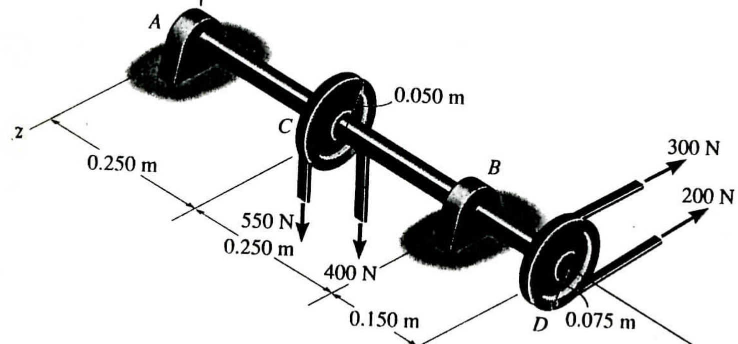
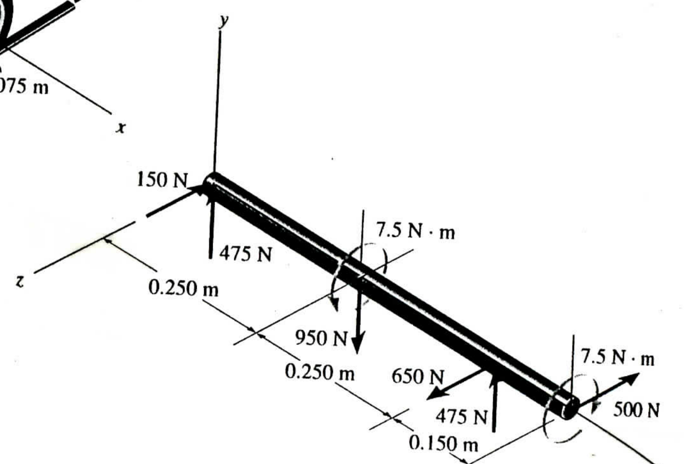
EXAMPLE

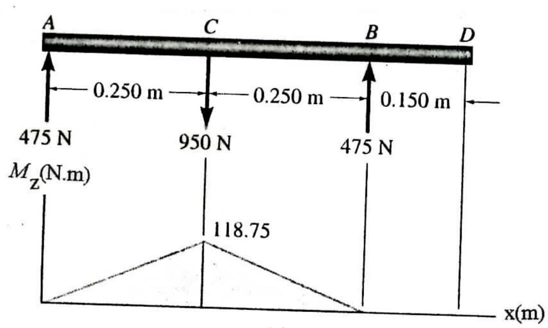
The shaft in Fig. 11–15*a* is supported by smooth journal bearings at *A* and *B*. Due to the transmission of power to and from the shaft, the belts on the pulleys are subjected to the tensions shown. Determine the smallest diameter of the shaft using the maximum-shear-stress theory, with $\tau_{allow} = 50$ MPa.



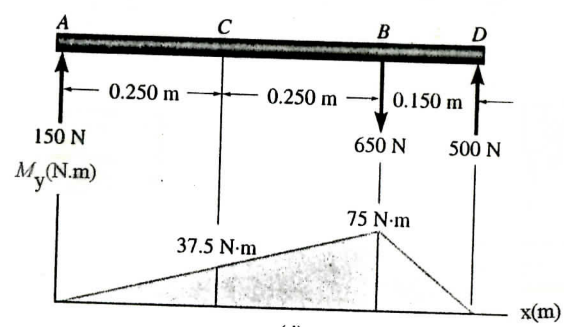
(a)



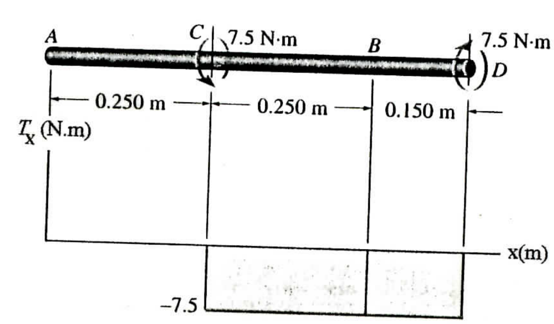
(b)



(c)

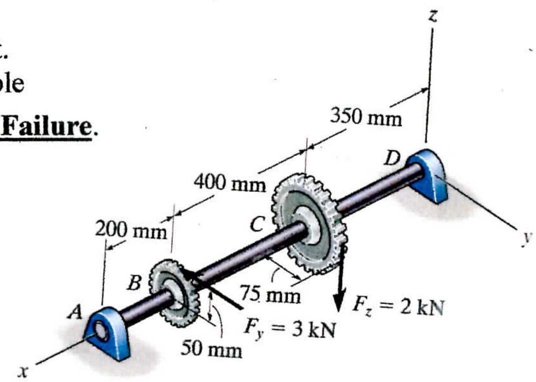


(d)

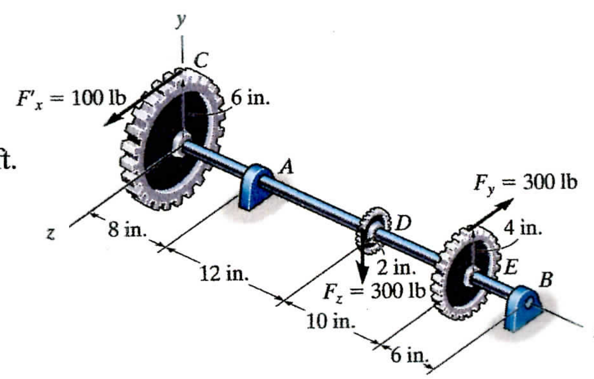


(e)

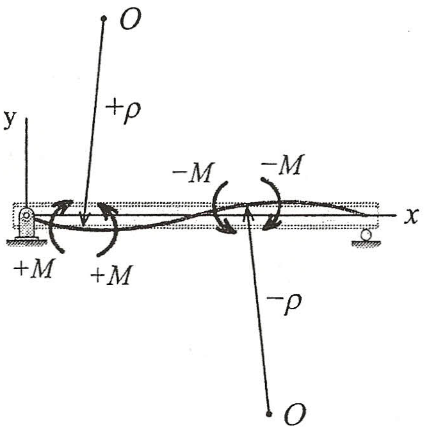
Question 1:
The bearings at A and D exert only y and z components of force on the shaft. If τ_{allow} = 60-MPa, determine to the nearest millimeter the smallest permissible outer diameter of the shaft. Use the **Maximum-Shearing-Stress Theory of Failure**.



Question 2:
The Shaft shown is supported by bearings at A and B that exert force components only in the y and z directions on the shaft.
If the allowable shear stress for the shaft is τ_{allow} = 6-ksi, determine to the nearest 1/8 in the smallest permissible outer diameter of the shaft.
Use the **Maximum-Shearing-Stress Theory of Failure**.



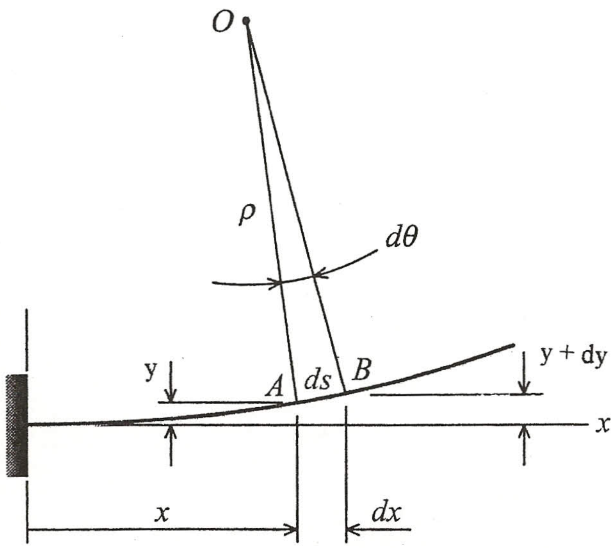
ME 219
Beams Deflection



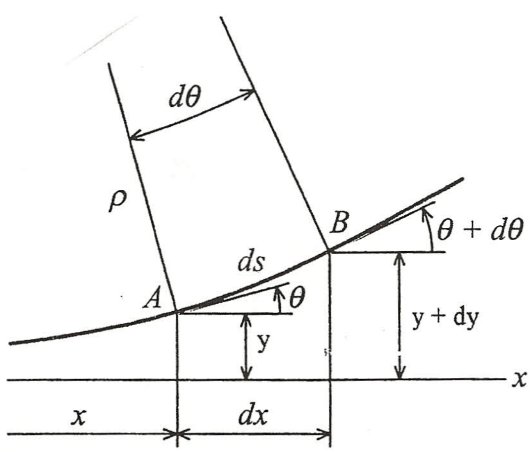
$$\boxed{\kappa = \frac{1}{\rho} = \frac{M}{EI_z}}$$

$$\frac{1}{\rho} = \frac{d^2y/dx^2}{[1 + (dy/dx)^2]^{3/2}}$$

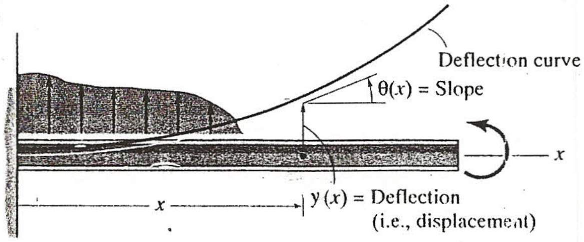
$$\frac{1}{\rho} = \frac{d^2y}{dx^2}$$



Elastic curve.



Beam's Slope & Deflection



Boundary Conditions

(1) θ, y = 0

pin

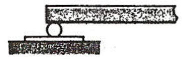
V, M = 0

pin

(2) θ, y = 0

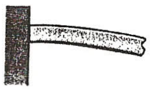
roller

V, M = 0



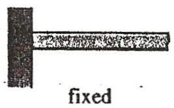
roller

(3) θ = 0, y = 0



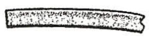
fixed

V, M



fixed

(4) θ, y



free

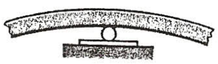
V = 0, M = 0

free

(5) θ, y = 0

internal pin

(6) θ, y = 0



internal roller

V, M

roller

(7) θ, y

hinge

V, M = 0

hinge

Sign Conventions

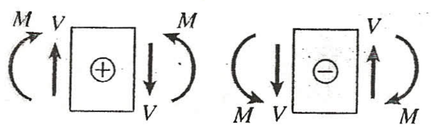
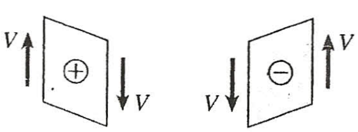
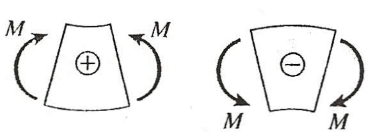


Fig. 4-5 Sign conventions for shear force V and bending moment M

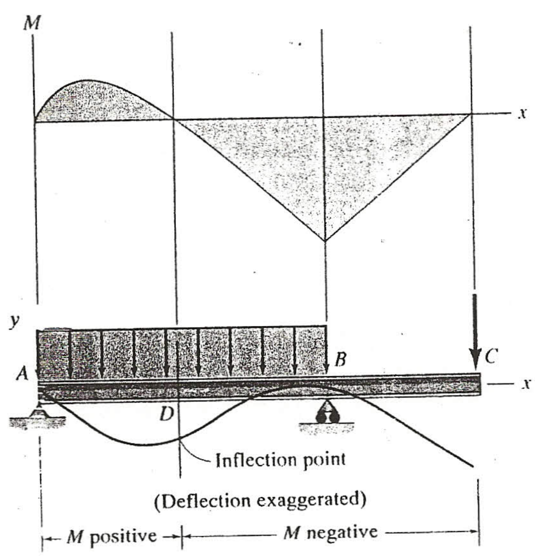


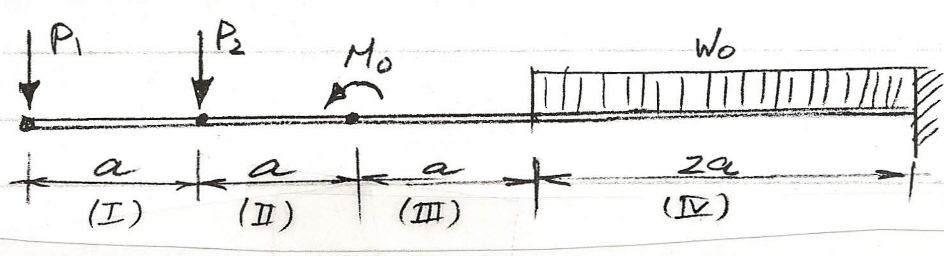
(a)



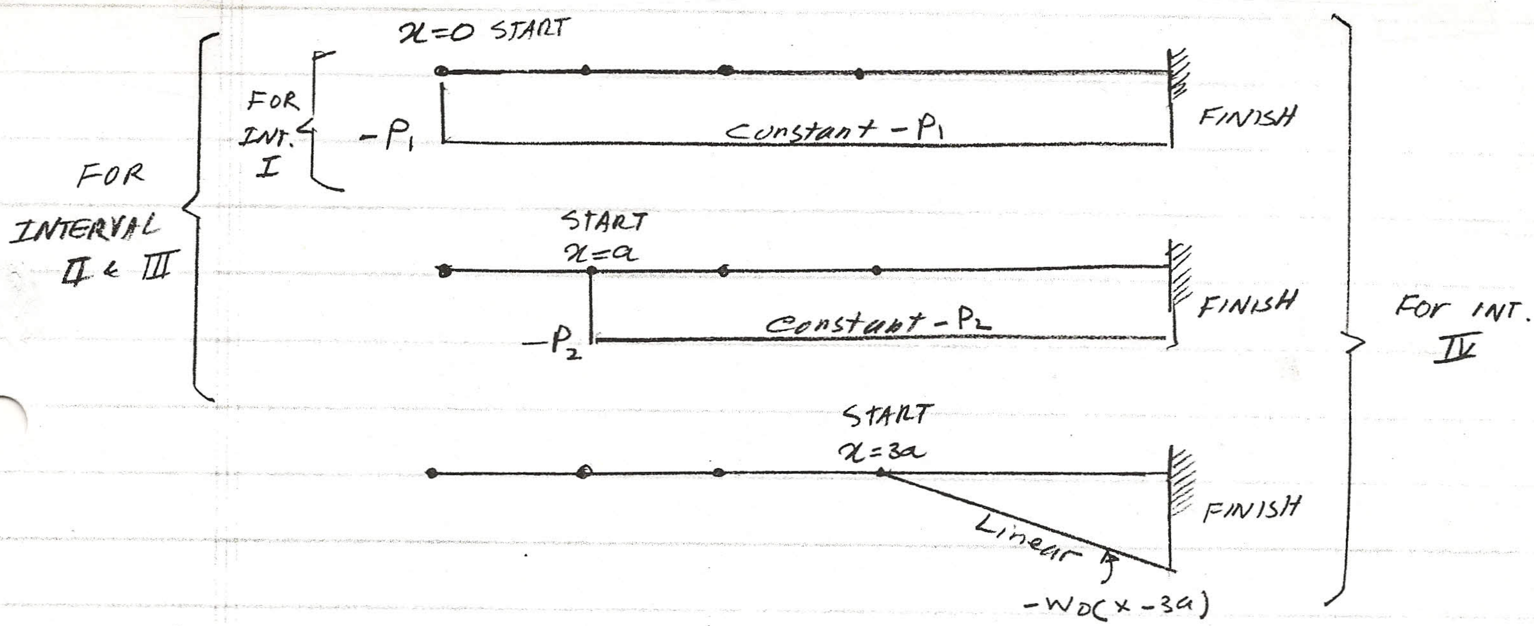
(b)

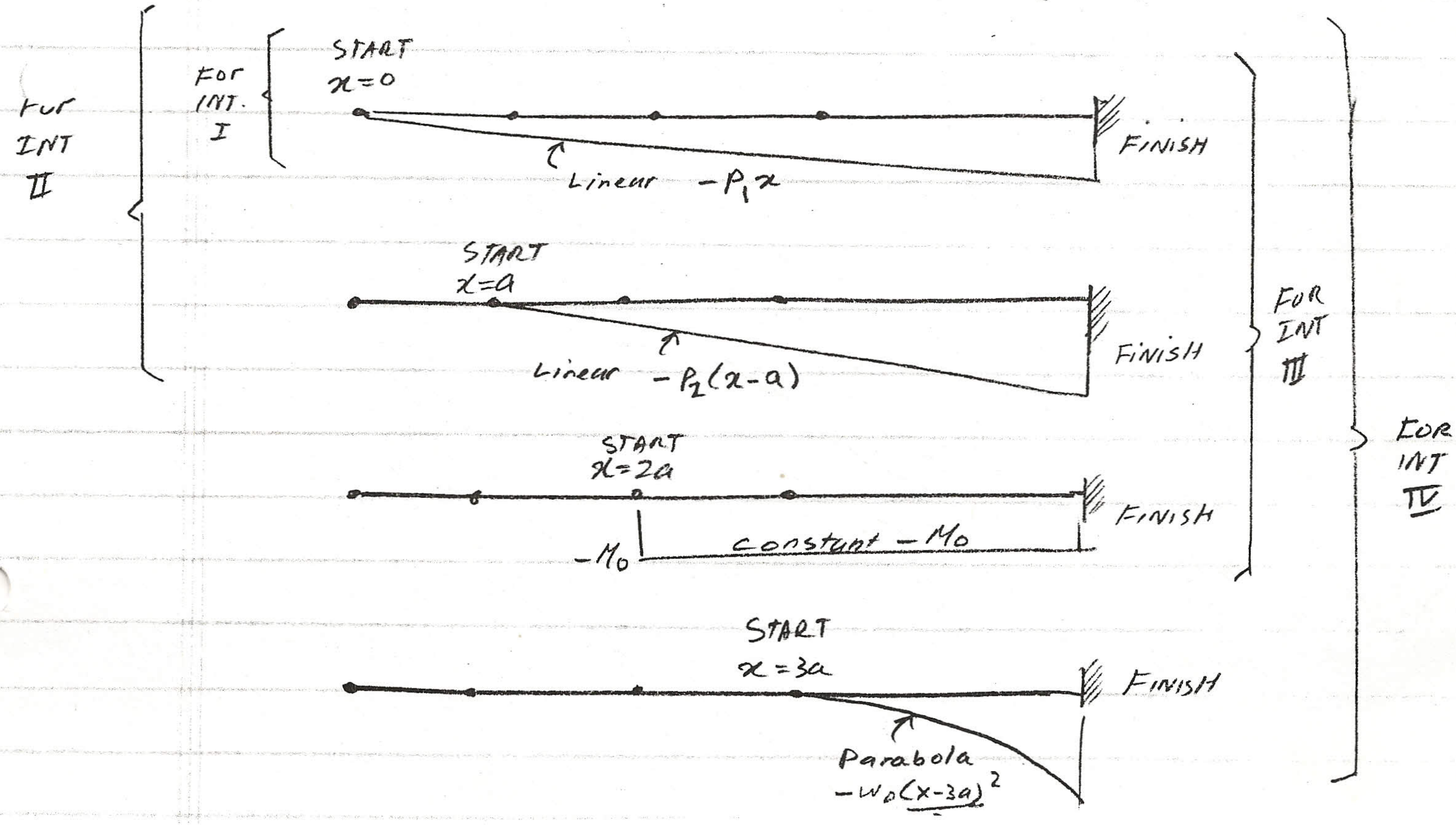
Fig. 4-6 Deformations (highly exaggerated) of a beam element caused by: (a) shear forces, and (b) bending moments





Interval	Shear Equation	Moment Equation
I	$V_x = - P_1$	$M_x = - P_1 x$
II	$V_x = - P_1 - P_2$	$M_x = - P_1 x - P_2 (x - a)$
III	$V_x = - P_1 - P_2$	$M_x = - P_1 x - P_2 (x - a) - M_o$
IV	$V_x = - P_1 - P_2 - w_o (x\text{-}3a)$	$M_x = - P_1 x - P_2 (x - a) - M_o - w_o (x\text{-}3a)^2/2$

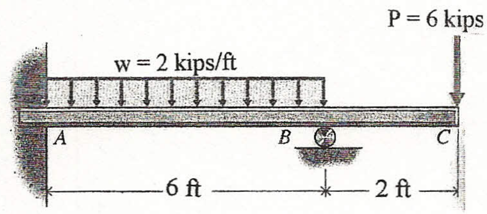




NAME:______________________________ **SID #**________________________

Question 1:

A beam is loaded and supported as shown. Use ***Singularity Method*** to find:
a-The reactions at the fixed support A and the roller support B.
b-The slope of the beam at point C.

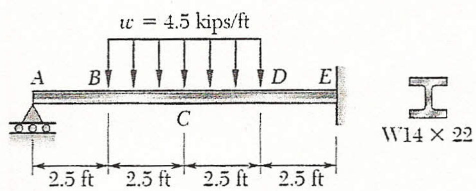


Assume: $E = 29{,}000$-ksi $I = 60\ in^4$

Answers:
$R_A = 4.5$-kips
$R_B = 13.5$-kips
$M_A = 3$-kips-ft CCW
$\theta_C = -0.00174$-rad

Question 2:

A beam is loaded and supported as shown. Use ***Singularity Method*** to find:
a-The reactions at the roller support A and at the fixed support E.
b-The deflection at point C.

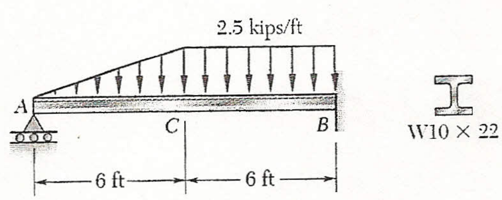


Assume: $E = 29{,}000$-ksi

Answers:
$R_A = 7.38$-kips
$R_E = 15.12$-kips
$M_E = 38.7$-kips-ft CW
$y_C = -0.0526$-in

Question 3:

A beam is loaded and supported as shown. Use ***Singularity Method*** to find:
a-The reactions at the roller support A and at the fixed support B.
b-The deflection at point C.

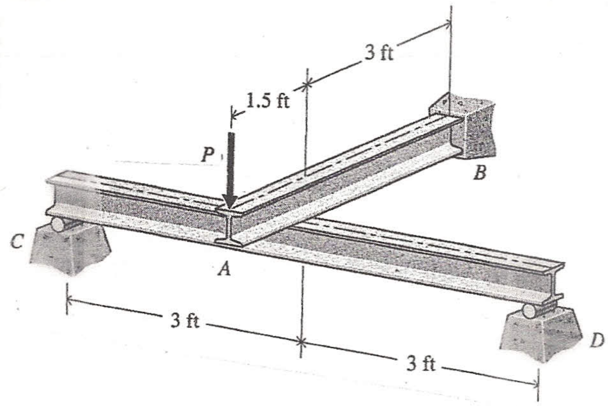


Assume: $E = 29{,}000$-ksi

Answers:
$R_A = 5.58$-kips
$R_B = 16.92$-kips
$M_B = 38.04$-kips-ft CW
$y_C = -0.107$-in

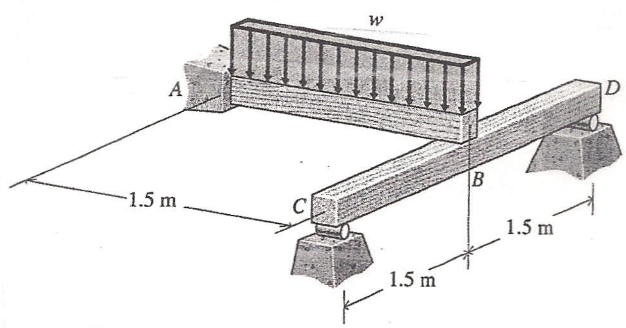
NAME:______________________________ SID #______________________

Question 1:
For the two beams and loading shown use superposition method to find:
a- the reactions at supports B, C and D.
b- the displacement at point A.
Assume P = 10-kips and EI the same for both beams.



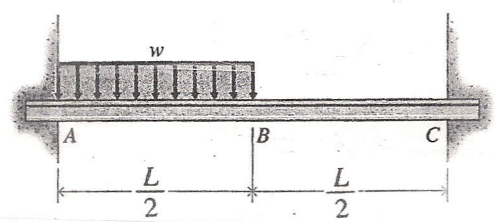
Answers:
$R_B = -1.7$-kips
$R_C = R_D = 5.85$-kips
$Y_A = -119.5/EI$

Question 2:
For the two beams and loading shown use superposition method to find:
a- the reactions at supports A, B, C and D.
b- the displacement at point B.
Assume A as fixed support and EI the same for both beams.
w = 4-kN/m



Answers:
$R_A = 4.5$-kN
$R_B = 1.5$-kN
$R_C = R_D = 0.75$-kN
$Y_B = -844/EI$

Question 3:
For the two beams and loading shown use superposition method to find:
a- the reactions at supports A and C.
b- the beam deflection at B.



w = 3 kips/ft L = 8-ft
E = 29,000-ksi $I = 50\text{-in}^4$

$R_A = 9.75$-kips
$R_C = 2.25$-kips
$M_A = 11$-kips-ft CCW
$Y_B = -0.019$-in