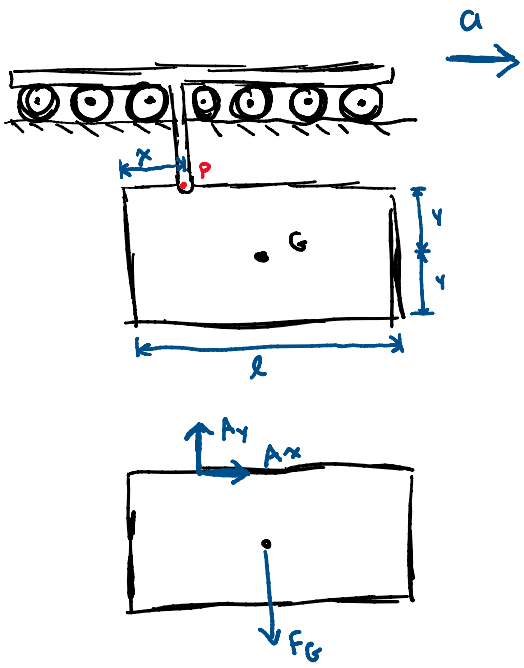
20-R-KIN-DK-33 Intermediate General Plane Motion

Inspiration: 17-103 Hibbeler



An engineering student is testing a component of her vehicle for a design competition. The ***5 kg*** rectangular plate is pinned to a carriage at P. If the track is given an acceleration of ***2 m/s^2***, determine the reaction forces at P and the angular acceleration of the plate.
The height of the plate is ***h = 2y*** and G is located a vertical distance ***y = 0.8 m*** away from P.
The plate has a length ***l = 2 m*** and point P is a horizontal distance ***x = 0.6 m*** from the edge.

$$I_G = \frac{1}{12}(5)(2^2 + 1.6^2) = \frac{41}{15}$$

$$\Sigma F_x = m a_{Gx} = A_x \qquad 5 a_{Gx} = A_x$$

$$\Sigma F_y = A_y - F_g = m a_{Gy} \Rightarrow A_y - (5)(9.81) = 5 a_{Gy}$$

$$\Sigma M_G = -A_x(0.8) - A_y(0.4) = I_G \alpha = \frac{41}{15}\alpha$$

$$a_G = a_P + \alpha \times \vec{r}_{G/P} - \omega^2 \vec{r}_{G/P}$$

$$= 5\hat{i} + \alpha \hat{k} \times (0.4\hat{i} - 0.8\hat{j})$$

$$= 5\hat{i} + 0.4\alpha\hat{j} + 0.8\alpha\hat{i}$$

$$a_{Gx} = 5 + 0.8\alpha$$

$$a_{Gy} = 0.4\alpha$$

$$25 + 4\alpha = A_x \qquad A_y = 49.05 + 2\alpha$$

$$-20 - 3.2\alpha - 19.62 - 0.8\alpha = \frac{41}{15}\alpha$$

$$-39.62 = \frac{101}{15}\alpha$$

$$\alpha = -5.884$$

$$A_x = 1.46336$$

$$A_y = 37.2816$$