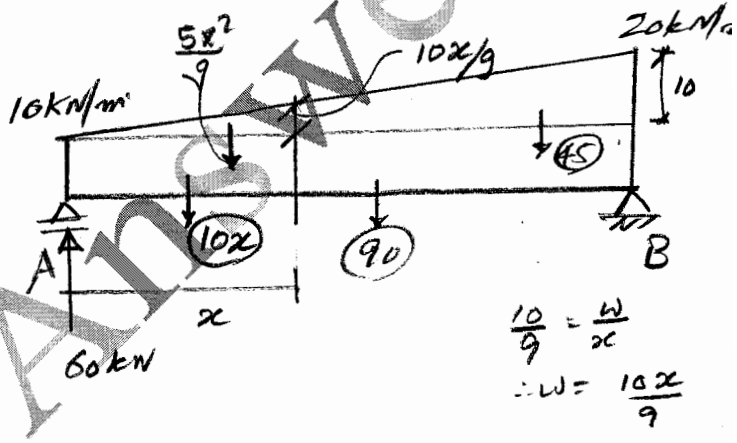
ΣM_A [1] $90 \times 4.5 + 45 \times 6 - 9Y_B = 0$

$Y_B = 75$ kN

ΣM_B $45 \times 3 + 90 \times 4.5 - 9Y_A = 0$

$Y_A = 60$ kN

Check $\Sigma y = 0$ $75 + 60 - 90 - 45 = 0$



$\frac{10}{9} = \frac{W}{x}$

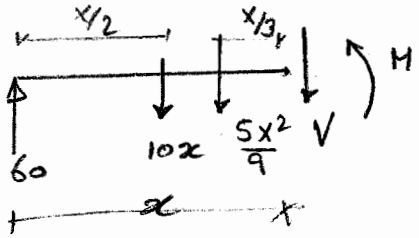
$\therefore W = \frac{10x}{9}$

Shear Equation.

ΣF_y

[2] $60 - 10x - \frac{5x^2}{9} - V = 0$

$$V = 60 - 10x - \frac{5x^2}{9}$$



Moment Equation.

ΣM $60x - 10x \cdot \frac{x}{2} - \frac{5x^2}{9} \cdot \frac{x}{3} - M = 0$

[2] $\therefore$ $$M = 60x - 5x^2 - \frac{5x^3}{27}$$

Position of max Moment. at $V = 0$ $\therefore$ $60 - 10x - \frac{5x^2}{9} = 0$

OR $0.556x^2 + 10x - 60 = 0$

$x^2 + 17.986x - 107.9 = 0$

$\therefore x = \frac{-17.986 \pm \sqrt{(17.986)^2 + 4 \times 107.9}}{2}$

$x = 4.747$ m

$X = -22.7$ m Rejected.

[2] $\therefore x = 4.747$ m.

$\therefore$ Max Moment $= M_{max} = 60(4.747) - 5(4.747)^2 - \frac{5}{27}(4.747)^3$

[1] $= 152.34$ KN.m

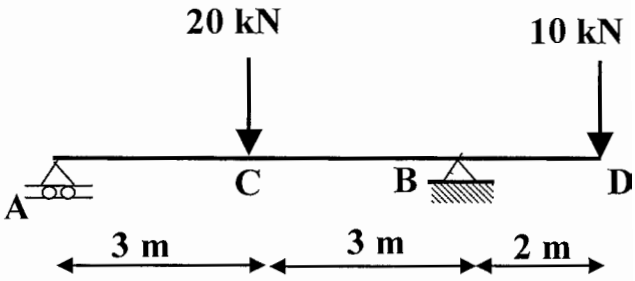
Name in Arabic :	Lecture time :
Student Number:	

Problem 3: (10 points)

For the shown beam , Use Conjugate beam method to:

1- Determine the deflection at "C"
2- Determine the slope at "B"
3- Determine deflection at "D"
4- Sketch the elastic curve

Given that I = 200 x 10^6 mm^4 and E = 200 GPa



Reactions for real beam

$\Sigma M_B \quad 20\times3 - 10\times2 - 6Y_A = 0 \qquad Y_A = 6.67\ KN$

Reactions for Conjugate beam

$\Sigma M_A =$

$$\frac{30}{EI}\times2 + \frac{15}{EI}\times3.5 - \frac{15}{EI}(5.5) + 6Y_B = 0$$

$$Y_B = -\frac{5}{EI}$$

$\Sigma M_B =$

$$\frac{15}{EI}(0.5) - \frac{15}{EI}(2.5) - \frac{30}{EI}(4) - 6Y_A = 0$$

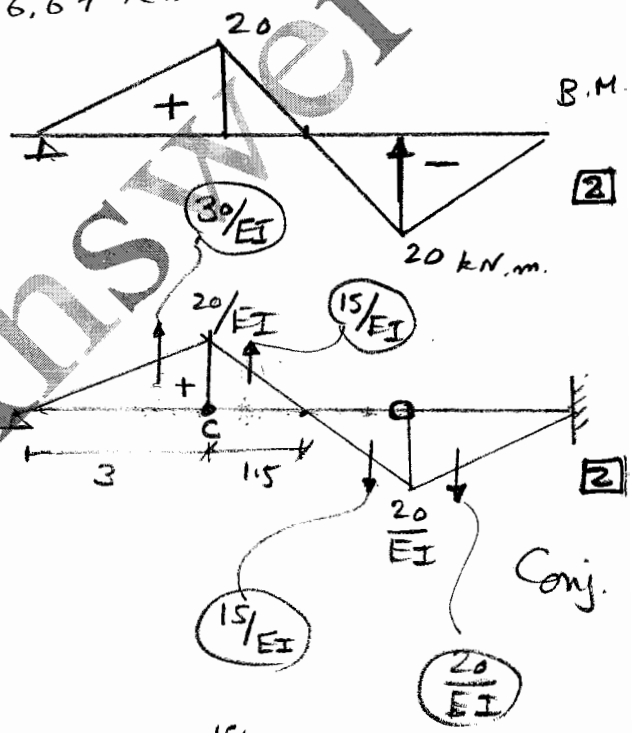
$$Y_A = \frac{-25}{EI}$$

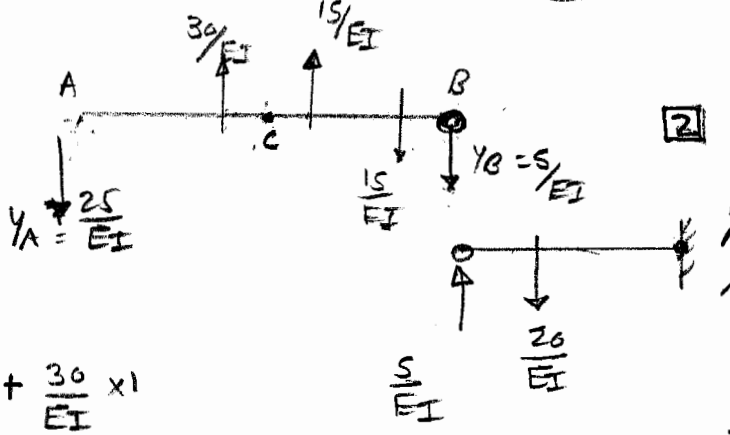
Check $\Sigma y = 0$

$\Sigma M_D = 0$

$$\frac{5}{EI}(2) - \frac{20}{EI}\frac{4}{3} - M = 0$$

$$\therefore M = +\frac{16.7}{EI}$$





- Deflection at C = $M_C = \frac{-25}{EI}(3) + \frac{30}{EI}\times1$

$$= \frac{-45}{EI} = \frac{-45}{200\times10^6\times200\times10^6\times10^{-12}} = -1.125\times10^{-4}$$

- Slope at B = $V_B = +\frac{5}{EI} = \frac{5}{200\times200} = +1.25\times10^{-4}$ rad.

- Deflection at D = $M_D = \frac{+16.7}{EI} = \frac{+16.7}{200\times200} = +4.175\times10^{-4}$ m