

Student Name:
Student Number:

GNG 1105E - ENGINEERING MECHANICS (W2011)

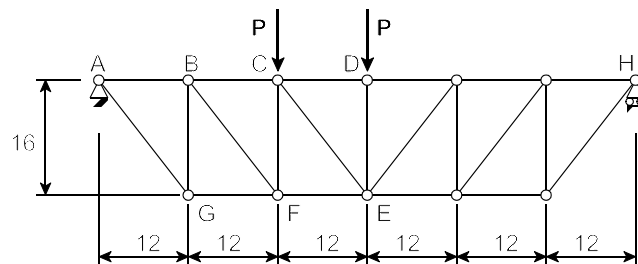
Second Midterm Examination (Optional)
April 01, 2011
Professor Y. M. Haddad

Time: 90 minutes
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Closed Book. Non-programmable calculators only allowed. Free-body diagrams must be drawn wherever appropriate. **Full mark: 20 points**

1. (13 points total) The sketch shows a pin-jointed railway truss bridge. A locomotive loads the bridge with two forces $P = 60\text{N}$. All dimensions are in meters.

- (a) (2 points) Determine the reactions at the supports A and H.
- (b) (2 points) Replace the two external forces acting on the truss by a force-couple system acting at point A.
- (c) (9 points) Using the method of sections, determine the forces in members CD, CE, and FE, stating in each case whether the member is in tension or compression. **Don't use the method of joints.**



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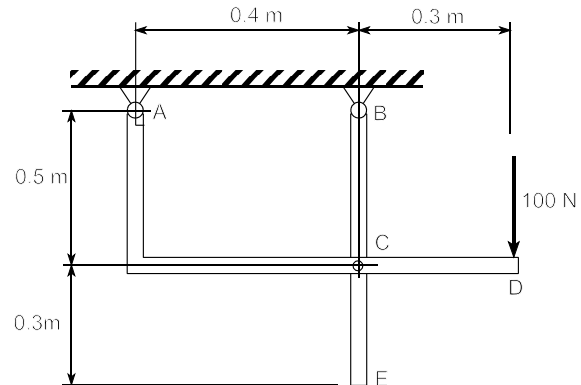
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2. (7 points total) The figure shows an engineering structure made of two members AD and BE and supported by frictionless pivots at A and B. The two members are joined together by a frictionless pivot at C. The structure is acted upon by the vertical force of 100 N as shown in the figure.

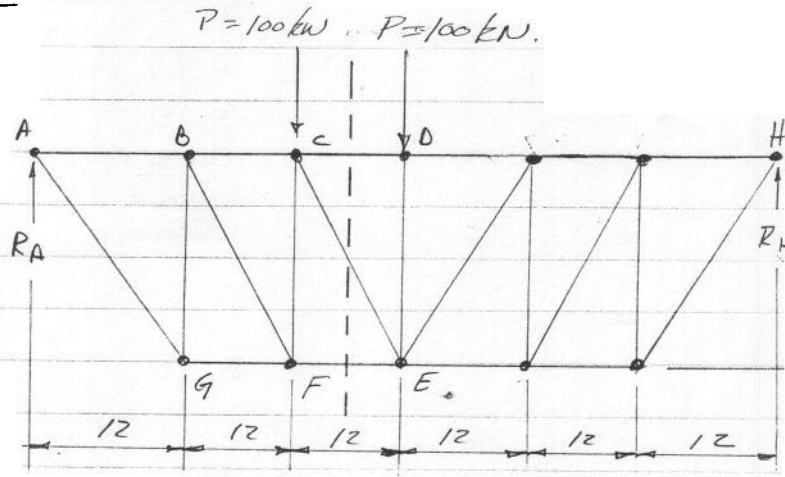
Determine:

- (a) (4 points) the reactions at the supports A and B.
- (b) (3 points) the reaction force acting on pivot C.



Déterminer les forces dans les membrures CD, CE & FE en utilisant la méthode des sections

F.B.D ①



16.

Pour résoudre il faut d'abord trouver les réactions aux appuis.

$$\sum M_A = 0$$

$$(24 \cdot P) - (36 \cdot P) + (72 R_H) = 0 \Rightarrow R_H = 83.3 \text{ kN}$$

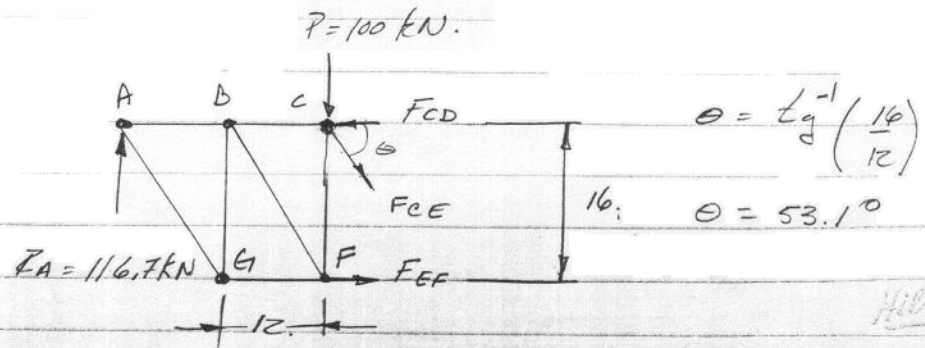
$$\sum F_y = 0$$

$$-P - P + R_A + R_H = 0$$

$$\Rightarrow R_A = 116.7 \text{ kN}$$

Ensuite on coupe la structure au travers les membrures dont on cherche à déterminer les forces.

F.B.D ②



La structure ainsi sectionnée doit être en équilibre, donc;

$$\sum M_c = 0$$

$$R_A \cdot 24 + F_{EF} \cdot 16 = 0 \Rightarrow F_{EF} = 175 \text{ kN.}$$

$$\sum F_y = 0.$$

$$-P + R_A - F_{CE} \sin 53.1^\circ = 0 \Rightarrow F_{CE} = 20.9 \text{ kN.}$$

$$\sum F_x = 0.$$

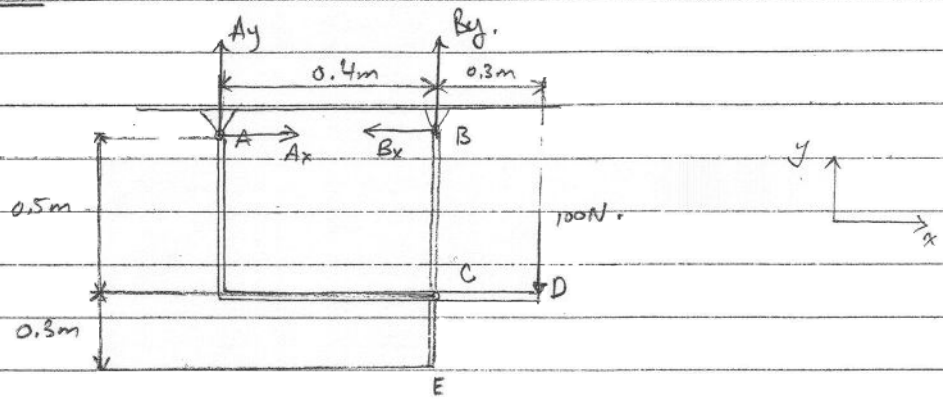
$$F_{EF} - F_{CD} + F_{CE} \cos 53.1^\circ = 0 \Rightarrow F_{CD} = 188.1 \text{ kN.}$$

Donc on peut dire que la membrure.

- CD est en compression.
- CE est en Tension.
- EF est en Tension.

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Solution:



$$\sum F_x = 0$$

$$\Rightarrow \boxed{A_x = B_x} \quad (1)$$

$$\sum F_y = 0$$

$$\Rightarrow \boxed{A_y + B_y = 100} \quad (2)$$

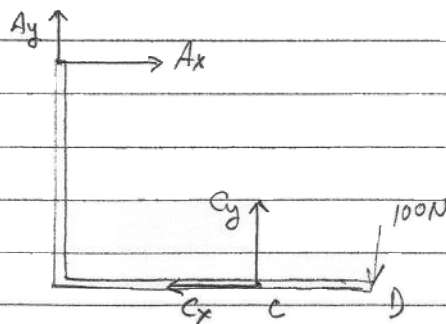
$$\sum M_A = 0$$

$$\Rightarrow B_y (0.4) - 100 (0.7) = 0$$

$$\Rightarrow \boxed{B_y = 175 \text{ N}}$$

$$(2) \Rightarrow \boxed{A_y = -75 \text{ N}} \quad \downarrow$$

• SCT de ACD.



$$\sum F_x = 0$$

$$\Rightarrow \boxed{A_x = C_x} \quad (3)$$

$$\sum F_y = 0$$

$$\Rightarrow C_y + A_y = 100$$

$$\Rightarrow \boxed{C_y = 100 - (-75) = 175 \text{ N}}$$

$$\sum M_C = 0$$

$$\Rightarrow -100 (0.3) - A_y (0.4) - A_x (0.5) = 0$$

$$\Rightarrow \boxed{A_x = 0}$$

$$\therefore \boxed{R_x = 0} \quad \boxed{R_y = 0}$$