QUIZ 1
Spring 2004-2005
(Tuesday April 12, 2005)
CIVE311 – STRUCTURES I
CLOSED BOOK, 1 & 1/2 HOURS

Name: Key Key **ID#:** 0000-00000

NOTES

- 3 PROBLEMS – 13 PAGES.
- ALL YOUR ANSWERS SHOULD BE PROVIDED ON THE QUESTION SHEETS.
- **ONE EXTRA SHEET IS 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.
- DRAFT BOOKLET WILL BE PROVIDED; BUT DO NOT USE FOR ANSWERS.
- BOTH QUESTION SHEETS AND DRAFT BOOKLET SHOULD BE RETURNED.
- CHECK BOXES ARE TO CONFIRM THAT YOU HAVE SOLVED A QUESTION. ☑

YOUR COMMENT(S)

DO NOT WRITE IN THE SPACE BELOW

MY COMMENT(S)

YOUR GRADE

Problem I: 30 /30
Problem II: 20 /20
Problem III: 50 /50
Other: ___

TOTAL: 100 /100

Problem I: *(30 points)*

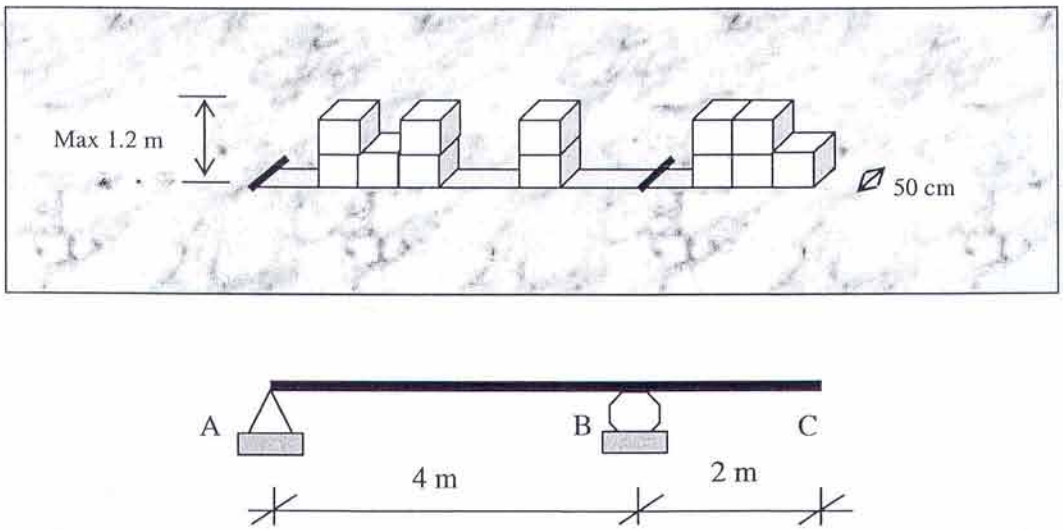


Figure I

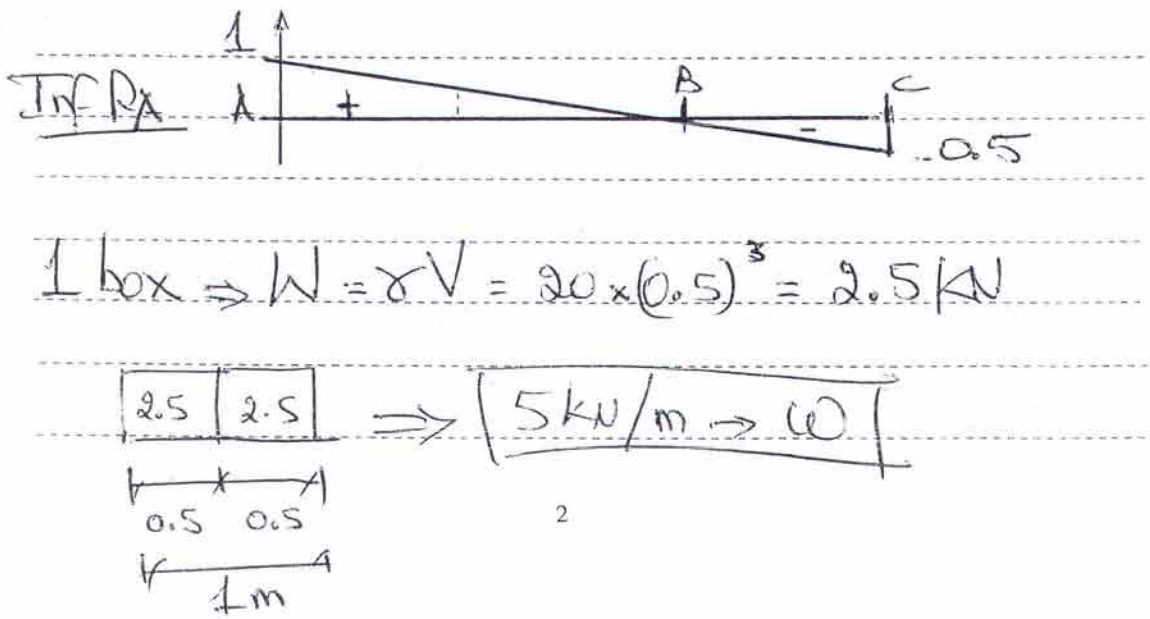
The shelf in Figure I is supported as shown. The shelf is to carry a maximum of 12 cubic boxes (shown arbitrarily distributed in the figure) at any one time, each sized 50x50x50 cm and having a density of 20 kN/m^3. Ignore the own weights of the shelf and its supports.

Compute the maximum absolute vertical reaction R_A and sketch the corresponding distribution of boxes on the shelf for each of the following conditions:

1. One level of boxes is allowed, and boxes are fully spread between A and C.
2. One level of boxes is allowed.
3. More than one level of boxes is allowed.

Compare results from conditions 1 to 3 and ***briefly*** comment.

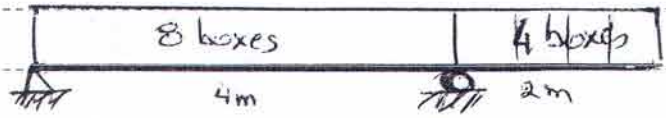
Calculations and/or Diagrams:



Calculations and/or Diagrams (cont'd):

5 kN/m

1.

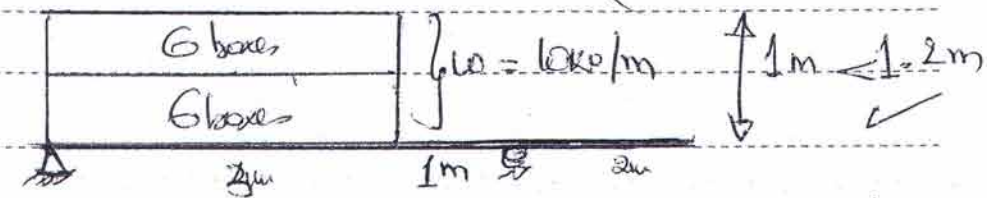


$R_A = \left(\frac{1 \times 4}{2} + \frac{0.5 \times 2}{2}\right) \times 5 = 7.5\,kN \ (\uparrow)$

2.

$R_A = \left(\frac{1 \times 4}{2}\right) \times 5 = 10\,kN \ (\uparrow)$ (Nde $\rightarrow -2.5\,kN$)

3.



$R_A = \left(\frac{1 \times 4}{2} + \frac{0.25 \times 1}{2}\right) \times 10 = 18.75\,kN \uparrow$

$R_{A3} > R_{A2} > R_{A1}$ → Smallest contribution

↓ maximum three boxes concentrated at largest R_A

Problem II: *(20 points)*

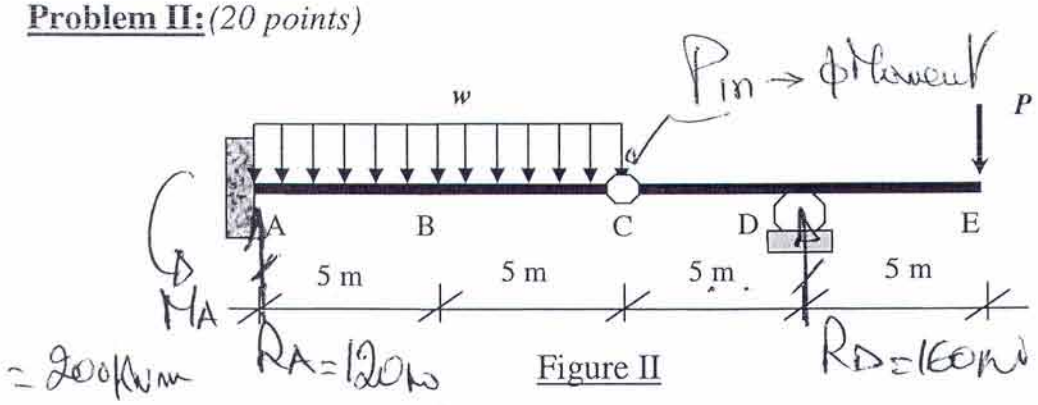
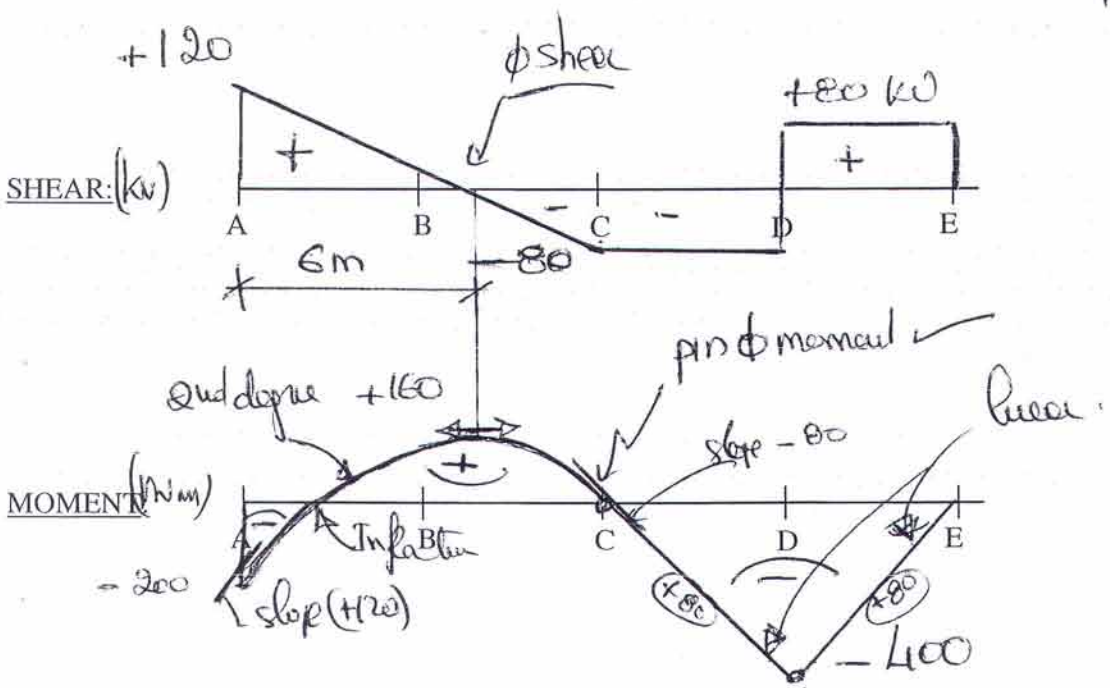
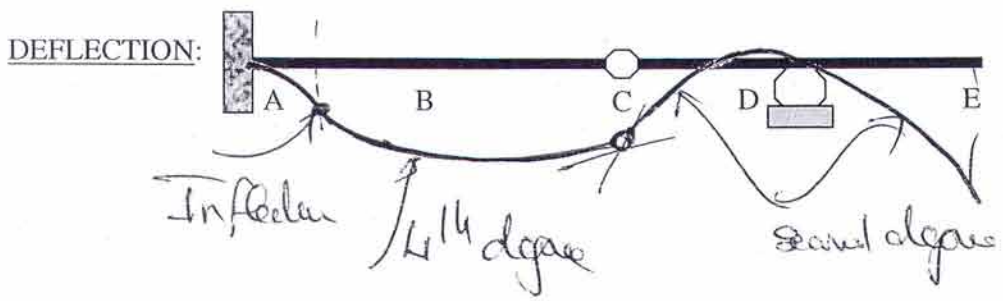


Figure II

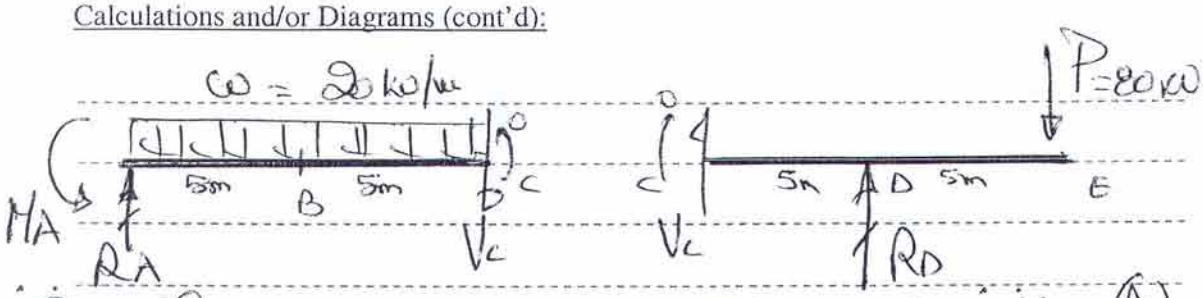
For the beam shown in Figure II, the own weight is neglected.
Your diagrams/sketches should include any feature/value you think is relevant or important.

Let w=**20 kN/m** and **P=80 kN**
Compute the ***reactions*** in the beam, and draw the ***shear*** and bending ***moment*** diagrams; sketch the ***deflected shape***. *(20 points)*





Calculations and/or Diagrams (cont'd):



Cwell

$\Sigma M_C = 0 \Rightarrow R_D = 160\,kN(\uparrow)$

$\Sigma F_y = 0 \Rightarrow R_A = 20\times10 + 80 - 160 = 120\,kN(\uparrow)$

$\Sigma M_{A=0} \Rightarrow M_A = \frac{20\times10^2}{2} + 80\times20 - 160\times15 = 200\,kNm(\circlearrowleft)$

Problem III: *(50 points)*

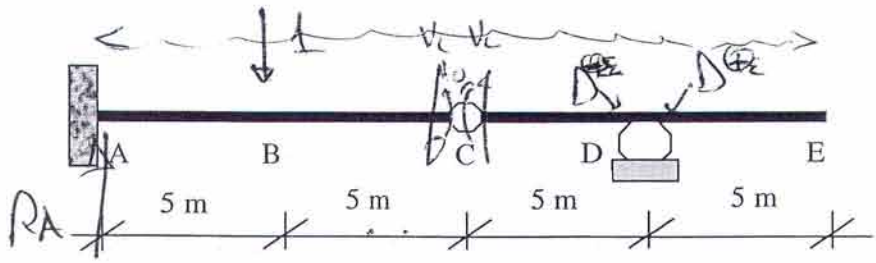
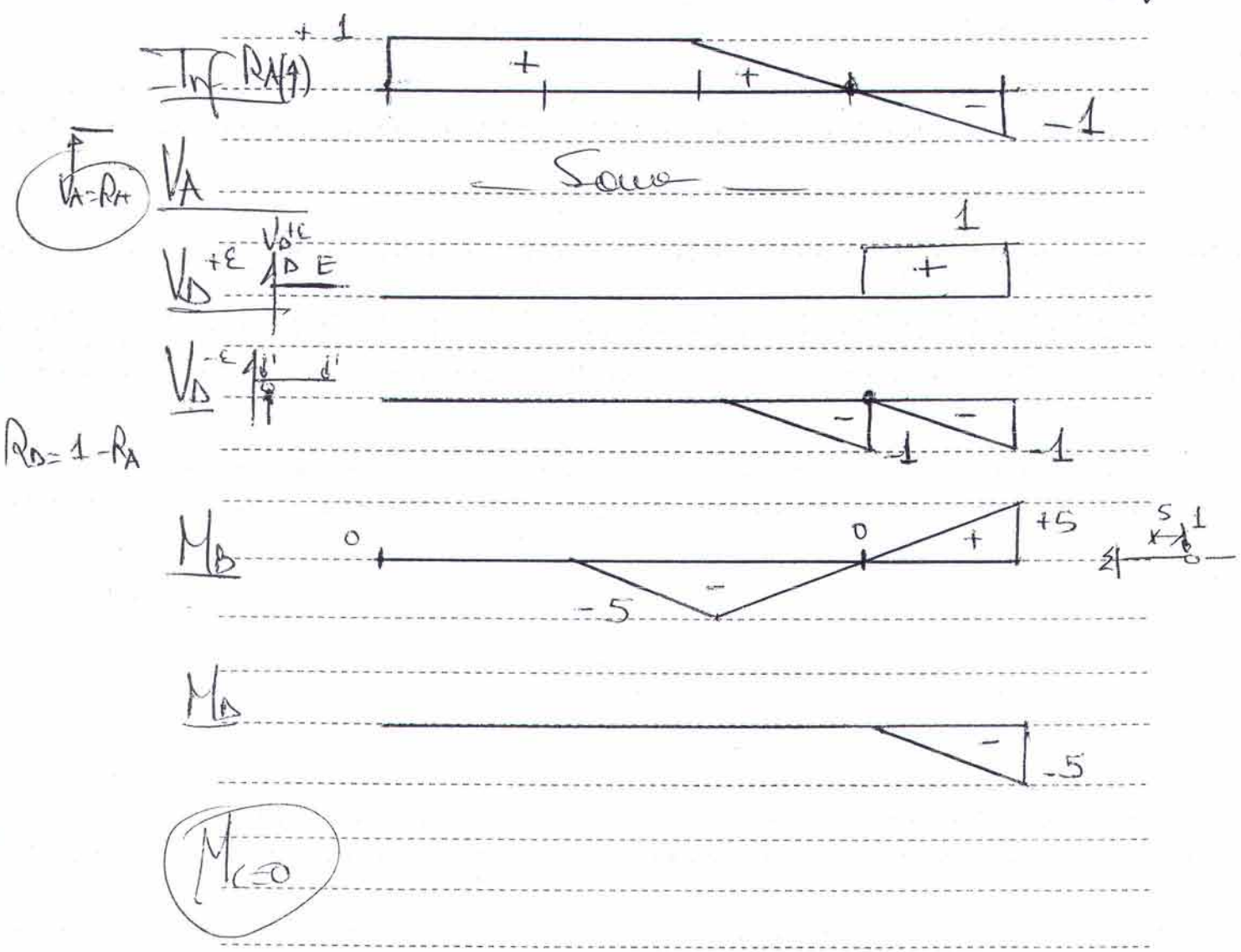


Figure III

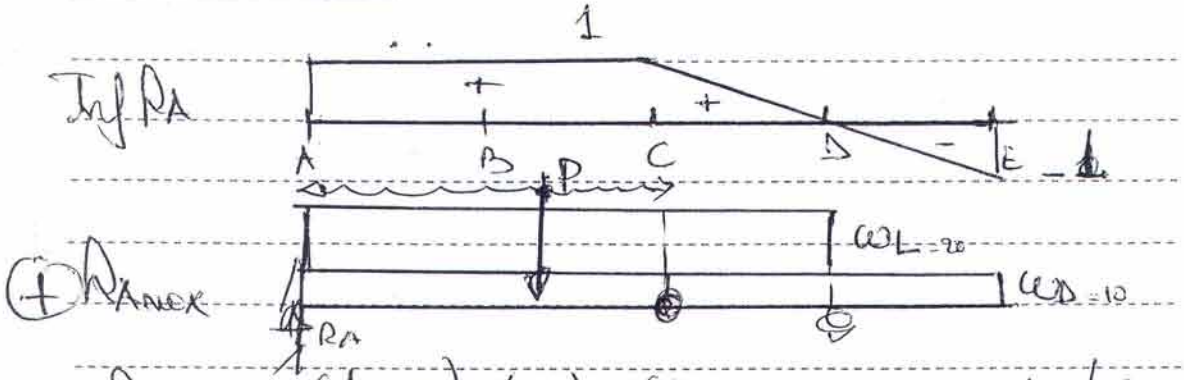
1. Referring to Figure III, draw the influence lines for R_A, V_A, V_D, M_B, M_C, and M_D. Draw in the order which you find appropriate. *(25 points)*

Calculations and Diagrams:



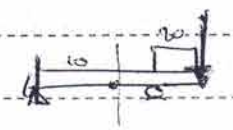
2. Let w_D=**10 kN/m** (dead load); w_L=**20 kN/m** and P=**80 kN** (live loads)
   - Compute the maximum absolute value for R_A, and show the corresponding loading position. *(9 points)*
   - Compute R_A for w_L on AC only and P on E and compare with Problem II (do not include w_D). *(6 points)*

Calculations and Diagrams:

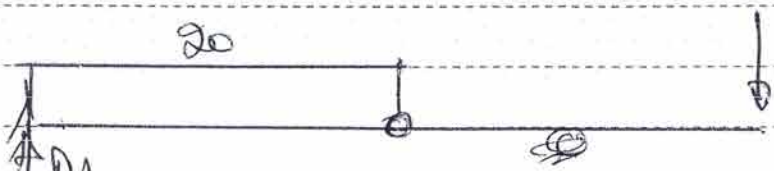


$(+)R_{A\,max} = (1\times 10)\times(30) + \left(\frac{1\times 5}{2}\right)\times 20 + 80\times 1 = 430\ kN$

$|(+)R_{A\,max}| > |(-)R_{A\,max} \;\; (+)R_{A\,min}|$ ⇒



(check ↳ $(1\times 10)\times 10 - \left(\frac{1\times 5}{2}\right)\times 20 - 80 = -30$)



$R_A = (1\times 10)\times 20 - 80 = 120\ kN\ (\uparrow)$

Same as Problem II

3. Compute the maximum absolute value of M_B for the truck load shown, assuming that the truck can travel in either directions, and show the corresponding position(s) of the truck. *(10 points)*

Calculations and Diagrams: