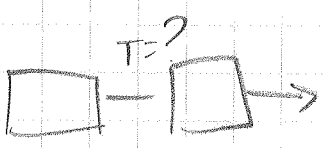
TEST QUESTIONS

1. An 18 wheeler pulls 2 trailers, with a force of 2.0×10^4 N. The front trailer has a mass of 5000 kg and the rear trailer has a mass of 4100 kg. If μ is 0.25, find the tension between the trailers.



$m_2 = 4100\text{kg}$ $m_2 = 5000\text{kg}$

$$F_{net} = m_T a \Rightarrow a = \frac{F_{net}}{m_T} = \frac{F_{net}}{(m_1 + m_2)}$$

$$a = \frac{2.0 \times 10^4 \text{N}}{(4100\text{kg} + 5000\text{kg})}$$

$$a = 2.1970\ \text{m/s}^2$$

Rear Trailer

$$F_{net} = T - F_f$$

$$m_2 a = T - \mu F_n = T - \mu m_2 g$$

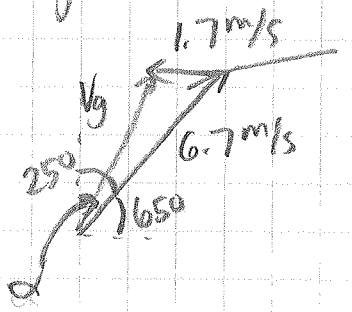
$$T = m_2 a + \mu m_2 g$$

$$T = (4100\text{kg})(2.1970\text{m/s}^2) + (0.25)(4100\text{kg})(9.8\text{N/kg})$$

$$T = 20\,000\text{ N}$$

TEST QUESTIONS

2. A bird flies 6.7 m/s [N 25° E]. The wind blows 1.7 m/s [W]. Find the bird's velocity relative to the ground.



by Z-pattern = 65°

$$c^2 = a^2 + b^2 - 2ab\cos C$$

$$V_g^2 = (6.7)^2 + (1.7)^2 - 2(6.7)(1.7)\cos 65°$$

$$V_g = 6.2 \text{ m/s}$$

$$\frac{\sin A}{a} = \frac{\sin B}{b}$$

$$A = \sin^{-1}\left(\frac{a\sin B}{b}\right)$$

$$\alpha = \sin^{-1}\left(\frac{(1.7)\sin 65}{6.2}\right)$$

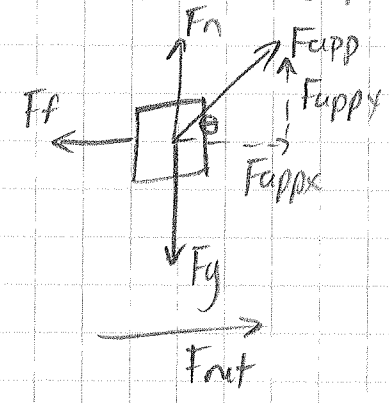
$$\alpha = 14°$$

$14° + 65° = 79°$

$\vec{V}_g = 6.2 \text{ m/s}\ [E\ 79°\ N]$

TEST QUESTIONS

3. a) A child pulls a 9.6 kg toboggan at an angle of 13° to the horizontal, with a force of 72 N. If the coefficient of friction between the toboggan and the snow is 0.167, determine the acceleration.



$m = 9.6\,kg$

$F_{app} = 72\,N$

$\theta = 13°$

$\mu = 0.167$

In the y: $\sum F_y = 0\,N = F_n + F_{appy} - F_g$

$F_g = F_n + F_{appy}$

$mg = F_n + F_{app}\sin\theta$

$F_n = mg - F_{app}\sin\theta$

$F_n = (9.6\,kg)(9.8\,N/kg) - (72\,N)\sin 13°$

$F_n = 77.88\,N$

In the x: $\sum F_x = F_{net} = F_{appx} - F_f$

$ma = F_{app}\cos\theta - \mu F_n$

$a = \dfrac{F_{app}\cos\theta - \mu F_n}{m}$

$a = \dfrac{F_{app}\cos\theta - \mu(mg - F_{app}\sin\theta)}{m}$

TEST REVIEW QUESTIONS

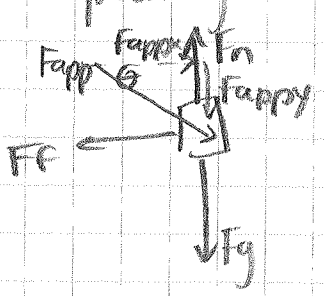
#3 cont

$$a = \frac{(72N)\cos 13^\circ - (0.167)[(9.6kg)(9.8N/kg) - (72N)\sin 13^\circ]}{9.6kg}$$

$a = 5.9529 m/s^2$

$a = 6.0 m/s^2$

b) If it's now pushing a lawnmower:



$\sum F_y = ON = F_n - F_g - F_{appy} \Rightarrow F_n = F_g - F_{appy}$

This means the normal force will increase,

which means F_f will also increase.

TEST REVIEW QUESTIONS

4. A hammer-throw hammer is 7.2kg. An athlete swings the hammer in a vertical circle with a radius of 1.215m. If the frequency is 5.76 Hz, find the maximum & minimum tensions.

$m = 7.2\text{kg}$

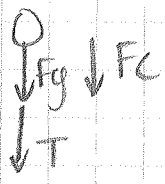
$r = 1.215\text{m}$

$f = 5.76\text{ Hz}$

$T_{max} = ?$

$T_{min} = ?$

TOP



$F_c = F_g + T \Rightarrow T = F_c - F_g$

$T = m4\pi^2 r f^2 - mg$

$T = (7.2\text{kg})(4\pi^2)(1.215\text{m})(5.76\text{Hz})^2 - (7.2\text{kg})(9.8\text{N/kg})$

$T = 11397.56\text{N}$

$T_{min} = 1.1 \times 10^4\text{N}$

BOTTOM

$F_c = T - F_g$

$T = F_c + F_g$

$T = m4\pi^2 r f^2 + mg$

$T = (7.2\text{kg})\,4\pi^2 (1.215\text{m})(5.76\text{Hz})^2 + (7.2\text{kg})(9.8\text{N/kg})$

$T = 11528.68\text{N} = 1.2 \times 10^4\text{N}$