QUIZ 1
Spring 2003-2004
(Wednesday, March 25, 2004)
CIVE311 – STRUCTURES I
CLOSED BOOK, 2 HOURS

Name: Key **ID#:** 007

NOTES

- 2 PROBLEMS – 12 PAGES.
- ALL YOUR ANSWERS SHOULD BE PROVIDED ON THE QUESTION SHEETS.
- ONE 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.
- DRAFT BOOKLET WILL BE PROVIDED; BUT DO NOT USE FOR ANSWERS.
- BOTH QUESTION SHEETS AND DRAFT BOOKLET SHOULD BE RETURNED.
- CHECK BOXES ARE FOR YOU TO CONFIRM THAT HAVE SOLVED A QUESTION ☑

YOUR COMMENT(S)

OK !

DO NOT WRITE IN THE SPACE BELOW

MY COMMENT(S)

OK !

YOUR GRADE

Problem I: 40 /40
Problem II: 60 /60
Other: ---

TOTAL: 100 /100

Problem I: *(40 points)*

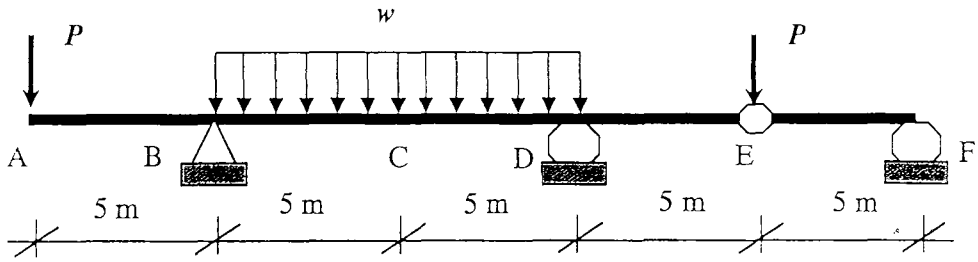
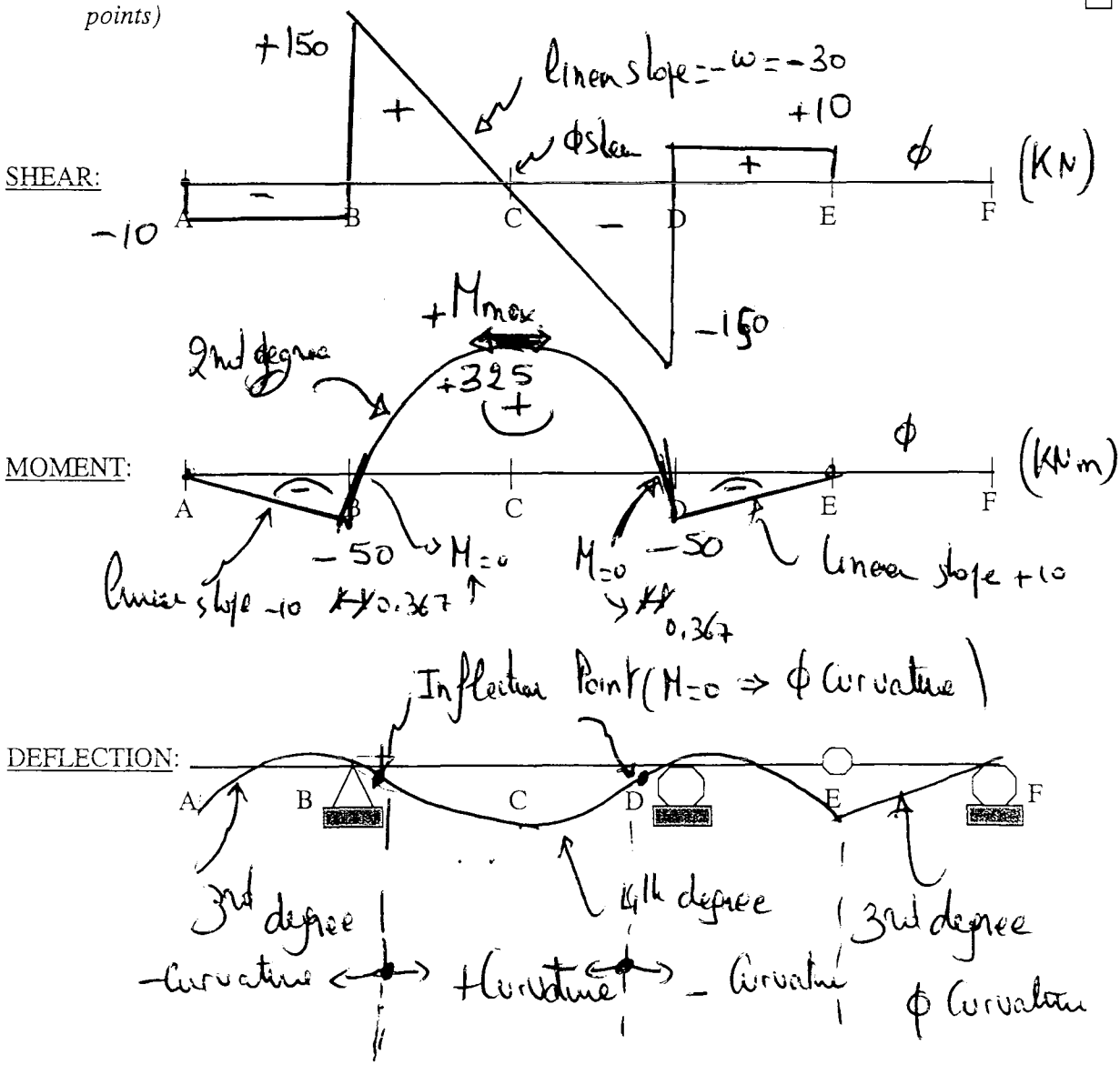


Figure I

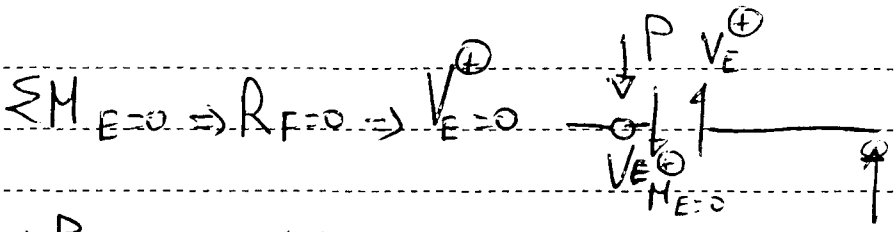
For the beam shown in Figure I, the own weight is neglected.
Your diagrams/sketches should include any feature/value you think is relevant or important.

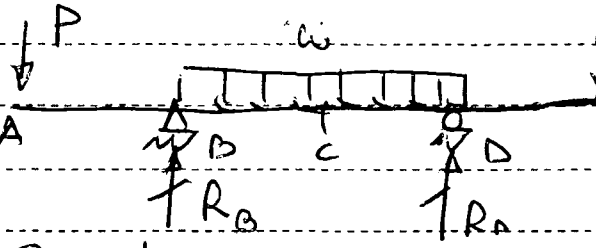
1. Let w=**30 kN/m** and **P=10 kN**
   - Compute the reactions in the beam, and draw the ***shear*** and bending ***moment*** diagrams and sketch the ***deflected shape***. *(20 points)* ☐
   - Briefly explain the behavior of member EF. *(5 points)* ☐
   - Compare the vertical deflections at A and E (no calculations) and briefly comment. *(5 points)* ☐



Calculations and/or Diagrams (cont'd):

(20) $\Sigma M_E = 0 \Rightarrow R_F = 0 \Rightarrow V_E = 0$





$w = 30\ kN/m$

$P = 10\ kN$

Symmetry: $R_B = R_D = \frac{w \times 10}{2} + P = 150 + 10 = 160\ kN (\uparrow)$

Diagrams on page 3

M_{max} @ C $= +325\ kN.m$

$R_F = 0$

$R_{B/D} = 160\ kN \uparrow$

(5) EF rotates as rigid body: No moment or curvature (Note: Weight neglected)

Linear ($M = 0$, $V = 0$)

$\Rightarrow$ No stresses (Bending or Shear = 0)

(5) Since EF is a rigid motion $\Rightarrow$ it is not helping AE, rather it is being dragged by AE $\Rightarrow$ No effect

AE is "Symmetric" with w & P

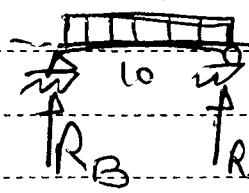
$\Rightarrow$ A & E deflect equally

2. Let w=**30 kN/m** and **P=0 kN**
Explain how the beam behaves (namely part BD), and deduce the reactions at B and D and the moment at C, and sketch the deflected shape of the beam (do not draw shear and moment diagrams). *(10 points)*

Calculations and Diagrams:

(10)

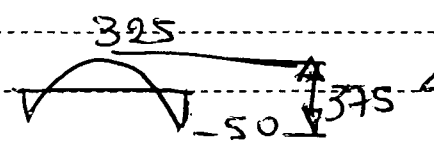
P=0 ⇒ AE, DE, and EF are "rigid" members

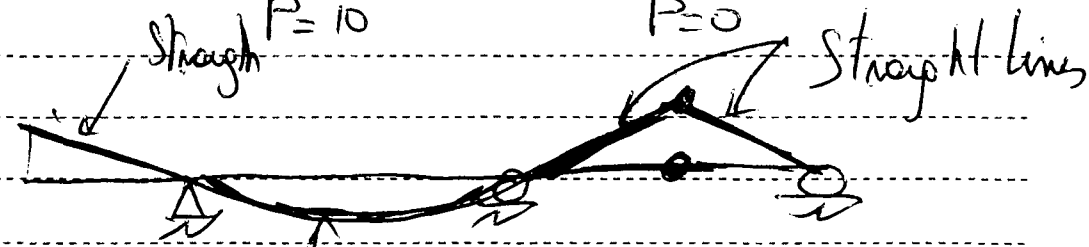
BD ⇔ 

= Simple Beam

$R_B = R_D = \frac{w \times 10}{2} = 150$ kN

M_{max} at C $= \frac{w \times 10^2}{8} = 375$ kNm

Note 



with degree

Problem II: *(55 points)*

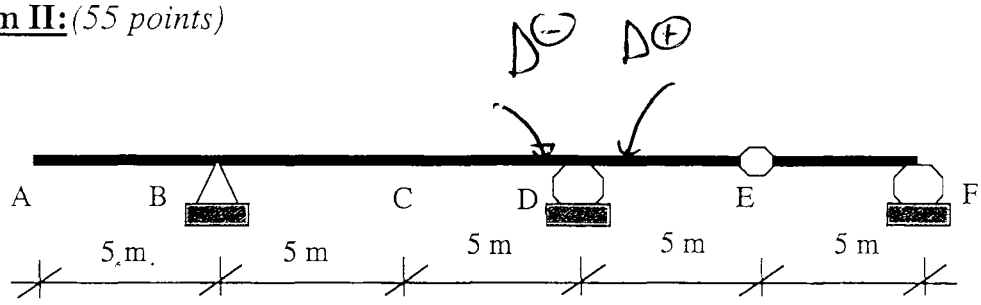
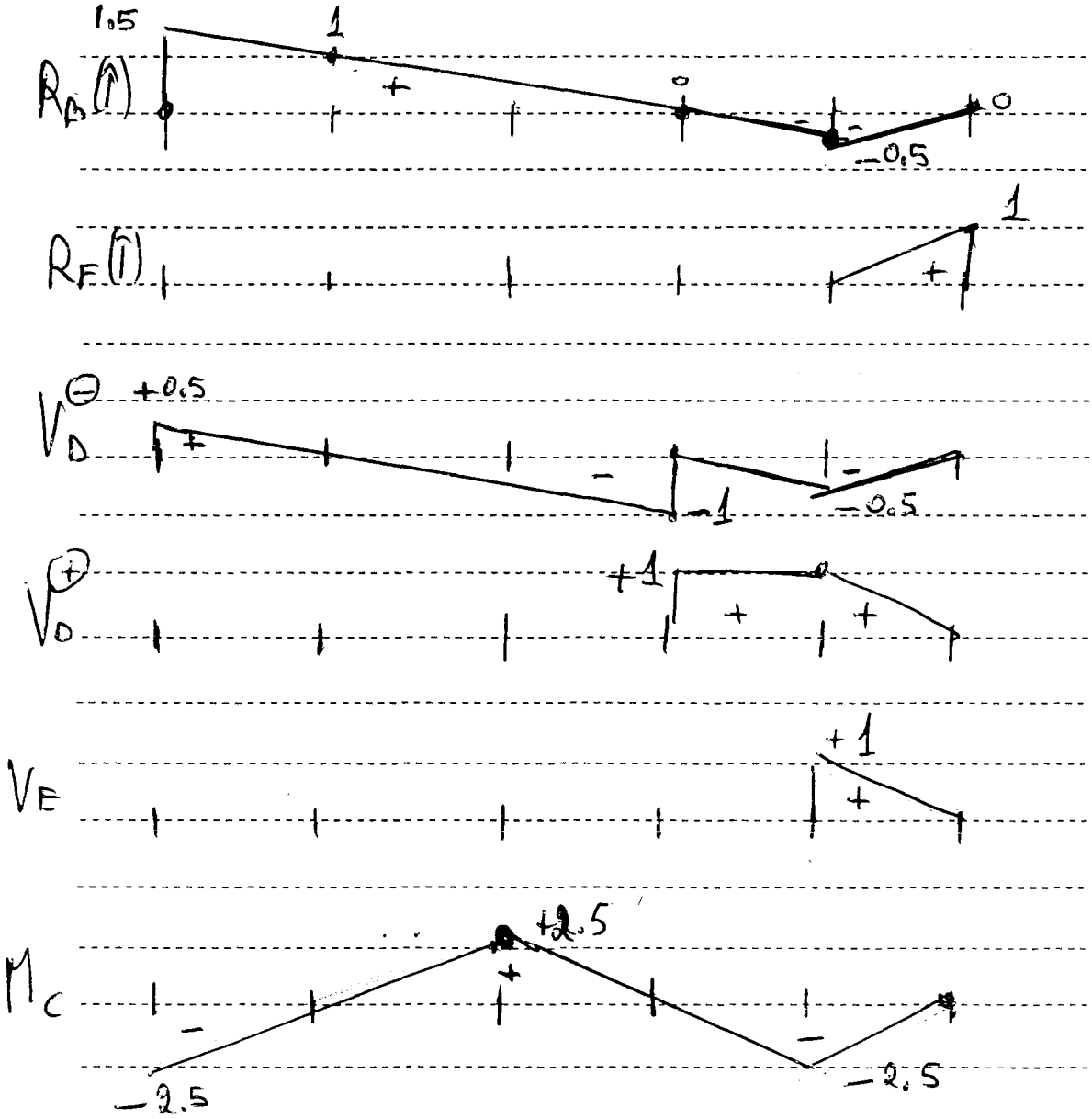
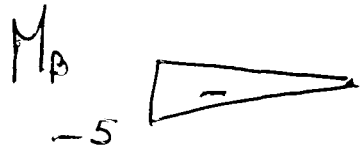


Figure II

1. Referring to Figure II, draw the influence lines for R_B, R_F, V_A, V_D, V_E, M_B, M_C, and M_E. *(30 points)*

Calculations and Diagrams:





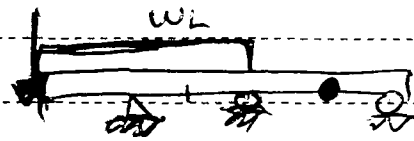
2. Let w_D=10 kN/m (dead load); w_L=30 kN/m and P=10 kN (live loads)
   - Compute the maximum absolute value for R_B. *(8 points)*
   - Compute R_B for live load w_L on BD only and P on A and E and compare with Problem I. *(7 points)*

Calculations and Diagrams:

(8) Dead $w_D = 10$ kN/m Live $w_L = 30$ kN/m, $P = 10$ kN

Max R_B → By Inspection Max ⊕ R_B

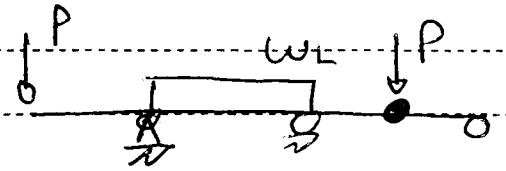
Max ⊕ Configuration



$$\Rightarrow R_B = w_D\left(\frac{1.5\times 15}{2} - \frac{0.5\times 10}{2}\right) + w_L\left(\frac{1.5\times 15}{2}\right) + P\times 1.5 = 44.0\text{ kN}$$

$$|Max^{+} R_B| = 44.0\text{ kN}\ (\uparrow)$$

(7)

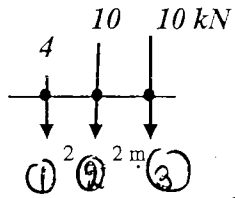


$$R_B\ (\text{from I.L.}) = w_L\left(\frac{1\times 10}{2}\right) + P(1.5 - 0.5)$$

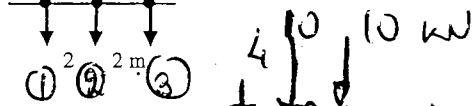
$$= 160\text{ kN}\ (\uparrow)$$

⇒ Same as in Problem I (Same loading) ✓

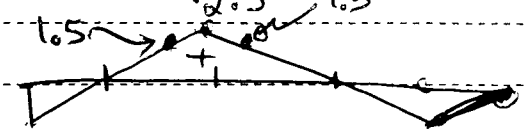
3. Compute the maximum positive value for M_C for the following truck moving load, which can travel in one direction as shown, and compute the maximum positive moment that can ever occur between B and D. Compare and comment *(15 points)*



Calculations and Diagrams:



I.L. M_C

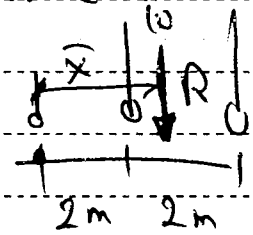


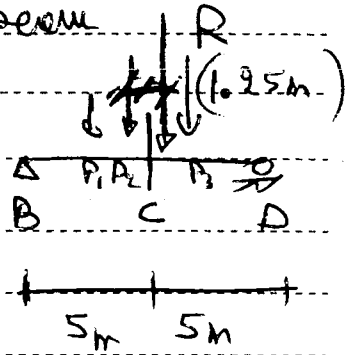
Max @ M_C when P_2 is at C

$\Rightarrow M_C = 4 \times 1.5 + 10 \times 2.5 + 10 \times 1.5 = 46\ kN\,m$

BD behaves like a simple beam

Max Absolute Moment





$R = 24\ kN$ @ $\bar{X} = \frac{10 \times 2 + 10 \times 4}{24} = 2.5\ m$

By Inspection, P_2 & R equidistant from C

$d_2 = 2.5\ m \quad d_2/2 = 1.25\ m$

$R_D = 24 \times \frac{3.75}{10} = 11.4\ kN \uparrow$ ($R_D = 12\ kN \uparrow$)

(max) $M_{P_2} = R_D \times 3.75 - P_1 \times 2 = 46.15\ kN\,m > M_{C\,max}$

but max M_{P_2} slightly greater than $M_{C\,max}$ (expected)