[redacted] A person with a mass of 52 kg runs with a speed of 6.8 m/s (with respect to the ground) jumps onto the outer rim of a merry-go-round. The merry-go-round has a radius of 1.5 m and can be modeled as a large disk. The merry-go-round was initially at rest before the person jumped onto it and rotates at 1.3 rad/s (with respect to the ground) immediately after the person jumps on. What is the mass (in kg) of the merry-go-round? You may treat this as an isolated system and model the person as a point particle.

① Since the system is isolated, the angular momentum <u>must</u> be conserved

$$L_i = L_f$$

$$L_i = m_{person} v_{person} R_{disk}$$

$$L_f = m_{person} R_{disk}^2 \omega_{person} + \frac{1}{2} m_{disk} R_{disk}^2 \omega_{disk}$$

$$\Rightarrow \quad m_{disk} = 2 m_{person}\left(\frac{v_{person}}{R_{disk}\cdot\omega_{disk}} - 1\right)$$

$$\therefore \quad = 259 kg.$$

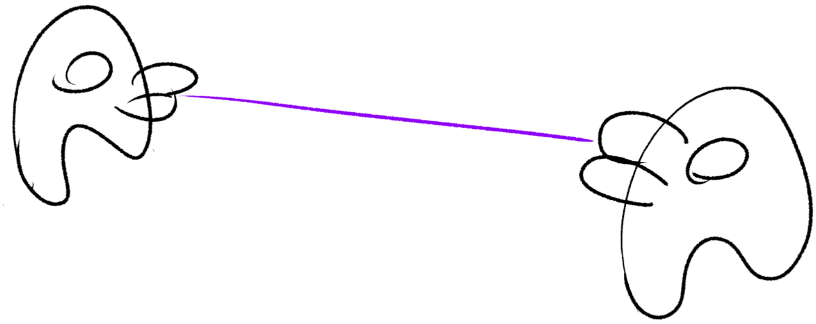
$$m_{disk} = 2\cdot\frac{1}{R_d^2}\cdot\frac{1}{\omega_d}\left(m_p v_p R_d - m_p R_d^2 \omega_p\right)$$

$$= 258.67$$

F

2. Two astronauts, each with a mass of 50 kg, are connected by a 7 m massless rope. Initially they are rotating around their center of mass with an angular velocity of 0.5 rad/s. One of the astronauts then pulls on the rope and begins moving toward the other astronaut at a constant acceleration of 0.2 m/s^2. What is the magnitude of the angular acceleration (in rad/s^2) of this system 5 s after the first astronaut starts pulling on the rope? You may model each astronaut as a point particle.

2



1) See Notes from April 19th.

2) $D = 2R \Rightarrow \omega_f = \dfrac{\left(\frac{D_i}{2}\right)^2}{\left(\frac{D_f}{2}\right)^2}\omega_i$

$$= \frac{D_i^2}{D_f^2}\omega_i$$

$$\alpha_f = \frac{d\omega_f}{dt} \Rightarrow \alpha_f = -2\frac{D_i^2}{D_f^3}\omega_i \frac{dD_i}{dt}.$$

$$\frac{dD_f}{dt} = v \Rightarrow \alpha_f = -2\frac{D_i^2}{D_f^3}\omega_i v$$

Since the ~~acc.~~ acceleration is constant

$$D_f = D_i - \frac{1}{2}at^2$$

$$\Rightarrow \alpha_f = -2\frac{D_i^2}{\left(D_i - \frac{1}{2}at^2\right)^3}\omega_i v$$

II

We have $\quad v = at$

$$\Rightarrow \alpha_f = -2 \frac{D_i^2}{\left(D_i - \frac{1}{2}at^2\right)^3} v_i a t$$

$$= (\text{math})$$

$$= -0.538 \frac{\text{rad}}{s^2}$$

$\therefore$

$\boxed{III}$