

## Problem 1 - Impulse Momentum I

Each of the double pulleys shown has a weight of the wheel is 700 lbs a mass moment of inertia of 20 slug-ft<sup>2</sup> and is initially at rest. The outer radius is 2 ft and the inner radius is 1 ft. Determine the angular velocity of each pulley at  $t = 2$  sec.

a)

CLASSIFY MOTION  
ALL RAFA  
CHECKS TRANS  
MOM 1

PROPERTIES  
 $W = 700 \text{ lbs}$   $I_G = 20 \text{ slug} \cdot \text{ft}^2$

$0 + \int_0^2 \text{IMPULSE} = \text{MOM 2}$

$\sum M_G = 0 + \int_0^2 -500(1) dt = -20\omega_2$

$0 - 1000 = -20\omega_2$   $\omega_2 = 50 \text{ rps} \uparrow$

b)

PROPERTIES  
 $W_{\text{block}} = 500 \text{ lb}$   $m_{\text{block}} = \frac{500}{32.2} = 15.53 \text{ slug}$

$\sum M_G = 0 + \int_0^2 -T(1) dt = -20\omega_2$

$2T - 20\omega_2 = 0$  (1)

$\sum F_y = 0 + \int_0^2 (T - 500) dt = -15.53 V_{G2}$

$2T + 15.53 V_{G2} = 1000$

$2T + 15.53\omega_2 = 1000$  (2)

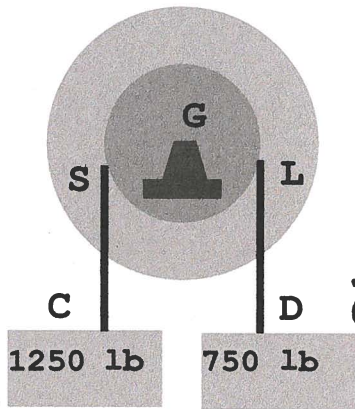
KINEMATICS  
 $V_{G2} = V_S = \omega_2 r = (1)\omega_2$

$\begin{bmatrix} 2 & -20 \\ 2 & 15.53 \end{bmatrix} \begin{Bmatrix} T \\ \omega_2 \end{Bmatrix} = \begin{Bmatrix} 0 \\ 1000 \end{Bmatrix}$

SOLVE  $\omega_2 = 28.1 \text{ rps} \uparrow$

## Problem 27: Impulse Momentum (cont'd)

c)



$$\text{MOM 1} + \text{IMPULSE} = \text{MOM 2}$$

$$\cancel{0} + \int_0^2 \begin{array}{c} \text{pulley diagram with } T_1 \text{ and } T_2 \end{array} dt = \begin{array}{c} \text{pulley diagram with } I_G \omega_2 \end{array}$$

$$\sum M_G 0 + \int_0^2 (-T_1(1) + T_2(1)) dt = -20\omega_2$$

$$-2T_1 + 2T_2 + 20\omega_2 = 0 \quad (1)$$

PROPERTIES

$$\omega_C = 1250 \text{ lbs } m_C = \frac{1250}{32.2} = 38.82 \text{ slug}$$

$$\omega_D = 750 \text{ lbs } m_D = \frac{750}{32.2} = 23.3 \text{ slug}$$

$$\cancel{0} + \int_0^2 \begin{array}{c} \text{block C diagram with } T_1 \text{ and } 1250 \text{ lbs} \end{array} dt = \begin{array}{c} \text{block C diagram with } m v_{Gc2} \end{array}$$

$$\uparrow \sum y \quad 0 + \int_0^2 (T_1 - 1250) dt = -38.82 v_{Gc2}$$

$$2T_1 + 38.82 v_{Gc2} = 2500 \quad (2)$$

KINEMATICS

$$V_S = V_L = V_C = V_D = \omega_2 r = (1) \omega_2$$

$$\cancel{0} + \int_0^2 \begin{array}{c} \text{block D diagram with } T_2 \text{ and } 750 \text{ lbs} \end{array} dt = \begin{array}{c} \text{block D diagram with } m v_{Gd2} \end{array}$$

$$\uparrow \sum y \quad 0 + \int_0^2 (T_2 - 750) dt = 23.3 v_{Gd2}$$

$$2T_2 - 23.3 v_{Gd2} = 1500 \quad (3)$$

$$\begin{bmatrix} -2 & 2 & 20 \\ 2 & 0 & 38.82 \\ 0 & 2 & -23.3 \end{bmatrix} \begin{Bmatrix} T_1 \\ T_2 \\ \omega_2 \end{Bmatrix} = \begin{Bmatrix} 0 \\ 2500 \\ 1500 \end{Bmatrix}$$

SOLVE  $\omega_2 = \underline{\underline{12.18 \text{ rps}}}$