COE 2001 Statics

Fall 2013

Quiz 2

NAME _Solution_

The quiz is closed books and closed notes. Scientific calculators are allowed. No ipods, cellphones, laptops etc.

Linearly document all steps and show all supporting work. Answers given without supporting work will be given zero credit. Write legibly and box all your final answers.

HONOR STATEMENT: I have red and strictly abided by all conditions set forth by Georgia Tech Honor Code and thus have neither given nor recived assistance of any type regarding the content or solution of the problems in this examination, nor will I discuss the content with other students until the exam has been graded and returned.

SIGNATURE:

Problem 1 *(10 points)*

For the force systems shown find the force and couple resultant at point B. Show the direction of the resultant force (angle it closes with line AB) and couple at point B. *(8 pts)*
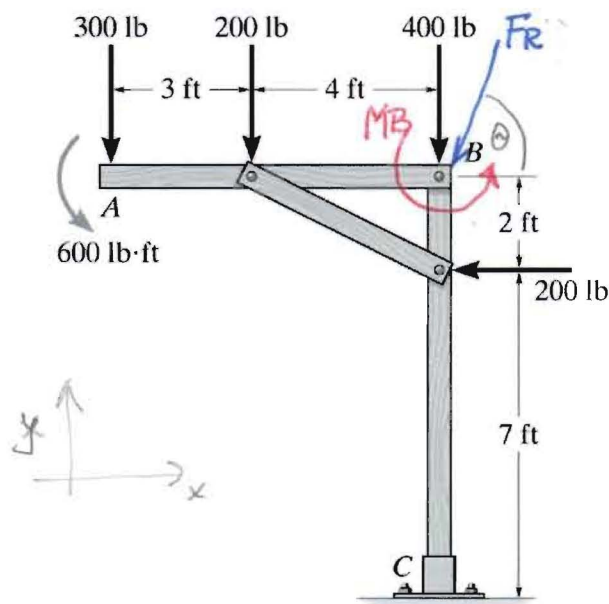
(1) $F_R = \Sigma F_i$

Component in x (or $\hat{i}$) direction

$$F_x^R = -200 \text{ lb}$$

Component in y (or $\hat{j}$) direction

$$F_y^R = (-300) + (-200) + (-400) = -900 \text{ lb}$$

$$F_R = \sqrt{F_x^2 + F_y^2} = 922 \text{ lb}$$

$$tg\theta = \frac{F_y}{F_x} = \frac{900}{200} \; ; \; \theta = 77.5°$$

(2) $M_B = \Sigma M_{Bi}$ — all forces in xy plane
     — use (force)·($\perp$distance)

$$M_B = 600 + (300)(7) + (200)(4) - (200)(2)$$

$$M_B = 3,100 \text{ lb-ft} \qquad \circlearrowleft \;\; (+\epsilon)$$

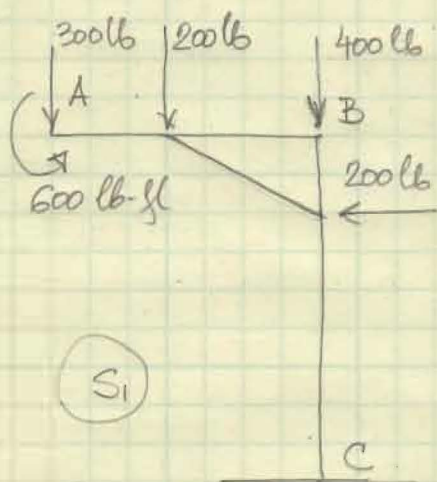Does the force only resultant exist for this force system? Why? *(2 pts)*

<u>Yes.</u>

<u>Coplanar force system (all forces in the same plane)</u>.
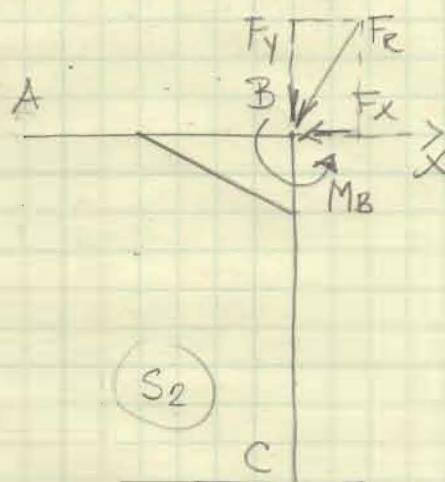
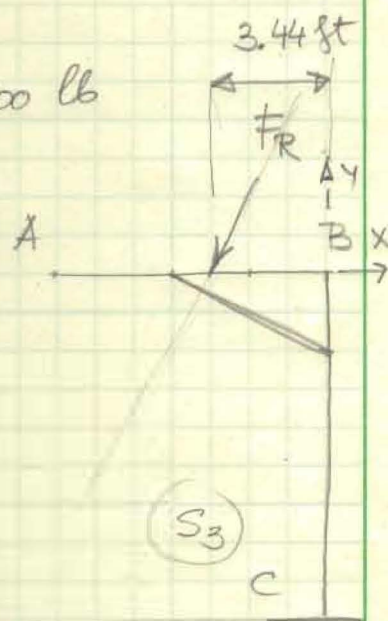✱ Find force-only resultant (see the following pages)

Force-only resultant

$|F_R| = 922\ lb \qquad F_x = -200\ lb \qquad F_y = -900\ lb$

3.44 ft

300 lb   200 lb   400 lb

A   B

600 lb-ft   200 lb

S_1 S_2 S_3

C   C   C

Given force system   Force & couple resultant @ B   Force-only resultant

(1) Force-only resultant using S_2: Force & couple resultant @ B

· position coordinate system so that the origin is @ B

· equation of the line for F_R.

· P(x,y) is a point on that line, any point

$$r_{PB} \times F_R = M_B$$
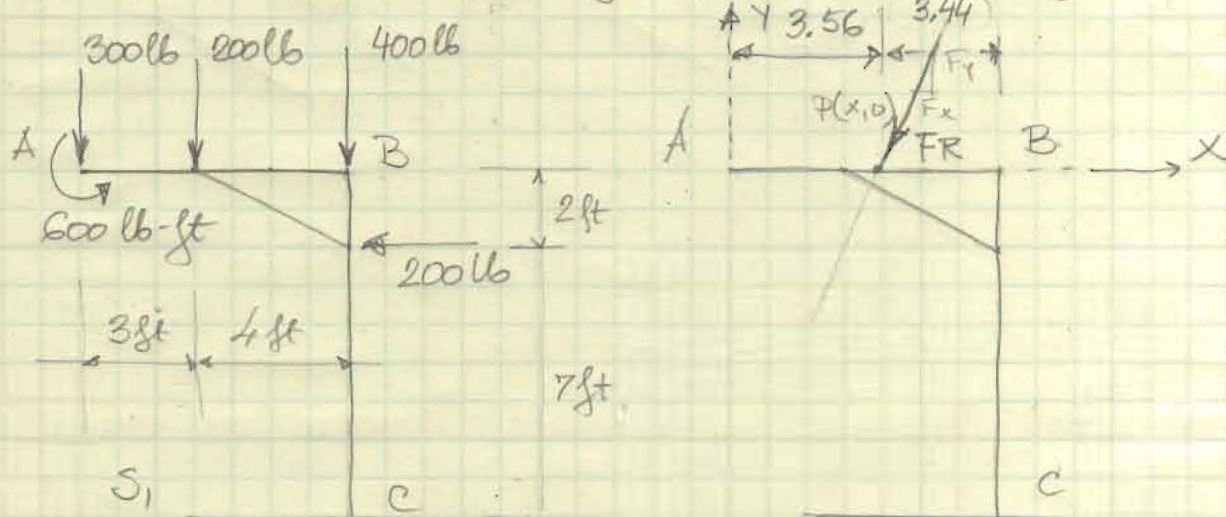
$$F_y(x) - F_x(y) = 3100$$

$$-900x + 200y = 3100$$

$$\boxed{y = 4.5x + 15.5}$$

When F_R intersects line AB: $y=0 \qquad x = -3.44\ ft$

F_R intersects line AB @ 3.44 ft left from B

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(2) Force-only resultant directly from the given
    force system S_1

· position coordinate system so that the origin is @ A

300lb 200lb 400lb

A | ↓   ↓   ↓ B
  600 lb-ft

  200 lb

  3ft | 4ft

  2ft

  7ft

S_1 C

Y 3.56   3.44

  P(x,0) F_x F_y
A | F_R B   → X

  C

· find equation of the line for F_R
· chose point $P(x,y)$ on that line (any point)
· if point $P(x,0)$ is chosen, that is the point
  wher line for F_R intersects X axis (line AB)
· slope of the line is known $m = F_y/F_x = 4.5$

$F_x = -200\ lb$ $F_y = -900\ lb$ $|F| = 922\ lb$

$M_A = \Sigma M_{Ai}$ $M_A = r_{AP} \times F_R = (x)(F_y)$

                    * moment due to component F_x is zero

$x(-900) = (-200)(3) + (-400)(7) + (-200)(2) + 600\ (-1)$

$900x = 600 + 2800 + 400 - 600$

$x = \dfrac{3200}{900} = 3.56\ ft$ (from A)

* note: distance from B is 3.44 ft to the left