CE 120 – Spring 2023
Instructor: M.J. DeJong Name:_____

CE 120 – Structural Engineering

Mid-Term Examination No. 1

Instructions:

- Do not open the exam until instructed to do so.
- This exam is closed notes and closed book. You are permitted to use writing and drawing instruments, and a calculator. Phones and other electronic devices are not permitted.
- Do all problems. Pace yourself so that you have time to work on each problem. Show all relevant work.
- Start solutions alongside or immediately following problem statements. If additional space is required, insert additional sheets. Do not show the work for more than one problem on any given sheet of paper.
- Organize and write solutions neatly. Points may be taken off for messy solutions.
- Indicate units and sign conventions in final solutions. Points will be taken off if units are missing or signs are unclear.
- If you have any questions, or need any paper or other materials, walk to the front of the classroom and ask the instructor.

Please sign the following Honor Pledge before starting the exam:

"I have neither given nor received aid during this examination. I have not concealed any violation of the Honor Code. I did not use lecture or study notes, the internet, or any software/program during the examination."

Signature: _____

Some potentially useful equations:

$\Sigma F_x = 0;\ \Sigma F_y = 0;\ \Sigma M = 0$

	Possible Points	Score	
	Problem 1	40	_____
	Problem 2	30	_____
	Problem 3	30	_____
	TOTAL	100	_____

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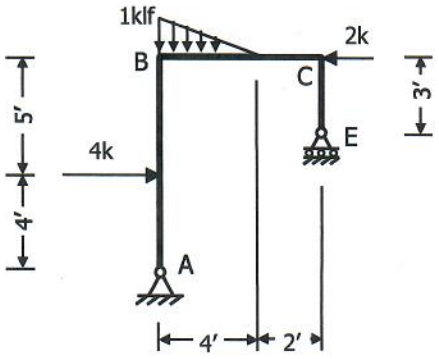
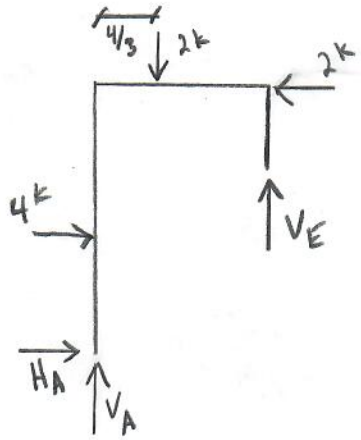
Problem 1 (40 points) – For the frame shown, draw shear and moment diagrams, indicating the peak values, and sketch the deflected shape. Clearly label your sign convention for the shear and moment diagrams.



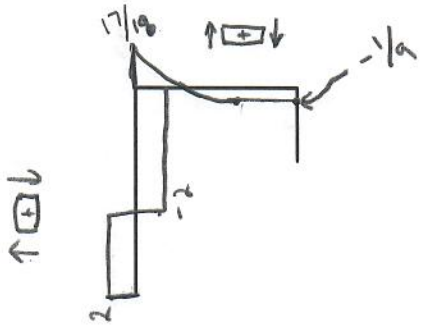
FBD:



$\circlearrowleft +$ $\Sigma M_A = 0$: $V_E(6') + 2^k(9') - 2^k(4/3') - 4^k(4') = 0$

$V_E = \frac{1}{9}\ k$

V



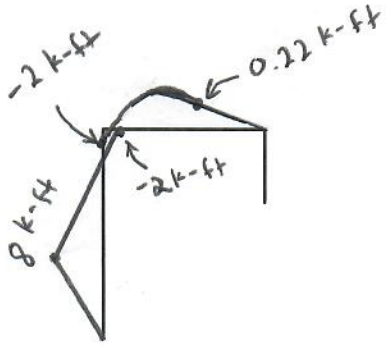
$\Sigma F_x = 0$: $H_A + 4 - 2 = 0$

$H_A = -2\ k$

$\Sigma F_y = 0$: $V_A + V_E - 2 = 0$

$V_A = \frac{17}{18}\ k$

M



Deflected Shape

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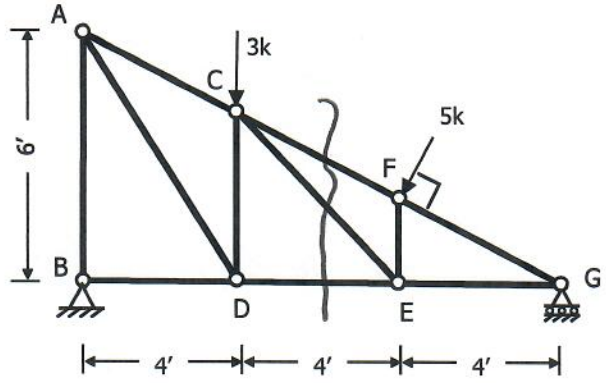
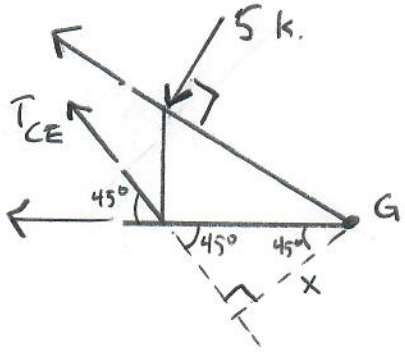
Problem 2 (30 points) – A weightless truss is subjected to the forces at point C and F.

Using clearly and correctly sketched free-body diagrams, calculate the force in member CE.





$\sum M_G = 0$

$+\circlearrowleft$

$5^k\left(\sqrt{4^2+2^2}\right) - T_{CE}\left(\frac{4}{\sqrt{2}}\right) = 0$

$T_{CE} = 7.9\ k$

$\sqrt{2}\,x = 4$

$x = \frac{4}{\sqrt{2}}$

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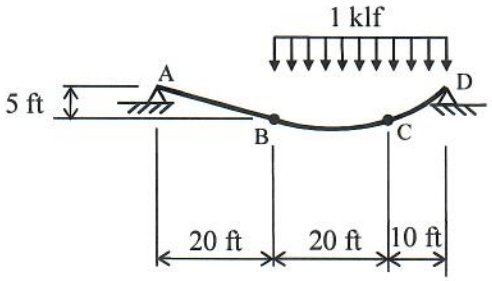
Problem 3 (30 points) – A weightless cable is subjected to a uniform load of 1 klf between points B and D. Support A is at the same elevation as support D.

Determine the tension in the cable at point C.

(Hint: Note that the sag at point C is not given, and points B and C are not necessarily at the same height.)



(Note: not drawn to scale)

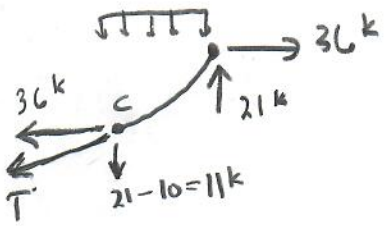
$\circlearrowleft +\quad \Sigma M_D = 0: \quad (1\,klf)(30')(15') - V_A(50') = 0$

$V_A = 9\ k$

$\Sigma F_y = 0: \quad V_D = 30^k - 9^k = 21^k$

$\curvearrowleft_D \quad H = V_A(4) = 36^k$

Cut @ C:



$T = \sqrt{36^2 + 11^2} = \underline{\underline{37.6\ k}}$