Stephen Giang

1. (20) Three metal links of a chain, each has same mass m. Not attached to each other; hanging from each other. Force $\vec{F}$ applied to link 3 chain moving downward, speeding up. $|\vec{a}|$ as shown.

   a) Draw free-body diagram (FBD) for entire system as one object. Label forces.

   b) Draw FBD for link 3. Label forces.

   c) Find magnitude of force that 3 exerts on 2 (Hint: use FBD's from (a) and (b)).

2. (20) Ferris wheel, person of mass m strapped to seat. Makes 3.5 revolutions each minute, rotating at constant speed in direction shown. Radius shown.

   a) speed of person?

   b) at point b; magnitude of acceleration of person?

   c) at point d; magnitude of acceleration of person?

   d) Draw the circle; at points a and b, draw vectors showing directions of velocity and acceleration of person. Label them $\vec{v}$, $\vec{a}$.

3. (20) Block on horizontal surface, initially at rest, and then the constant force $\vec{F}$ is applied and stays applied; $F = 45$ N. Coefficient of kinetic friction between the block and surface is 0.25. Coefficient of static friction: shown. Find magnitude of friction force on block while $\vec{F}$ acts.

   (14) Books, and something else, at rest on horizontal table. Masses are labeled. Draw FBD for book 2. Label the forces for each force in your diagram: state the object that exerts that force.

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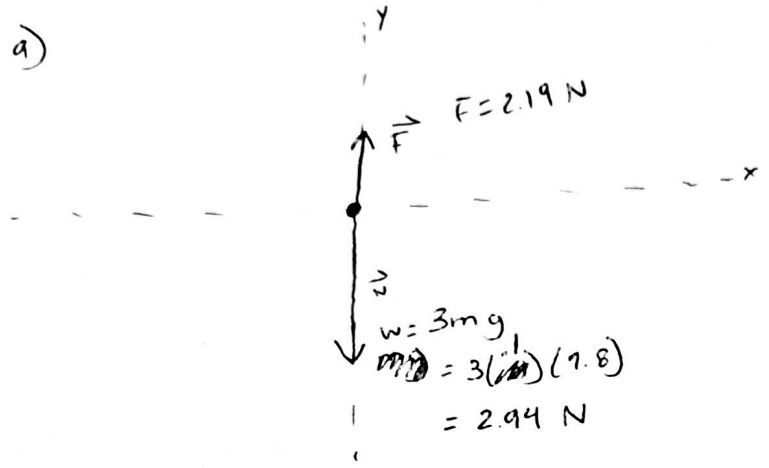
1

a)



$\vec{F}_{net} = \vec{w} - \vec{F}$

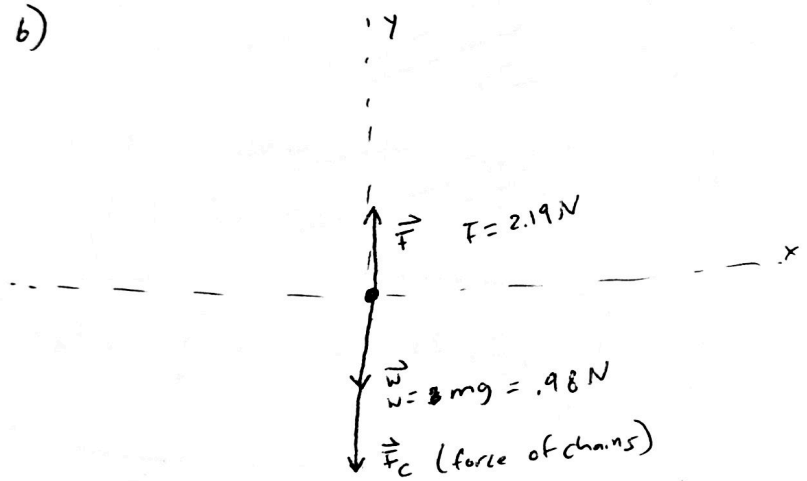
$F_{net} = w - F = 3ma$

$= 2.94 - F = 3(.1)(2.5)$

$2.94 - 3(.1)(2.5) = F$

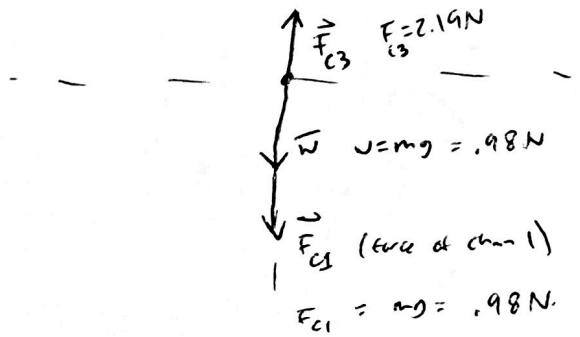
$2.19 = F$

b)



$F_C = 2mg = 1.96\ N$

c) FBD for link 2



$F_{C1} = mg = .98\ N$

magnitude of force that 3 exerts on 2 is equal to the magnitude of force that 2 exerts on 3. 2 exerts its weight and magnitude of the downward force from chain 1. So the magnitude of force that 3 exerts on 2 is $2mg = 1.96\ N$

2.a) $M = 130\ kg$

~~$|v| = \frac{2\pi r}{3.5} = \frac{2\pi(22)}{3.5} = \frac{37.49\ m}{1\ \text{revolution}}$~~

$$\frac{1\ \text{minute}}{3.5\ \text{revolutions}} = \frac{.2857\ m}{1\ \text{revolution}}$$

$$|v| = \frac{2\pi r}{\left(\frac{1}{3.5}\right)} = \frac{2\pi(22)\ m}{.2857\ m} = 3.5\left(2\pi(22)\right) = 483.82\ \frac{m}{m}$$

b) If constant speed, then acceleration is zero.

$|a| = 0$.

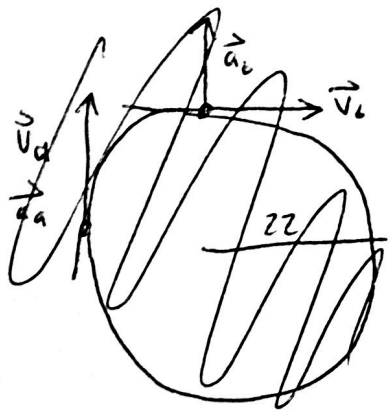
c) If constant speed, then accel. is zero.

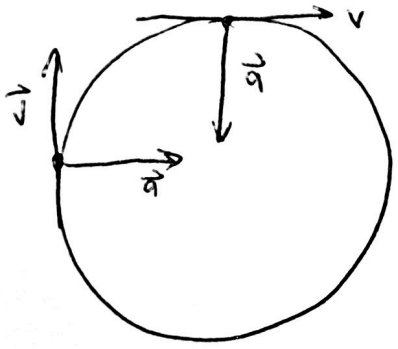
$|a| = 0$.

b) $|a| = \frac{v^2}{r} = 10640.08\ \frac{m}{m^2}$

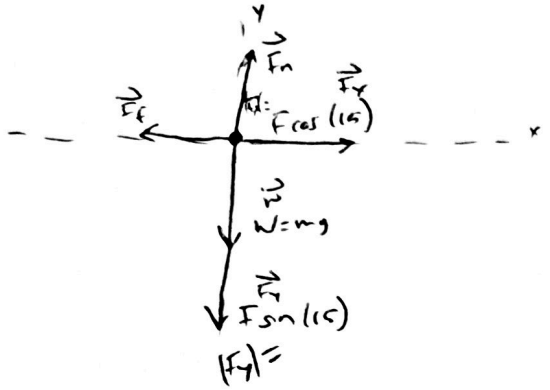
c) $|a| = \frac{v^2}{r} = 10640.08\ \frac{m}{m^2}$

d)





3. $\mu_k = .25$ Find $|F_f|$ (force of friction)



$f_k \leq \mu_k n$

$\leq .25\left(mg + F\sin(15)\right)$

$\leq .25\left(10(9.8) + 45\sin(15)\right)$

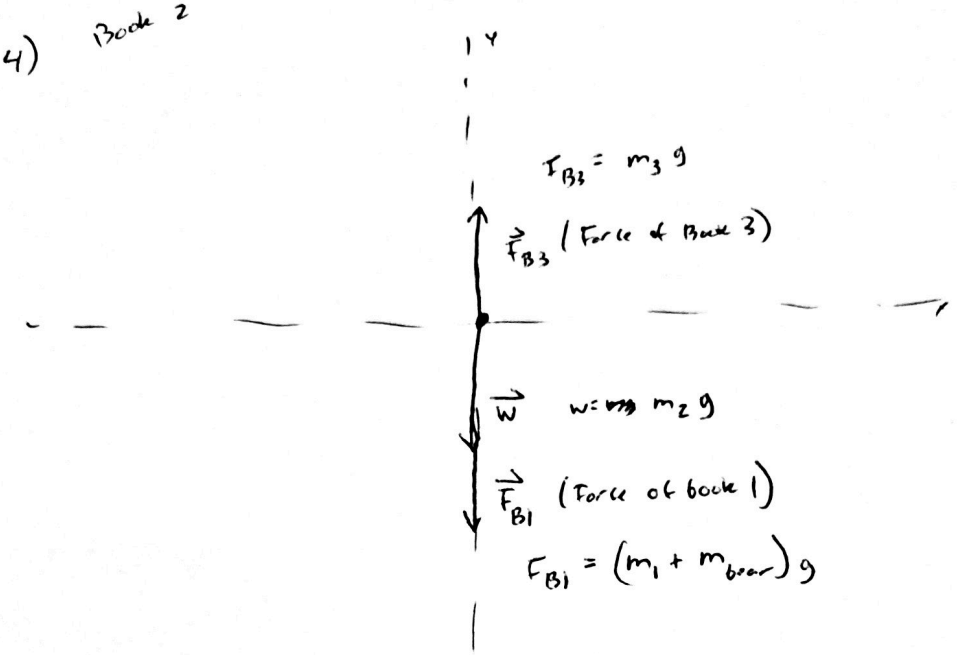
≤ 27.41 N

$F_x = 45\cos(15)$

$= 43.466$ N

So while $\vec{F}$ is acting the magnitude of the friction force is $f_k = 27.41$ N.

4) Book 2


y
$F_{B3} = m_3 g$
$\vec{F}_{B3}$ (Force of Book 3)
$\vec{w}$ $w = m_2 g$
$\vec{F}_{B1}$ (Force of book 1)
$F_{B1} = (m_1 + m_{bear}) g$