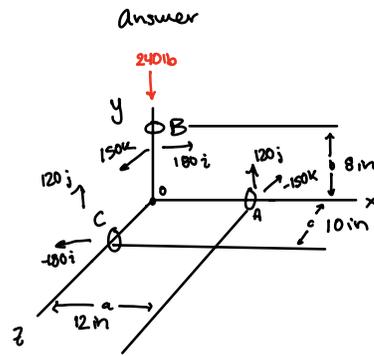
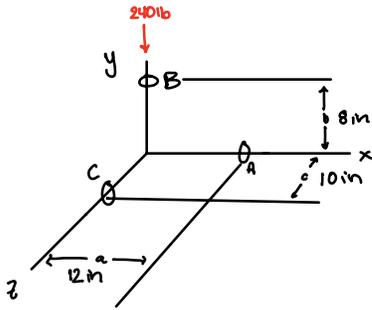


4.127 Three rods are welded together

Find reactions @ A B C

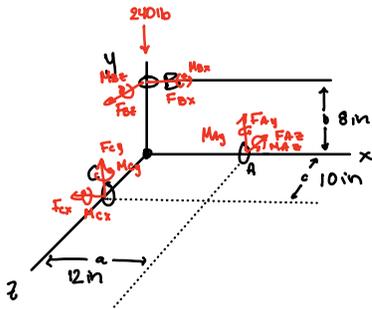


Evaluate @ origin

$$\sum \vec{F}_0 = F_A + F_B + F_C - P = 0$$

$$\sum M_0 = r_A \times F_A + r_B \times F_B + r_C \times C$$

$\downarrow$   $M_A$                    $\downarrow$   $M_B$                    $\downarrow$   $M_C$



## Moments

$$M_A = F_A \times r_A$$

$$\begin{array}{ccc} i & j & k \\ F_{Ax} & F_{Ay} & F_{Az} \\ a & 0 & 0 \end{array} = i(0 - F_{Az} \cdot a) + (0 - F_{Ay} \cdot a)k$$

$$M_A = (F_{Az} \cdot a)j - (F_{Ay} \cdot a)k$$

$$M_B = F_B \times r_B$$

$$\begin{array}{ccc} i & j & k \\ F_{Bx} & F_{By} & F_{Bz} \\ 0 & b & 0 \end{array} = i(0 - F_{Bz} \cdot b) - 0j + (F_{Bx} \cdot b - 0)k$$
$$M_B = (-F_{Bz} \cdot b)i + (F_{Bx} \cdot b)k$$

$$M_C = F_C \times r_C$$

$$\begin{array}{ccc} i & j & k \\ F_{Cx} & F_{Cy} & F_{Ck} \\ 0 & 0 & c \end{array} = i(F_{Cy} \cdot c) - j(F_{Cx} \cdot c - 0) + k(0)$$

$$M_C = (F_{Cy} \cdot c)i - (F_{Cx} \cdot c)j$$

$$M_A = (F_{Az} \cdot a)j - (F_{Ay} \cdot a)k$$

$$M_B = (-F_{Bz} \cdot b)i + (F_{Bx} \cdot b)k$$

$$M_C = (F_{Cy} \cdot c)i - (F_{Cx} \cdot c)j$$

i - moments

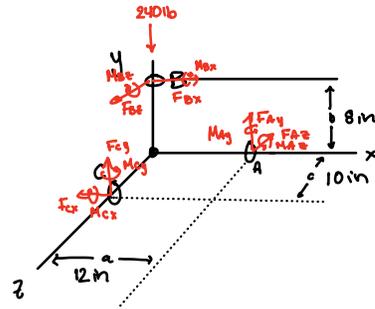
$$-FBz \cdot b + Fcy \cdot c = 0$$

j - moment

$$FAz \cdot a - Fcx \cdot c = 0$$

k - moments

$$-FAy \cdot a + FBx \cdot b = 0$$



Eye bolts are frictionless. B cannot exert an upward force.

$$-240 + Fcy + FAy = 0$$

$$FBz + FAz = 0$$

$$Fcx + FBx = 0$$
$$FBx = -Fcx$$

$$Fcy \cdot c = FBz \cdot b$$

$$FAz \cdot a = Fcx \cdot c$$

$$FBx \cdot b = FAy \cdot a$$

$$FAy = \frac{FBx \cdot b}{a}$$

$$Fcx = \frac{FAz \cdot a}{c}$$

$$FBz = \frac{Fcy \cdot c}{b}$$

$$-240 + F_{cy} + \frac{F_{bx} \cdot b}{a} = 0$$

$$-240 + F_{cy} - \frac{F_{cx} \cdot b}{a} = 0$$

$$-240 + F_{cy} - \frac{F_{Az} \cdot a \cdot b}{c \cdot a} = 0$$

$$-240 + F_{cy} - \frac{F_{Az} \cdot b}{c} = 0$$

$$F_{Az} = -F_{Bz}$$

$$-240 + F_{cy} + \frac{F_{Bz} \cdot b}{c} = 0$$

$$-240 + F_{cy} + \frac{F_{cy} \cdot c \cdot b}{b \cdot c} = 0$$

$$-240 + 2 F_{cy} = 0$$

$$240 = 2 F_{cy}$$

$$F_{cy} = 120$$

$$F_{Bz} = \frac{F_{cy} \cdot c}{b} = \frac{120 \text{ lb} \cdot 10 \text{ in}}{8 \text{ in}}$$

$$F_{Bz} = 150$$

$$\frac{-150 \cdot 12}{8} = F_{cx} = -225$$

List of Unknown

$$F_{cy} = 120$$

$$F_{Ay} = 120$$

$$F_{Bz} = 150$$

$$F_{Az} = -150$$

$$F_{cx} = -225$$

$$F_{Bx} = 225$$

⇒ Reaction @ A

$\langle 0, 120, -150 \rangle$

Reaction @ B

$\langle 225, 0, 150 \rangle$

Reaction @ C

$\langle -225, 120, 0 \rangle$