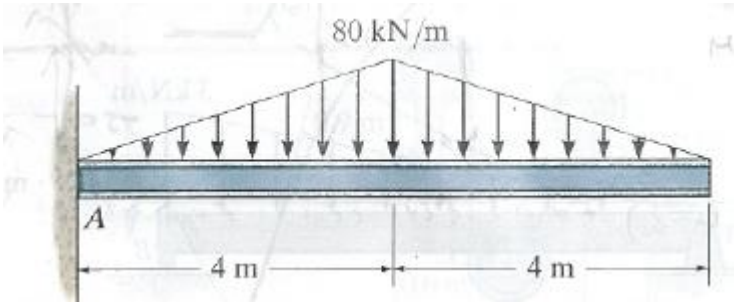
24/12/2020

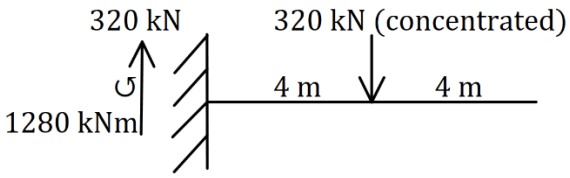
ES 221 MECHANICS I (STATICS) RECITATION X

Q1)

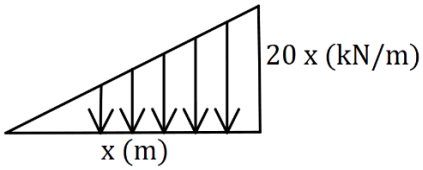
Draw the shear and moment diagrams for the beam.



Solution to Q1



$0 \leq x \leq 4\ m$

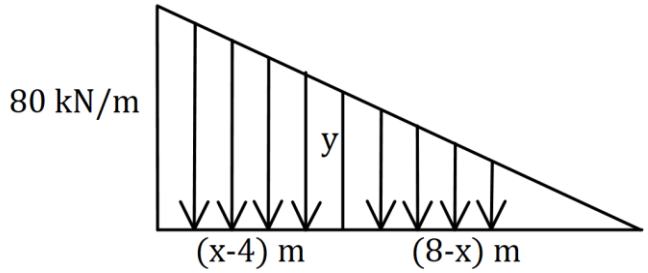


$V(x) = 320 - 10x^2$

$$M(x) = \frac{-10x^3}{3} + 320x + C_1, \quad @x = 0\ , M = -1280\ kNm$$

$$M(x) = \frac{-10x^3}{3} + 320x - 1280$$

$4\ m \leq x \leq 8\ m$



$$\frac{8-x}{4} = \frac{y}{80}$$

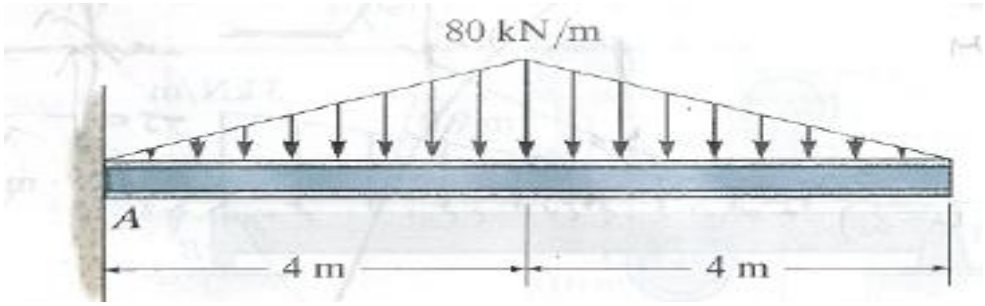
$$y = 20(8-x)kN/m$$

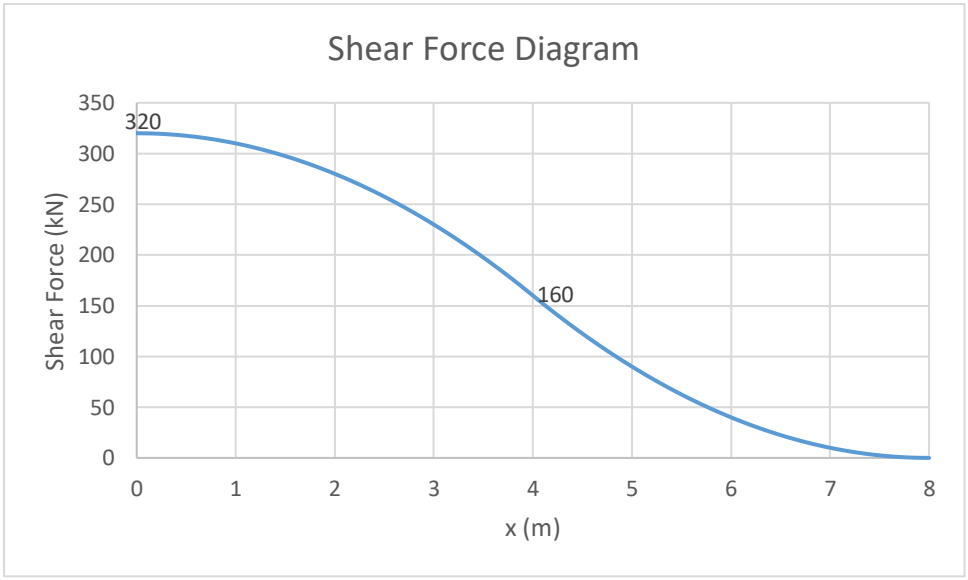
$$V(x) = 160 - [(-10x + 120)(x - 4)]$$

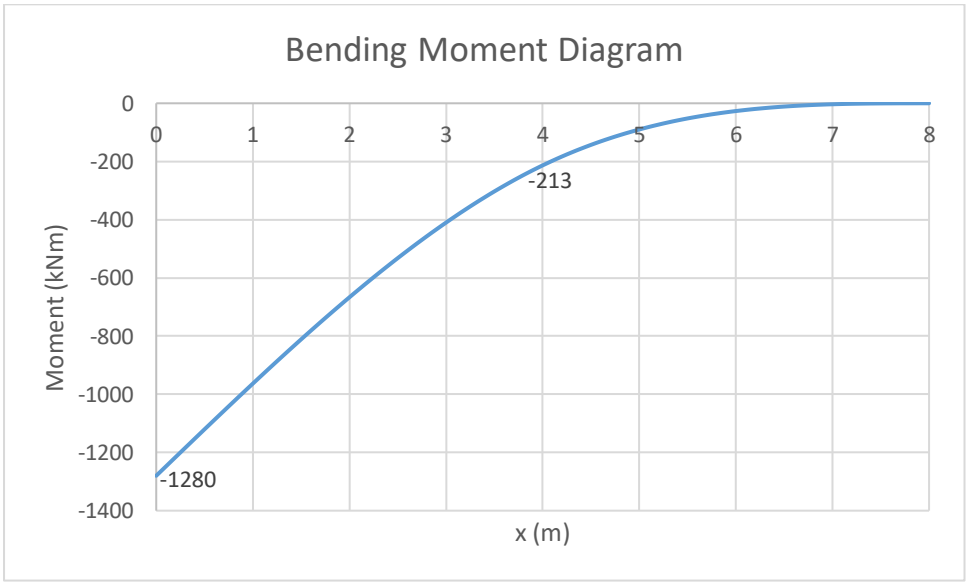
$$V(x) = 10x^2 - 160x + 640$$

$$M(x) = \frac{10x^3}{3} - 80x^2 + 640x - C_2, \quad @x = 8, M = 0$$

$$M(x) = \frac{10x^3}{3} - 80x^2 + 640x - 1706.67$$

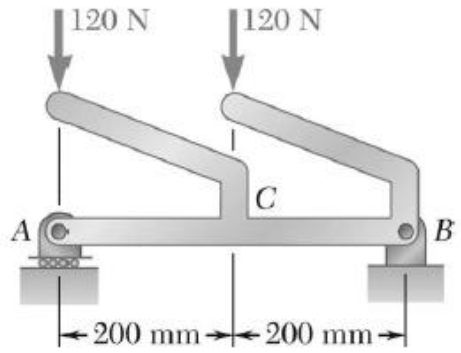

80 kN/m
A
4 m
4 m


Shear Force Diagram
Shear Force (kN)
350
300
250
200
150
100
50
0
320
160
0
1
2
3
4
5
6
7
8
x (m)


Bending Moment Diagram
Moment (kNm)
0
-200
-400
-600
-800
-1000
-1200
-1400
-213
-1280
0
1
2
3
4
5
6
7
8
x (m)

Q2)

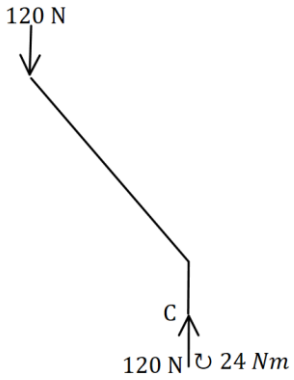
Draw the shear and bending moment diagrams for the beam AB, and determine the maximum absolute values of the shear and bending moment.



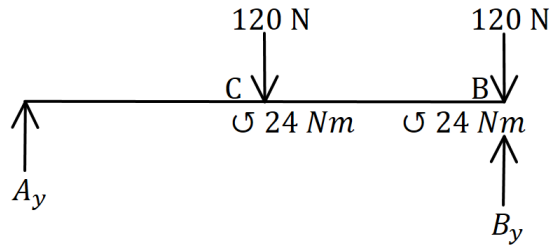
Solution to Q2

$A_x = 0$

Free-Body Diagram of the Extension:



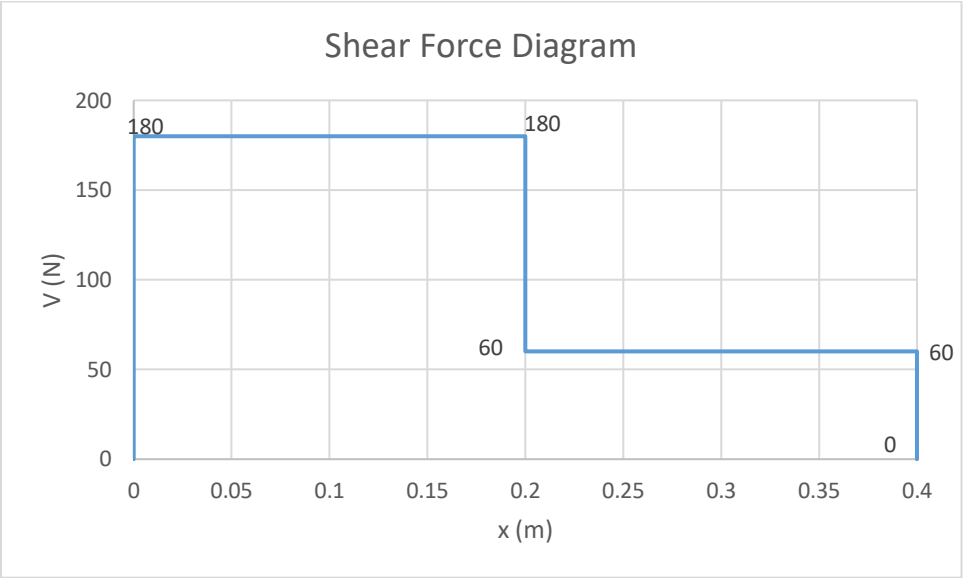
Free-Body Diagram of the Beam ACB:

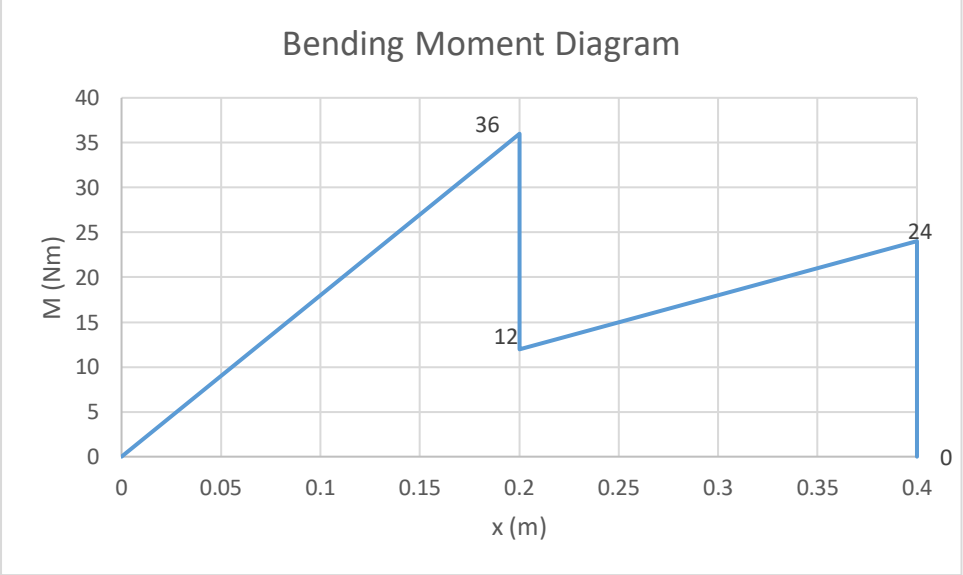


$$\circlearrowleft \sum M_A = 0$$

$$-120\ N \times 0.2\ m + 24\ Nm - 120\ N \times 0.4\ m + 24\ Nm + B_y \times 0.4\ m = 0$$

$A_y = 180\ N \uparrow,\quad B_y = 60\ N \uparrow$



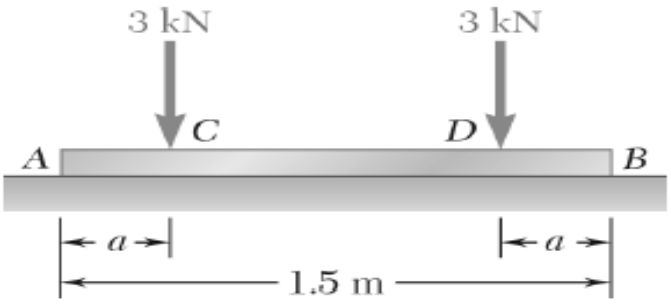


$|V_{max}| = 180\ N$

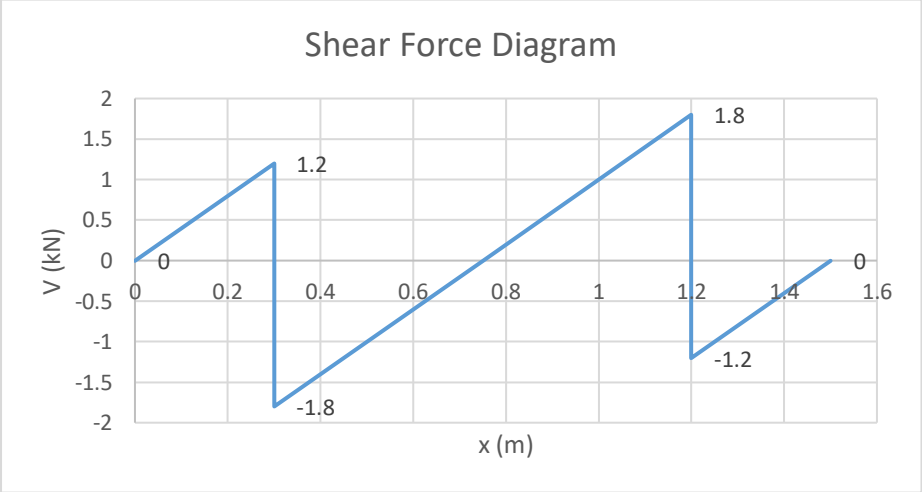
$|M_{max}| = 36\ Nm$

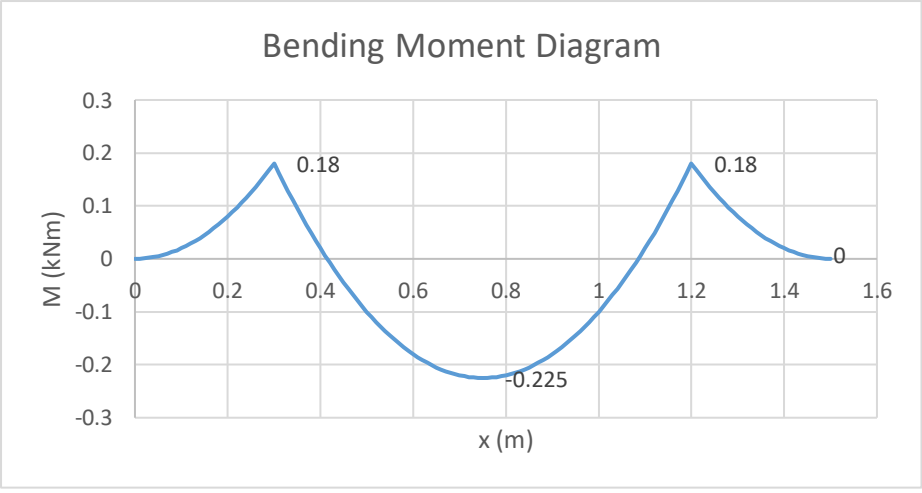
Q3)

Assuming the upward reaction of the ground on AB to be uniformly distributed and knowing that a=0.3 m, (a) draw the shear and bending moment diagrams, (b) determine the maximum absolute values of shear and bending moment.



Solution to Q3





$|V_{max}| = 1.8\ kN$, $|M_{max}| = 0.225\ kNm$