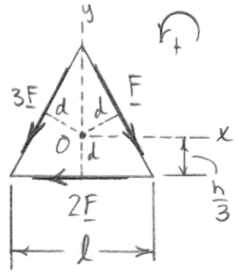
2/83 In each case, $h = \ell \sin 60 = \frac{\ell\sqrt{3}}{2}$ so.. $\frac{h}{3} = \frac{\ell\sqrt{3}}{6} = d$

a)



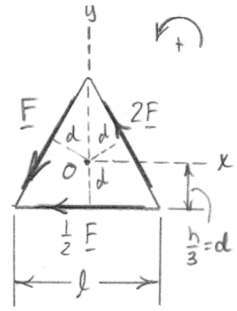
$$\underline{R} = (F\cos 60^\circ - 2F - 3F\cos 60^\circ)\underline{i} + (-F\sin 60^\circ - 3F\sin 60^\circ)\underline{j}$$

$$\underline{R} = -3F\underline{i} - 2\sqrt{3}F\underline{j}$$

$$M_O = 3Fd - Fd - 2Fd \longrightarrow \underline{M_O = 0}$$

$\underline{R}$ acts at $y = 0$.

b)



$$R = (-2F\cos 60^\circ - F\cos 60^\circ - \tfrac{1}{2}F)\underline{i} + (2F\sin 60^\circ - F\sin 60^\circ)\underline{j}$$

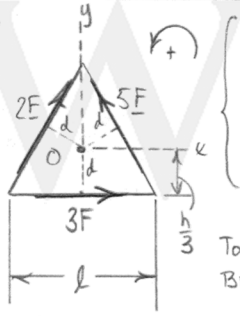
$$\underline{R} = -2F\underline{i} + \frac{\sqrt{3}}{2}F\underline{j}$$

$$M_O = 2Fd + Fd - \tfrac{1}{2}Fd \longrightarrow \underline{M_O = \frac{5\sqrt{3}}{12}F\ell \text{ CCW}}$$

To produce a CCW moment at O with negative R_x, R is placed above O.

$$R_x y = M_O \longrightarrow 2Fy = \frac{5\sqrt{3}}{12}F\ell \longrightarrow \underline{y = \frac{5\sqrt{3}}{24}\ell \text{ above O}}$$

c)



$$R = (3F - 5F\cos 60^\circ + 2F\cos 60^\circ)\underline{i} + (5F\sin 60^\circ + 2F\sin 60^\circ)\underline{j}$$

$$\underline{R} = \tfrac{3}{2}F\underline{i} + \frac{7\sqrt{3}}{2}F\underline{j}$$

$$M_O = 3Fd + 5Fd - 2Fd \longrightarrow \underline{M_O = \sqrt{3}F\ell \text{ CCW}}$$

To produce a CCW moment at O with positive R_x, R is placed below O.

$$R_x|y| = M_O \longrightarrow \tfrac{3}{2}F|y| = \sqrt{3}F\ell \longrightarrow \underline{|y| = \frac{2}{\sqrt{3}}\ell \text{ below O}}$$