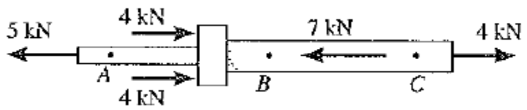
CE 221 ENGINEERING MECHANICS I (FALL 2014 – 2015)
Home Exercise V –Equilibrium
(http://www2.ce.metu.edu.tr/~ce221)

Q1.

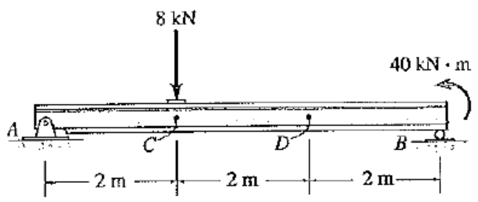
The forces act on the shaft shown. Determine the internal normal force at points *A*, *B*, and *C*.



ANS: N_A=5.0 kN, N_C=4.0 kN, N_B=3.0 kN

Q2.

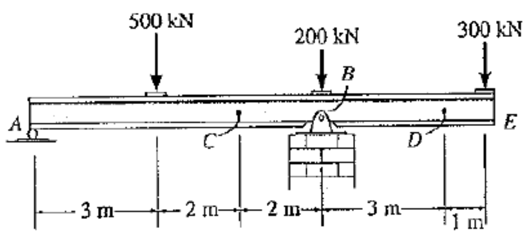
Determine the internal normal force and shear force, and the bending moment in the beam at points *C* and *D*. Assume the support at *B* is a roller. Point *C* is located just to the right of the 8-kN load.



ANS: N_C=0, V_C=-4.0 kN, M_C=8 kNm, N_D=0, V_D=-4.0 kN, M_D=48 kNm

Q3.

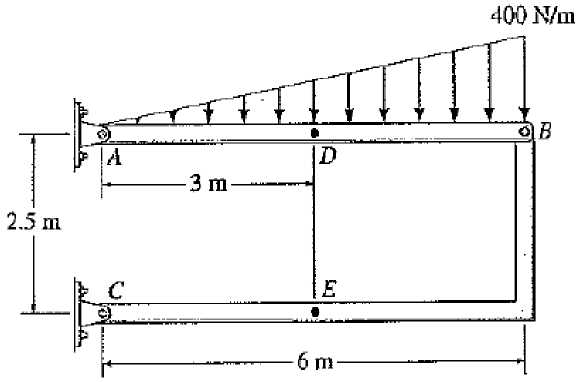
Determine the shear force and moment at points *C* and *D*.



ANS= N_C=0 kN, V_C=-386 kN, M_C=-428.6 kN.m, N_D=0 kN, V_D=300 kN, M_D=-300 kN.m

Q4.

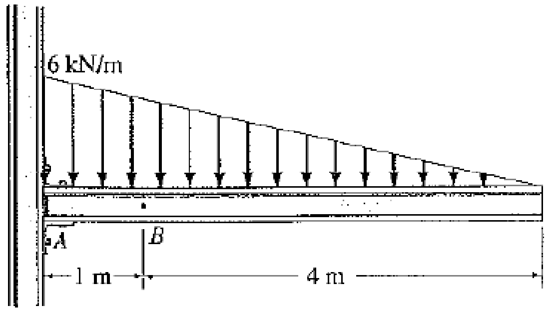
Determine the normal force, shear force, and moment at a section passing through point *D* of the two-member frame.



ANS: N_D= 1.92 kN, V_D= 100 N, M_D= 900 Nm

Q5.

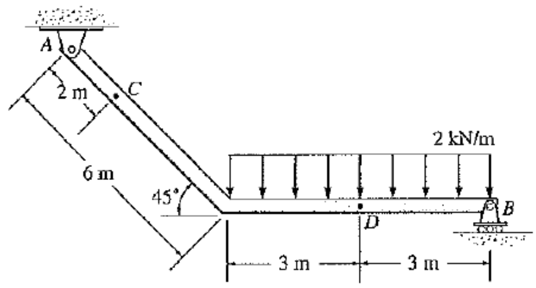
Determine the internal normal force, shear force, and bending moment in the beam at point *B*.



ANS: N_B=0 kN, V_B=9.6 kN, M_B=-12.8 kN.m

Q6.

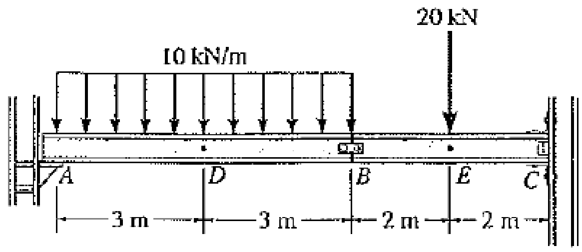
Determine the internal normal force, shear force, and the moment at points *C* and *D*.



ANS: N_C=2.49 kN, V_C=2.49 kN, M_C=4.97 kN.m
N_D= 0 kN, V_D=-2.49 kN, M_D=16.5 kN.m

Q7.

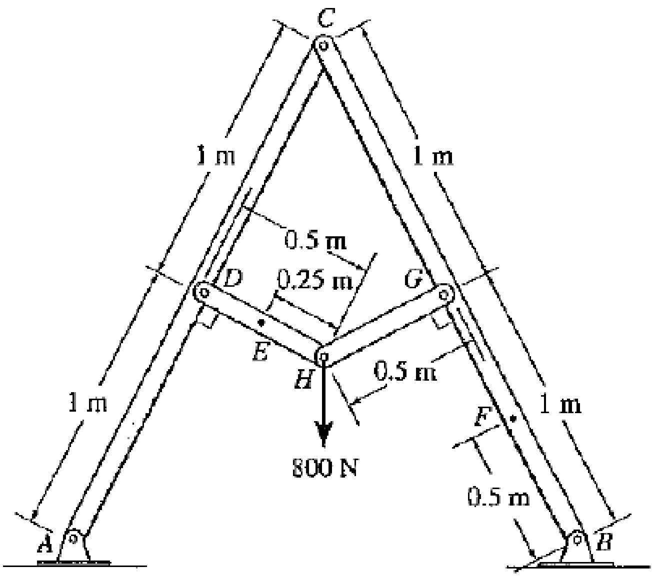
Determine the internal normal force, shear force, and bending moment in the beam at points *D* and *E*. Point *E* is just to the right of the 20-kN load. Assume *A* is a roller support, the splice at *B* is a pin, and *C* is a fixed support.



ANS: N_D= 0 kN, V_D=0 kN, M_D=45 kN.m
N_E= 0 kN, V_E=-50 kN, M_E=-60 kN.m

Q8.

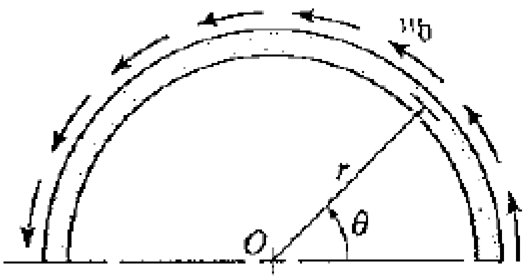
Determine the internal normal force, shear force, and bending moment at points E and F of the frame.



ANS: N_E= 894 kN, V_E=0 kN, M_E=0 kN.m,
N_F= 224 kN, V_F=447 kN, M_F=224 kN.m

Q9.

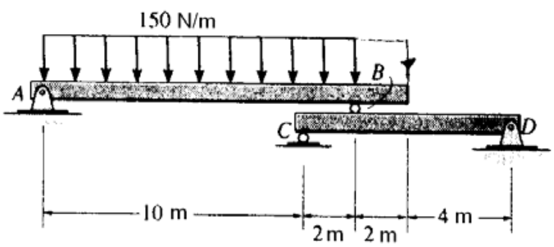
The semicircular arch is subjected to a uniform distributed load along its axis of w_0 per unit length. Determine the internal normal force, shear force, and moment in the arch at $\theta = 120°$.



ANS: N= -0.866 rw_o, V= -1.5 rw_o, M= 1.23 r^2w_o

Q10.

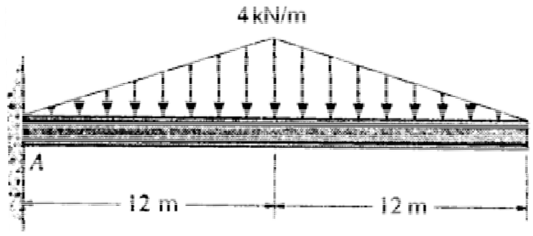
Draw the shear and bending-moment diagrams for each of the two segments of the compound beam.



ANS: Member AB: V={875 -150x} N, M={875x -75x²} N.m,
V={2100 -150x} N, M={-75x² +2100x-1400} N.m,
Member CBD: V=919 N, M={919x} N.m,

Q11.

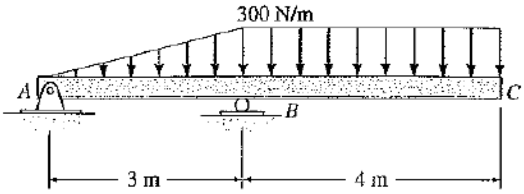
Draw the shear and moment diagrams for the beam.



ANS: V={4.8-x²/6} kN, M={4.8x-x³/18-5.76} kN.m
V={1/6(2.4-x²)} kN, M={1/18(2.4x-x)³} kN.m

Q12.

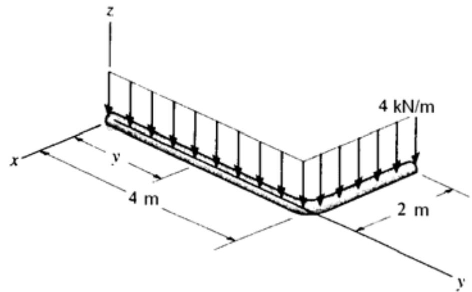
Draw the shear and bending-moment diagrams for the beam.



ANS: -

Q13.

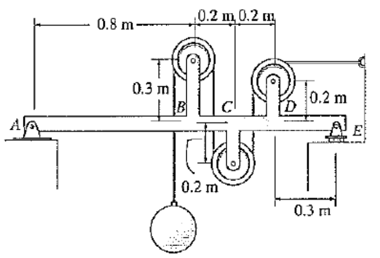
Express the internal shear and moment components acting in the rod as a function of y, where $0 \le y \le 4$ m.



ANS: V_x=0 kN, V_z={24-4y} kN,
M_x={2y²-24y+64} kN.m, M_y=8 kN.m, M_z=0 kN.m

Q14.

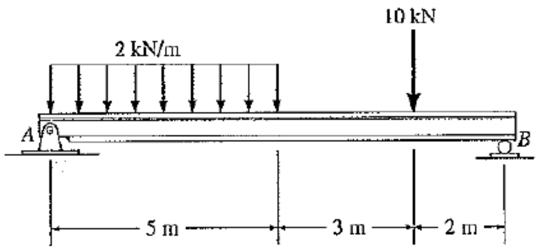
Draw the shear and moment diagrams for the beam $ABCDE$. All pulleys have a radius of 0.1 m. Neglect the weight of the beam and pulley arrangement. The load weighs 500 N.



ANS: E_y=333.33 N, A_y=166.67 N

Q15.

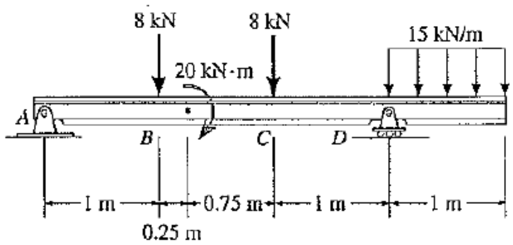
Draw the shear and moment diagrams for the beam.



ANS: B_y=10.5 kN, A_y=9.50 kN,

Q16.

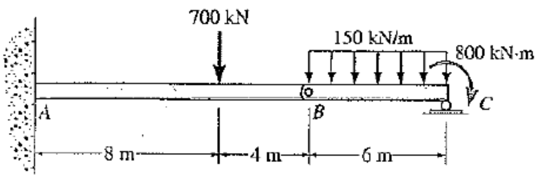
Draw the shear and moment diagrams for th beam.



ANS: D_y=32.167 kN, A_y=1.167 kN

Q17.

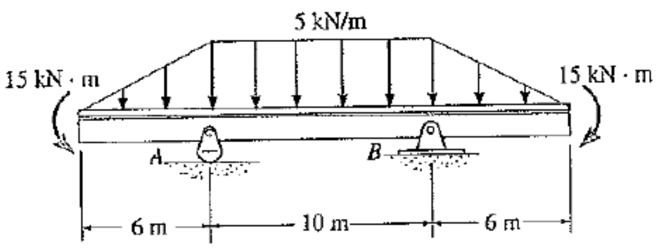
The beam consists of two segments pin connected at *B*. Draw the shear and moment diagrams for the beam.



ANS: -

Q18.

Draw the shear and moment diagrams for the beam.



ANS: B_y=40 kN, A_y=40 kN, M=-45 kN.m