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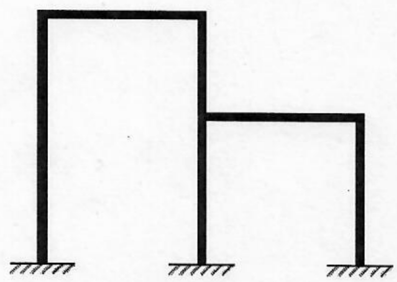
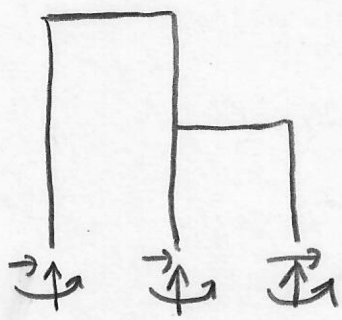
Problem 1 (16 points) – Solve the two problems below:

(a) Determine the value of n (degree of static indeterminacy), and then state whether it is statically determinate, statically indeterminate, or unstable.





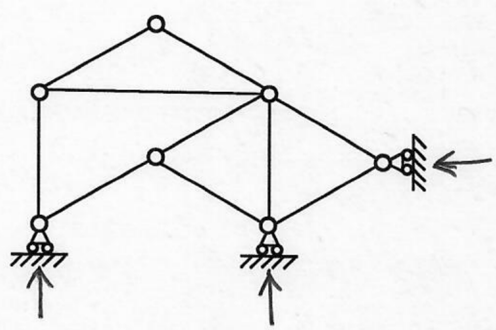
$r = 9$

$m = 1$

$n = r - 3m = \underline{\underline{6}}$

<u>indeterminate</u>

(b) Determine whether the structure is unstable, stable and determinate, or indeterminate. It is braced out of plane.



$\left.\begin{array}{l} b = 10 \\ R = 3 \end{array}\right\} r = 13$

$j = 7$

$n = r - 2j = 13 - 14 = \underline{\underline{-1}}$

<u>unstable</u>

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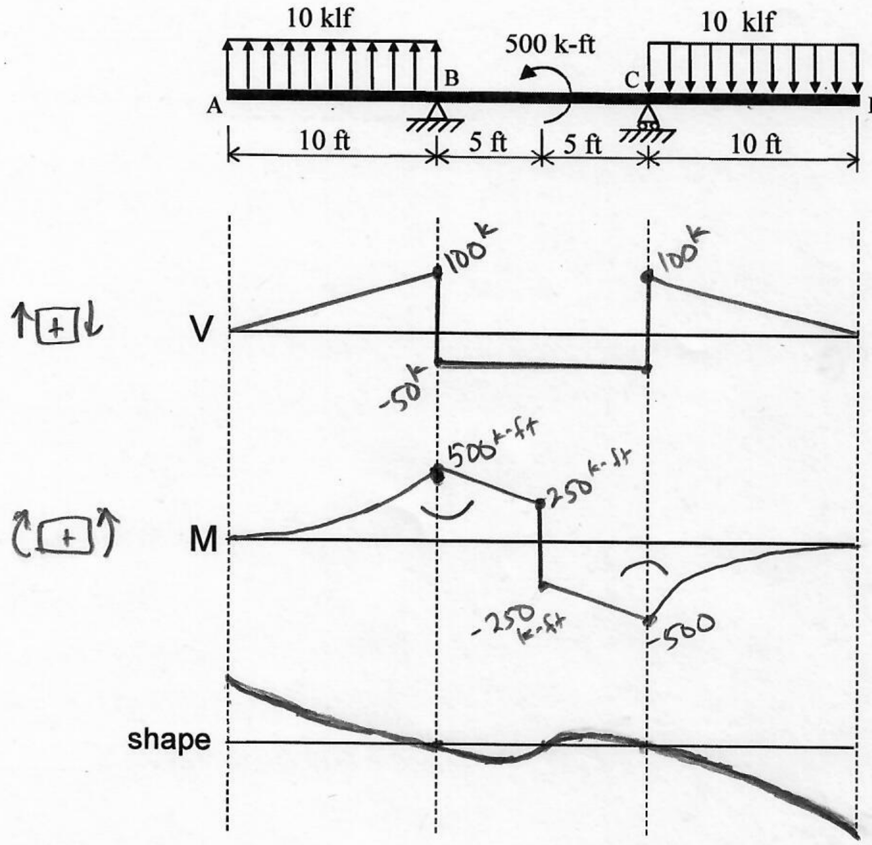
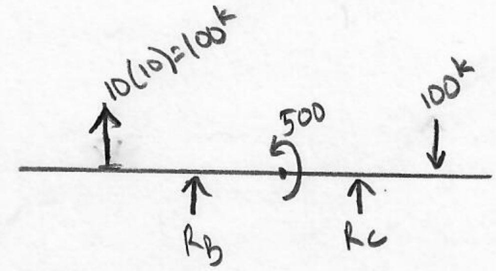
Problem 2 (30 points) – For the beam shown, draw shear and moment diagrams, indicating the peak values, and sketch the deflected shape.





$\circlearrowleft + \quad \Sigma M_B = 0 \rightarrow -(100k)(20) + 500 + R_C(10) = 0$

$R_C = +150\,k$

$R_B = -150^k$

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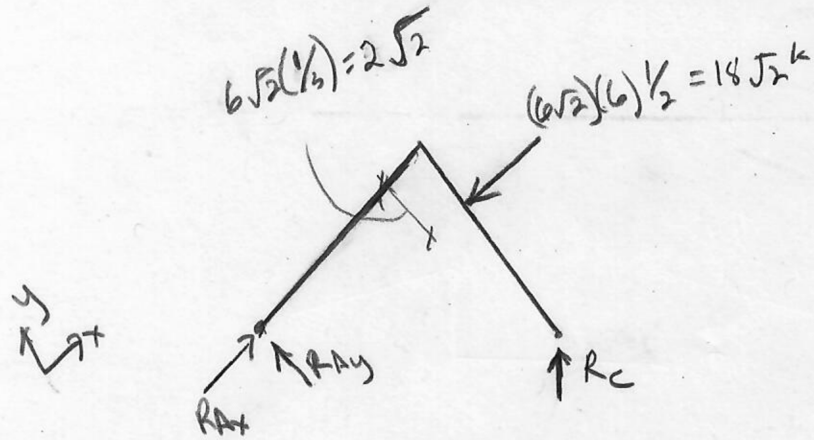
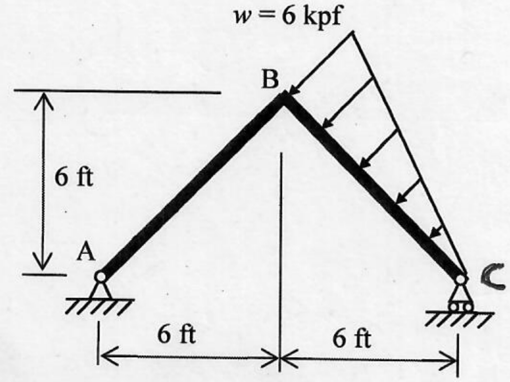
Problem 3 (30 points) – A distributed load with a maximum magnitude of 6 kips per foot is applied to a weightless frame as shown. Plot the axial force (P), shear (V), and moment (M) diagrams, showing key values.





$\Sigma M_A = 0: \; R_C(12) - 18\sqrt{2}(2\sqrt{2}) = 0$

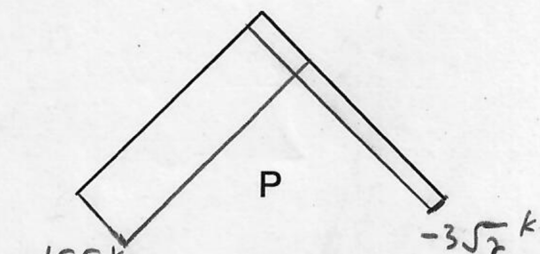
$\underline{R_C = 6^k}$

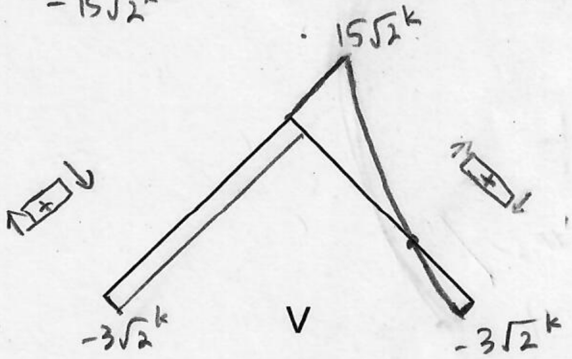
$\Sigma F_x = 0 \rightarrow R_{Ax} - 18\sqrt{2} + (6)\frac{\sqrt{2}}{2} = 0$

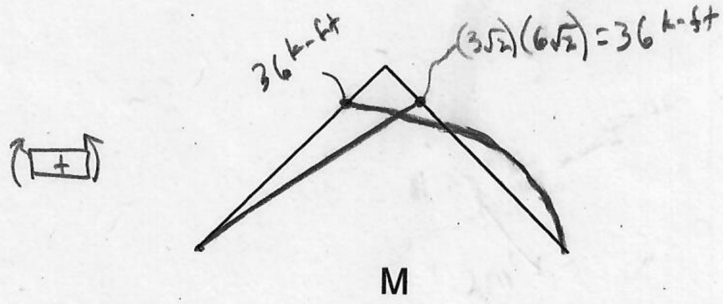
$R_{Ax} = 15\sqrt{2}^{\,k}$

$\Sigma F_y = 0 \rightarrow R_{Ay} + 6\left(\frac{\sqrt{2}}{2}\right) = 0$

$R_{Ay} = -3\sqrt{2}^{\,k}$







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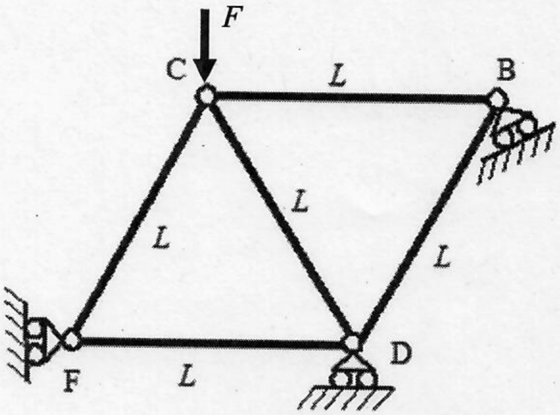
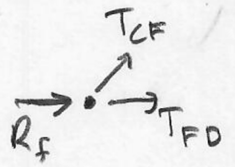
Problem 4 (24 points) – A weightless truss is subjected to the force *F* at point C. All truss members are of length *L*. The roller at point B restricts point B to only move along the BF direction.

Using clearly and correctly sketched free-body diagrams, calculate the force in members BC and CD.

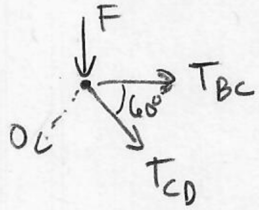


Joint F:



$\Sigma F_v = 0 \rightarrow T_{CF} = 0$

Joint C:



$\Sigma F_v = 0 \rightarrow F = -T_{CD} \sin 60^\circ$

$$\boxed{T_{CD} = -\frac{2}{\sqrt{3}} F}$$

$\Sigma F_h = 0 \rightarrow T_{BC} = -T_{CD} \cos 60^\circ$

$= \frac{2}{\sqrt{3}} F \left(\frac{1}{2}\right)$

$$\boxed{T_{BC} = \frac{F}{\sqrt{3}}}$$