

## Unified Quiz 1M

October 8, 2004

- Put your name on each page of the exam.
- Read all questions carefully.
- Do all work on that question on the page(s) provided. Use back of the page(s) if necessary.
- Show all your work, especially intermediate results. Partial credit cannot be given without intermediate results.
- Show the logical path of your work. Explain clearly your reasoning and what you are doing. *In some cases, the reasoning is worth as much (or more) than the actual answers.*
- Please be neat. It will be easier to identify correct or partially correct responses when the response is neat.
- Be sure to show the appropriate units. Intermediate answers and final answers are not correct without the units.
- Report significant digits only.
- Box your final answers.
- **Calculators and handwritten “crib sheets” are allowed.**

**NOTE:** This exam contains material both from “Unified Concepts” (U) and “Materials and Structures” (M).

### EXAM SCORING

#1U (25%)	
#2M (25%)	
#3M (25%)	
#4M (25%)	
FINAL SCORE	

**PROBLEM #1U (25%)**

A set of three forces acts in the  $x_1$ - $x_2$  plane. The force vectors and the  $(x_1, x_2)$  points at which they act are as follows:

$$\begin{aligned} \underline{F}_A &= (-10 \text{ N}) \underline{i}_2 && \text{acts at } (5\text{m}, 5\text{m}) \\ \underline{F}_B &= (-5 \text{ N}) \underline{i}_1 && \text{acts at } (5\text{m}, 0\text{m}) \\ \underline{F}_C &= (3 \text{ N}) \underline{i}_1 - (4 \text{ N}) \underline{i}_2 && \text{acts at } (5\text{m}, 0\text{m}) \end{aligned}$$

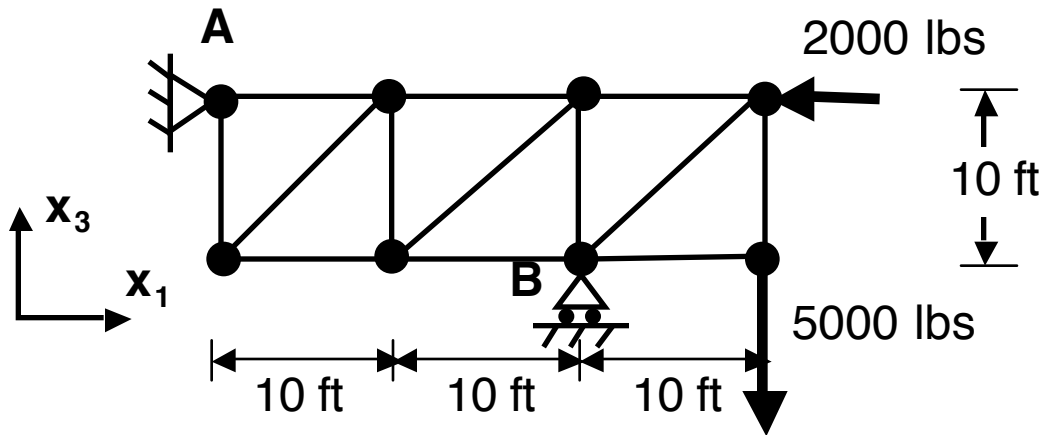
- (a) Determine the force system acting at the origin that is equipollent to this force system.

**PROBLEM #1U (continued)**

- (b) Express this equipollent system in a new set of coordinate axes  $y_1$ - $y_2$  that have been rotated  $-45^\circ$  about the  $x_3$  axis.

**PROBLEM #2M (25%)**

The 30-foot long by 10-foot high truss structure, depicted in the figure below, is supported by a pin at its upper left joint, A, and by a roller at its two-thirds length point, B. It is subjected to a tip load of 5000 pounds and by a load of 2000 pounds at its upper right joint.

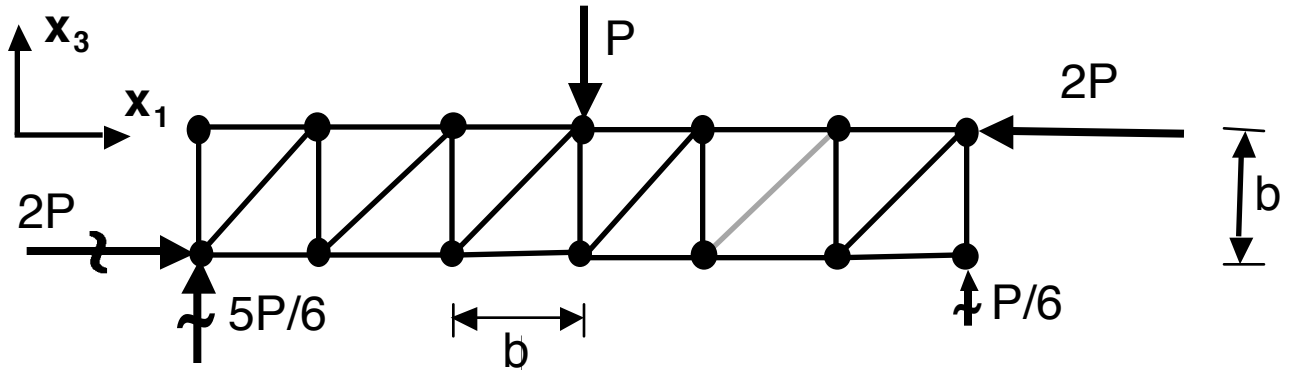


Determine the reaction forces at support points A and B **or** indicate all information available to determine the reaction forces and the additional information that is needed to fully determine these forces.

**PROBLEM #2M (continued)**

**PROBLEM #3M (25%)**

The free body diagram for a six-bay truss, with square bays of length and height  $b$ , is shown in the figure below.

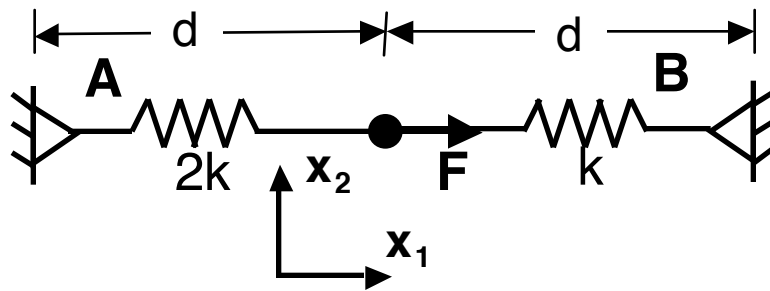


Determine the load in the diagonal bar member of the fifth bay (highlighted in the figure) or indicate the additional information needed in order to determine this load.

**PROBLEM #3M (continued)**

**PROBLEM #4M (25%)**

A collinear, two-spring system, with each spring of equal original length,  $d$ , and pinned at each end, is loaded at the system midpoint by a load,  $F$ , acting along the spring line. The left spring, A, has a stiffness of  $2k$ , and the right spring, B, has a stiffness of  $k$ . This configuration is depicted below.



- (a) Set up the equations available to determine the reaction loads.



**PROBLEM #4M (continued)**

***(extra credit)***

- (b) Determine the reactions loads or indicate what additional information is needed to do such.