Exam.3
Fall 2015
(December 8th, 2015)
CIE200 – STATICS
CLOSED BOOK, 1 HR 15 Minutes

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NOTES

- 4PROBLEMS– 12 PAGES.
- ALL YOUR ANSWERS SHOULD BE PROVIDED ON THE QUESTION SHEETS.
- **TWO EXTRA SHEETS ARE PROVIDED AT THE END.**
- **ASK FOR ADDITIONAL SHEETS IF YOU NEED MORE SPACE.**
- SOME ANSWERS MAY REQUIRE MUCH LESS THAN THE SPACE PROVIDED.
- ***DO NOT*** USE THE BACK OF THE SHEETS FOR ANSWERS.
- QUESTION SHEETS SHOULD BE RETURNED.

YOUR COMMENT(S)

DO NOT WRITE IN THE SPACE BELOW

MY COMMENT(S)

YOUR GRADE

Problem I:	___/25
Problem II:	___/25
Problem III:	___/25
Problem IV:	___/25
TOTAL:	/100

Problem I: *(25 points)*

For the truss in Figure I, determine the **INTERNAL** forces in the following members and state whether they are in tension or compression:

i. ***CD, DG &GF*** using method of sections.
ii. ***BG*** and ***BH*** using method of joints.

15 10

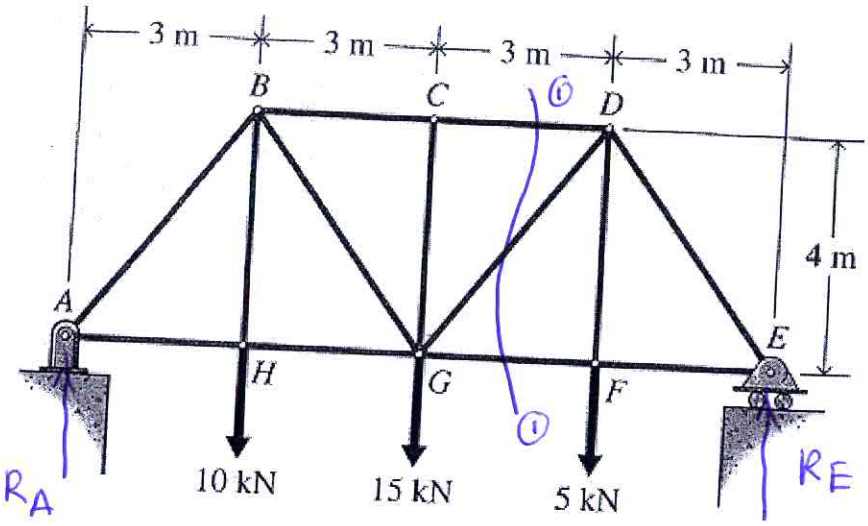


Figure I

5/4/3

Calculations and/or Diagrams:

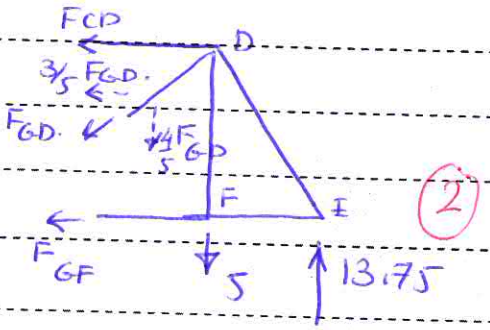
Reactions

$\circlearrowleft + \Sigma M_{@E} = 0 \quad -R_A(12) + 5(3) + 15(6) + 10(9) = 0$

$R_A = 16.25\ kN$

(5) $\uparrow + \Sigma F_y = 0 \quad R_E = 30 - 16.25 = 13.75\ kN$

Section ② - ①



(2)

$+\uparrow \Sigma F_y = 0$

$-\frac{4}{5}F_{GD} - 5 + 13.75 = 0$

$F_{GD} = +10.93\ kN\ (T)$ (2)

$\circlearrowleft + \Sigma M_{@D} = 0$

$-F_{GF}(4) + 13.75(3) = 0$

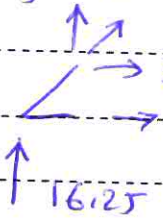
$F_{GF} = 10.31\ kN\ (T)$ (3)

$\rightarrow + \Sigma F_x = 0 \quad -\frac{3}{5}F_{GD} - F_{CD} - F_{GF} = 0 \quad F_{CD} = -16.86\ (C)$ (3)

Calculations and/or Diagrams (cont'd):

Part (2) joint method

Joint "A"



(2)

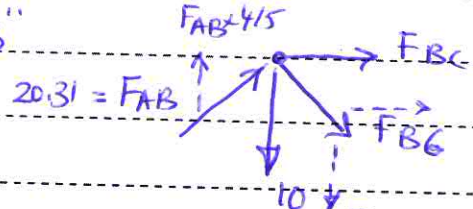
$+\uparrow \Sigma F_y = 0$

$4/5\ F_{AB} + 16.25 = 0$

$F_{AB} = -20.31$ (C) (2)

Joint "H" $\uparrow \Sigma F_y = 0$ $F_{BH} = 10_{KN}$ (T) ✓

Joint "B"



(3)

$+\uparrow \Sigma F_y = 0$

$F_{AB} \cdot \frac{4}{5} - 10 - \frac{4}{5} F_{BG} = 0$ (3)

$F_{BG} = 7.8_{KN}$ (T)

Problem II: *(25 points)*

The Frame in the Figure II supports a weight ***W =40lb***. Determine the horizontal and vertical component of reactions at Pin ***A***, the force in member ***BE*** and the reaction at the roller ***D***.

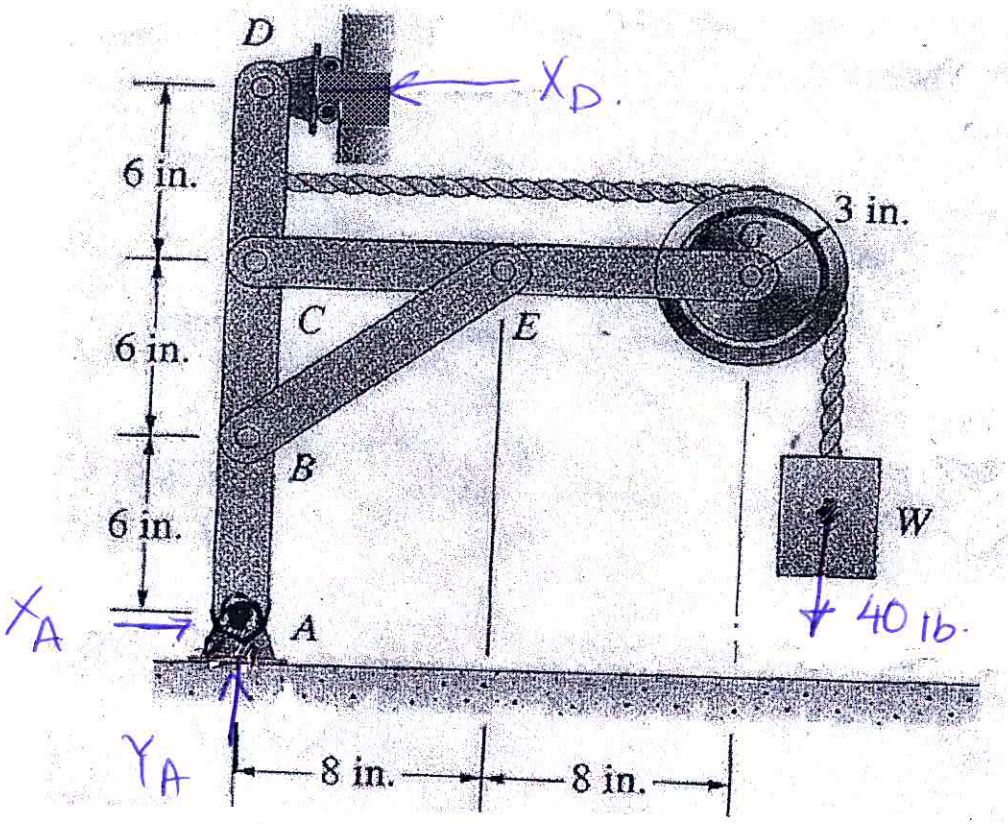


Figure II

Calculations and/or Diagrams:

Whole System $(+\circlearrowright \Sigma M_{@A}=0$ $\quad -40(8+8+3)+X_D(18)=0$

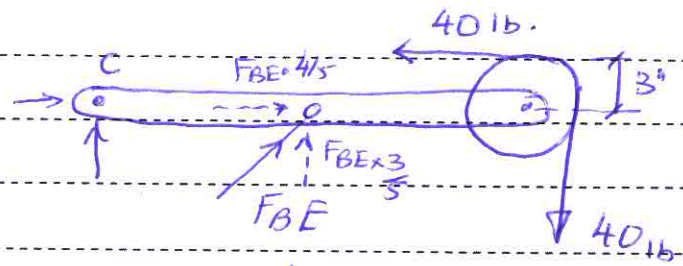
$X_D = 42.22$ lb.

$+\rightarrow \Sigma F_x=0$ $\quad -X_D+X_A=0$ $\quad X_A=42.22$ lb.

$+\uparrow \Sigma F_y=0$ $\quad Y_A-40=0$ $\quad Y_A=40$ lb.

For "BE" → Split C E G

Calculations and/or Diagrams (cont'd):



(+) $\Sigma M_{@C} = 0$

$\frac{3}{5} F_{BE}(8) - 40(19) + 40(3) = 0$ $\quad 8+8+3 = 19"$

$F_{BE} = 133.33$ lb

Problem III: *(25 points)*

Beam ***AB*** is supported by a pin at ***A*** and a cable at ***B*** and carries a triangular distributed load over its left half. Neglecting the weight of the beam, determine:

i. The normal force, shear force, and bending moment acting on the cross section at section (1).(*15 points*)

ii. Write the equations for shear force and bending moment and determine the shear and bending moment values at points ***A*** and ***C*** for part ***AC*** of the beam. (*10 points*)

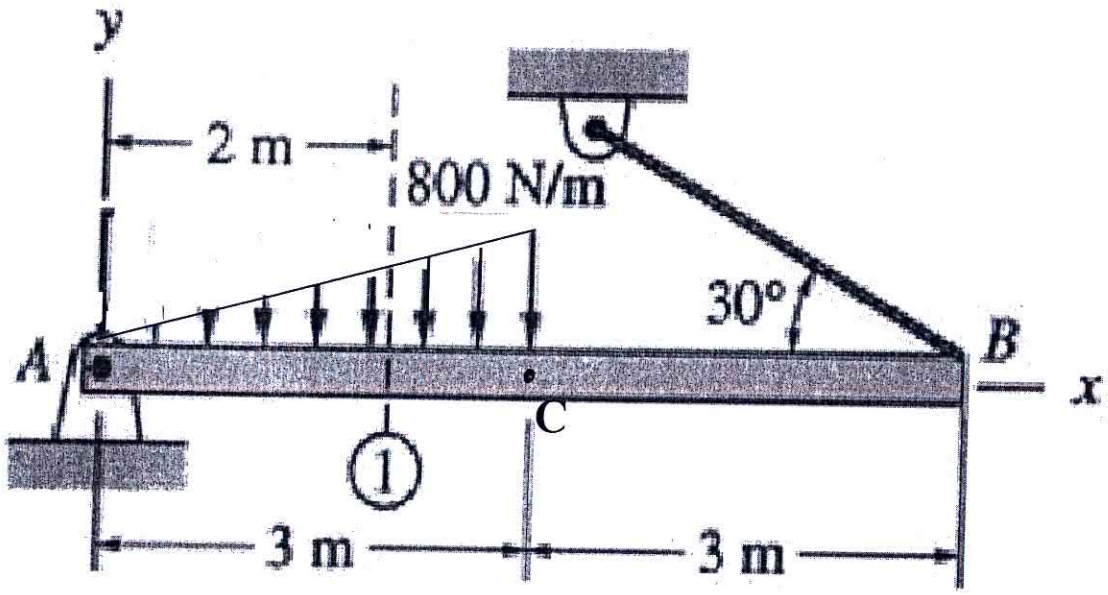
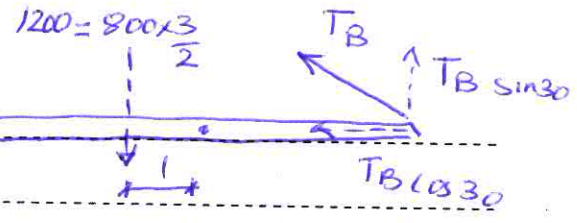


Figure III

Calculations and/or Diagrams:



Reactions

$(+\circlearrowleft) \sum M_A = 0$

$-Y_A(6) + 1200(3+1) = 0$

$Y_A = 800\ N.$

$+\uparrow \sum F_y = 0 \quad Y_A - 1200 + T_B \sin 30 = 0$

$T_B = 800\ N.$

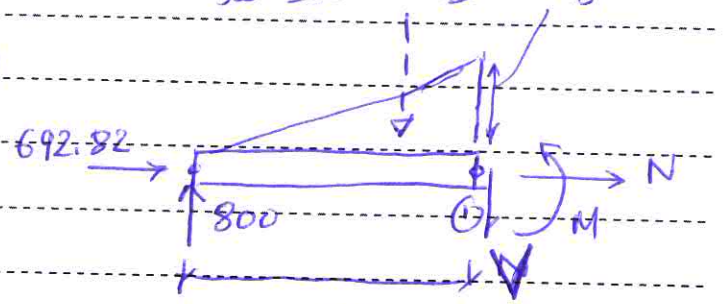
$\rightarrow \sum F_x = 0 \quad X_A - T_B \cos 30 = 0$

$X_A = 692.82\ N$

Calculations and/or Diagrams (cont'd):

$533^3 = 533.33 \times 2/2$ $\quad 2/3 \times 800 = 533.33$

Section ① - ①



$\rightarrow \Sigma F_x = 0$

$692.82 + N = 0$

$N = -692.82$ (Comp)

$+\uparrow \Sigma F_y = 0 \quad 800 - 533.33 - V = 0$

$V = 266.66$ N.

$(+) \Sigma M_{@(1)} = 0$

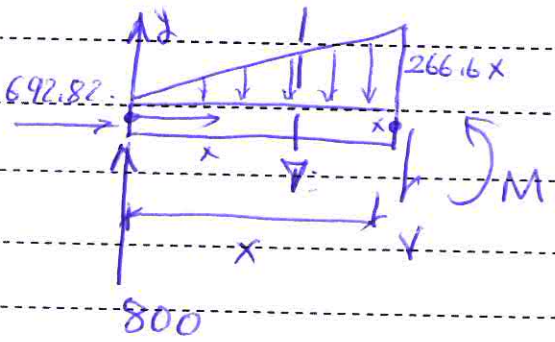
$-800(2) + 533.33\left(\frac{2}{3}\right) + M = 0$

$M = 1244$ Nm ↻

$\frac{x}{3} = \frac{P}{8}$

$P = 266$

Part (ii)



AC

$0 < x < 3$

$+\uparrow \Sigma F_y = 0$

$800 - 266.6x \cdot \frac{x}{2} - V = 0$

$V = 800 - 133.3x^2$ $\quad x=0 \quad V = 800$ N

$x = 3 \quad V = -400$ N

$(+) \Sigma M_{@(x)} = 0$

$-800(x) + 133.33x^2\left(\frac{x}{3}\right) + M = 0$

$M = -44.44x^3 + 800x$ $\quad x=0 \quad M=0$

$x=3 \quad M = 12($ N

Problem IV: *(25 points)*

For the beam shown in Figure IV:

1- Compute the reactions at supports ***B*** and ***E***. *(4points)*
2- Using the method of **SECTIONS**, compute the shear force and bending moments at points ***B,C& D***. Draw the necessary Free body diagrams.*(6 points)*
3- ~~For point ***B*** as origin~~, draw the Shear force and Bending moment diagrams for the whole beam using the method of **Integration(Area method)**, confirm your results obtained in part 2. (Use the space provided below for the diagrams and draw to scale as much as you can). Show the important and necessary features and values on the diagrams and indicate the maximum positive and negative shears and moments in the beam. *(15points)*

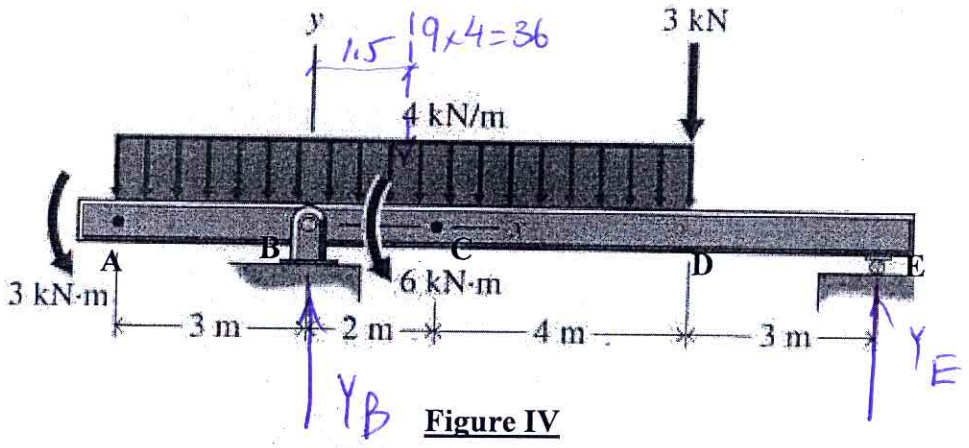


Figure IV

Calculations and/or Diagrams:

(1) Reactions: $(+\circlearrowleft \Sigma M_{@E} = 0$ ✓

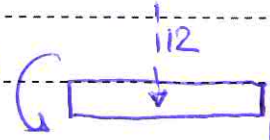
$-Y_B(9) + 3 + 6 + 3(3) + 36(9-1.5) = 0$

$Y_B = 32\ kN$

$+\uparrow \Sigma F_y = 0 \quad Y_E + Y_B = 3 + 36$

$Y_E = 7\ kN$

(2) Section at "B"



$+\uparrow \Sigma F_y = 0$

$-12 + V_B = 0$

$V_B^- = -12\ kN \rightarrow V_B^+ = 32 - 12 = 20\ kN$.

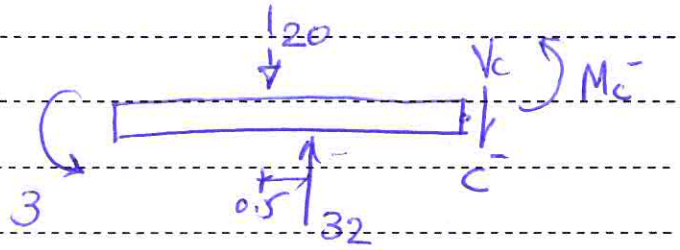
Calculations and/or Diagrams (cont'd):

$\circlearrowleft^{+} \Sigma M_B = 0$

$3 + 12(1.5) + M = 0$

$M_B = -21\ kN\cdot m$

point 'c' Section at 'c"



$\Sigma F_y = 0$

$-20 - V_c^- + 32 = 0$

$V_c^- = +12_{KN} = V_c^+$

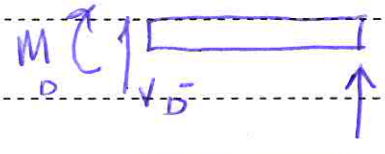
$\circlearrowleft^{+} \Sigma M_{c^-} = 0$

$3 + 20(2.5) - 32(2) + M_c^- = 0$

$M_c^- = +11_{KN\cdot m}$

$M_c^+ = 11 - 6 = 5_{KN\cdot m}$

At "D" Start from Right



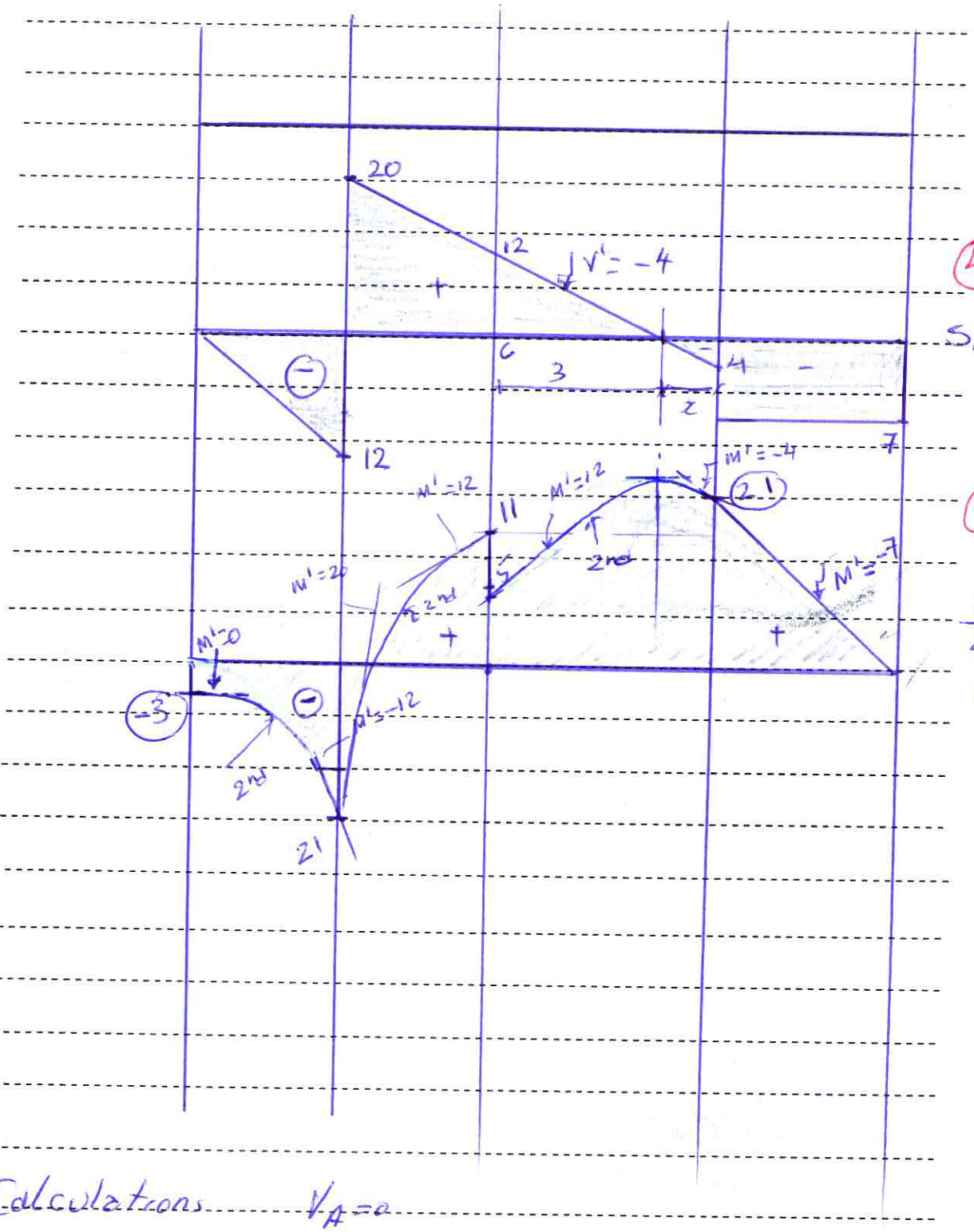
$+\uparrow \Sigma F_y = 0$

$V_D^- + 7 = 0 \qquad V_D^- = -7_{KN}$

$V_D^+ = -4_{KN}$

$\circlearrowleft^{+} \Sigma M_D = 0 \qquad -M_D + 7(3) = 0 \rightarrow M_D = 21_{KN\cdot m}$

Calculations and/or Diagrams (cont'd):



$\frac{x}{4} = \frac{4}{16}$

$x = 1\ m$

Calculations $V_A = 0$

$V_B^- - V_A = -4(3)$

$V_B^- = -12$ ✓ confirmed

$V_B^+ = +20_{KN}$ (3)

$V_C - V_B^+ = -4(2) \rightarrow V_C = 12_{KN}$

EXTRA SHEET 1: Continued from page

Name: _____ **ID#:** _____

Calculations and/or Diagrams:

$V_D - V_C = -4(2)$

$V_D^- = -4_{KN}$

$V_D^+ = -7_{KN}$

$V_E^- - V_D^+ = 0$ $V_E^- = -7_{KN}$

$M_A = ?$ $-3_{KN.m}$ (counter clock wise)

$M_B - M_A = -\frac{12(3)}{2}$

$M_B = -3-18 = -21_{KN.m}$ ✓ confirmed.

$M_C^- - M_B = (12\times 2 + \frac{8\times 2}{2})$ (4)

$M_C^- = 24+8-21 = 11_{KN.m}$

$M_C^+ = 11-6 = 5_{KN.m}$

$M_D - M_C^+ = \frac{12(3)}{2} - \frac{4(1)}{2}$ (2) $\rightarrow M_{max} = 16+7 = 23_{KN}$

$M_D - 5 = 16$

$M_D = +21\ KN.m$ ✓ confirm

$M_E - M_D = -7\times 3$ $M_E = 0$

EXTRA SHEET 2: Continued from page _____

Name: _____ **ID#:** _____

Calculations and/or Diagrams: