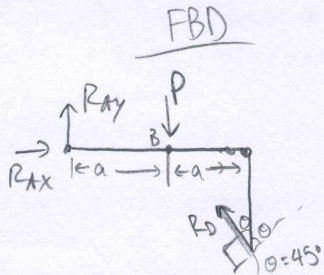
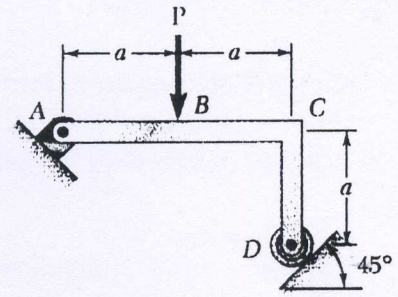


x20

1. (20 points) The massless, rigid structure ABCD is loaded at point B by a vertical force of magnitude P. Determine the reaction forces at pin A and roller D.



$$\sum M_B = 0$$

R_D has line of action through B, so does

$$P \neq R_{Ax}$$

$$R_{Ay} \cdot a = 0$$

$$R_{Ay} = 0 \quad \checkmark$$

$$\sum F_y = 0$$

$$\sum F_x = 0$$

$$R_{Ay} + R_D \cos \theta - P = 0$$

$$R_{Ax} - R_D \sin 45^\circ = 0$$

$$R_D \cos \theta = P$$

$$R_{Ax} = P\sqrt{2} \cdot \frac{1}{\sqrt{2}} = P$$

$$\cos 45^\circ = \sin 45^\circ = \frac{1}{\sqrt{2}}$$

$$R_D = \frac{P}{\cos 45^\circ}$$

$$R_D = P\sqrt{2} \quad \checkmark$$

$$R_{Ay} = 0 \quad \checkmark$$

$$R_{Ax} = P \rightarrow \quad \checkmark$$

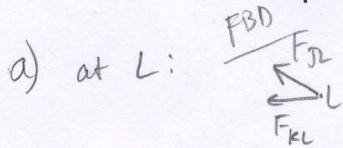
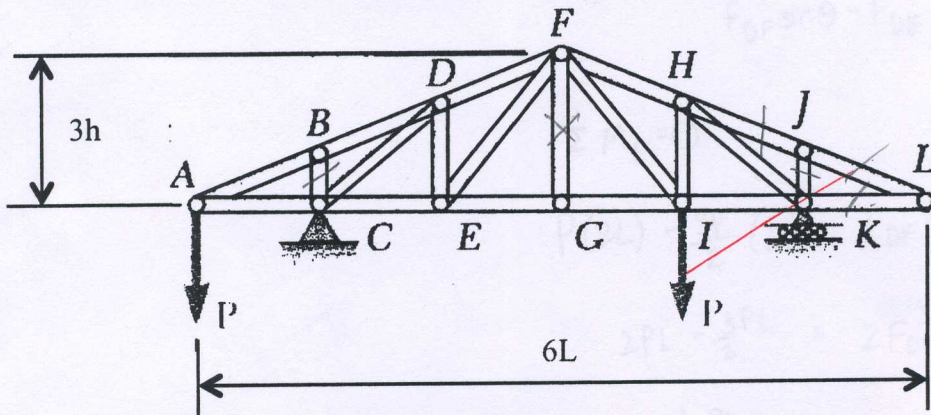
$$R_{Dy} = P \uparrow$$

$$R_{Dx} = P \leftarrow$$

30

2. (30 points total) The truss shown below is loaded by vertical forces of magnitude P at joints A and I. It is supported by a pin at joint C and a roller at joint K. All of the horizontal members of the truss are of length L , and the vertical member BC has length h . For purposes of this analysis, all members may be treated as massless.

- (a) (5 points) Identify any zero-force members that exist for this loading.
- (b) (10 points) Determine the reaction forces at C and K.
- (c) (15 points) Determine the forces in members CE and DE. Be sure to indicate clearly whether each member is in tension or compression.

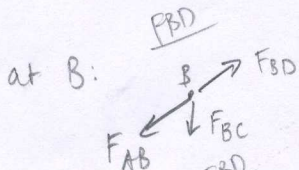


$$\sum F_y = 0$$

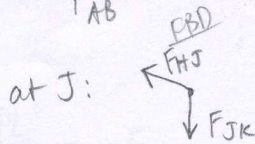
$$F_{JK} = 0$$

$$\sum F_x = 0$$

$$F_{KL} = 0$$



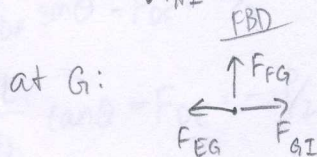
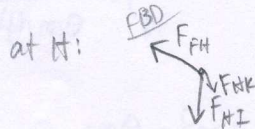
$$F_{BC} = 0$$



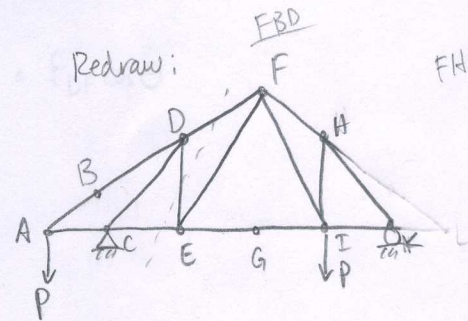
$$\sum F_x = 0$$

$$F_{HJ} = 0$$

$$F_{JK} = 0$$



$$F_{FG} = 0$$



b) $\sum F_x = 0$

$$R_{Cx} = 0$$

$$\sum F_y = 0$$

$$R_{Cy} + R_{Ky} - P - P = 0$$

$$R_{Cy} + R_{Ky} = 2P$$

$$\sum M_C = 0$$

$$P(L) + R_{Ky}(4L) - P(3L) = 0$$

$$4R_{Ky}L = 2PL$$

$$R_{Ky} = \frac{P}{2} \uparrow$$

$$R_{Cy} = \frac{3P}{2} \uparrow$$

Fall, 2012

