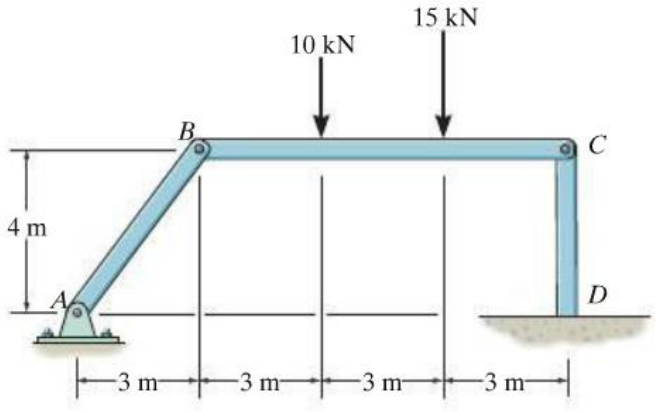
Name: _____ CWID #:_____ Section Number:_____

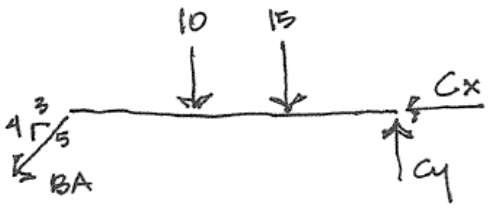
ENSC 2113 – FALL 18 – EXAM #3

EACH PROBLEM IS WORTH 25 POINTS. BOX YOUR ANSWERS AND PROVIDE PROPER UNITS, WHERE APPLICABLE. CALCULATIONS AND FREE BODY DIAGRAMS MUST BE SHOWN THAT SUPPORT THE ANSWER TO RECEIVE CREDIT.

1) The frame below consists of three members, AB, BC, and CD. Determine the external support reactions at the pin at A and the fixed support at D. Indicate direction in your answer with directional arrows and draw any pertinent free-body diagrams.



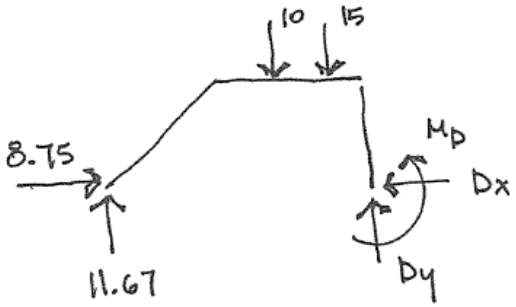
FBD BC:



$+\circlearrowleft \Sigma M_C = 0 = 15(3) + 10(6) + \frac{4}{5}BA(9)$

$BA = -14.58$ kN

OVERALL FBD:



$+\uparrow \Sigma F_y = 0 = 11.67 - 10 - 15 + D_y$

$\boxed{D_y = 13.33 \text{ kN} \uparrow}$

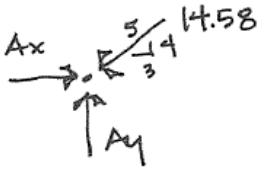
$+\rightarrow \Sigma F_x = 0 = 8.75 - D_x$

$\boxed{D_x = 8.75 \text{ kN} \leftarrow}$

$+\circlearrowleft \Sigma M_D = 0 = -11.67(12) + 10(6) + 15(3) + M_D$

$\boxed{M_D = 35.04 \text{ kN-m} \circlearrowleft}$

FBD @ A:



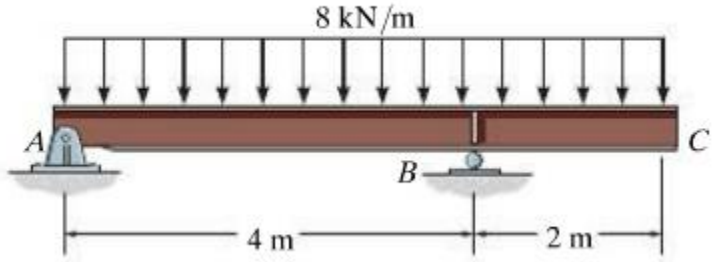
$A_x = \frac{3}{5}(14.58)$

$\boxed{A_x = 8.75 \text{ kN} \rightarrow}$

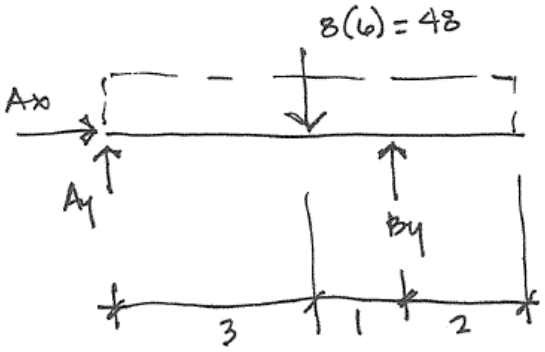
$A_y = \frac{4}{5}(14.58)$

$\boxed{A_y = 11.67 \text{ kN} \uparrow}$

2) Determine the shear and bending moment equations for the beam below for the load region 0<x<4 utilizing equilibrium equations. Draw any pertinent free-body diagrams.



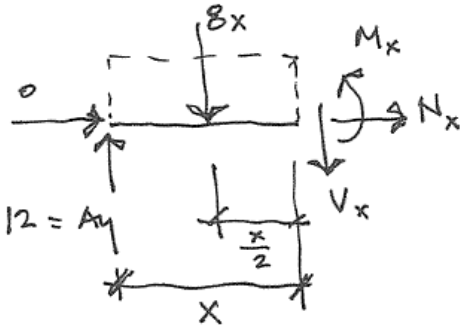
OVERALL FBD:



$+\circlearrowleft \Sigma M_B = 0 = 48(1) - A_y(4)$

$A_y = 12\ kN \uparrow$

LEFT CUT:



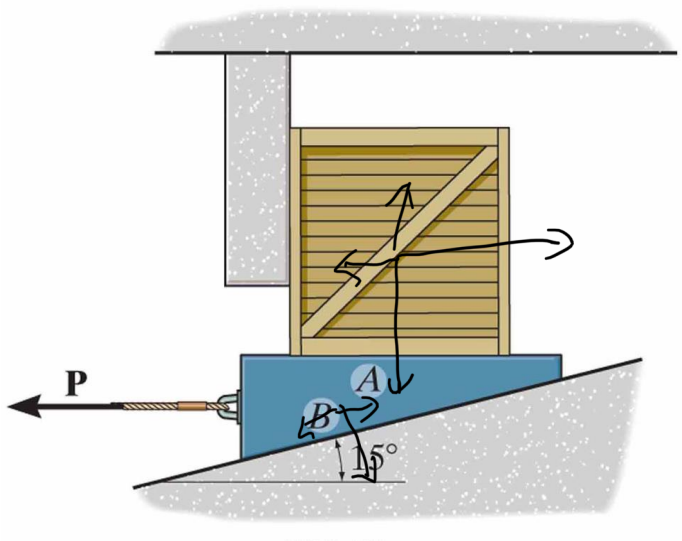
$+\uparrow \Sigma F_y = 0 = 12 - 8(x) - V$

$\boxed{V = 12 - 8x\ kN}$

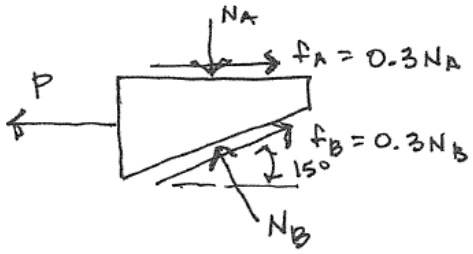
$+\circlearrowleft \Sigma M_x = 0 = 8(x)\left(\frac{x}{2}\right) - 12x + M_x$

$\boxed{M_x = -4x^2 + 12x\ kN\text{-}m}$

3) Determine the force required to move the wedge to the left. The crate has a weight of 300 lb and the static coefficient of friction at ~~all surfaces is 0.3~~. Neglect the size and weight of the wedge. Draw all pertinent free-body diagrams.



FBD WEDGE:



$+\uparrow \Sigma F_y = 0 = -275.23 + N_B \cos 15 + 0.3N_B \sin 15$

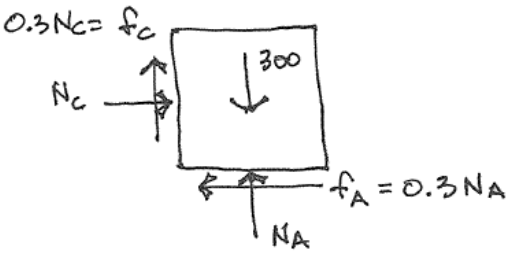
$275.23 = 1.044 N_B$

$N_B = 263.74$

$+\rightarrow \Sigma F_x = 0 = -P + 0.3(275.23) + 0.3(263.74)\cos 15 - 263.74 \sin 15$

$\boxed{P = 90.73 \text{ LB}}$

FBD CRATE



$+\rightarrow \Sigma F_x = 0 = N_C - 0.3N_A$

$N_C = 0.3N_A$

$+\uparrow \Sigma F_y = 0 = 0.3(0.3N_A) + N_A - 300$

$1.09 N_A = 300$

$N_A = 275.23$

4) Draw the shear and bending moment diagrams for the loading condition below. Label all diagrams appropriately.