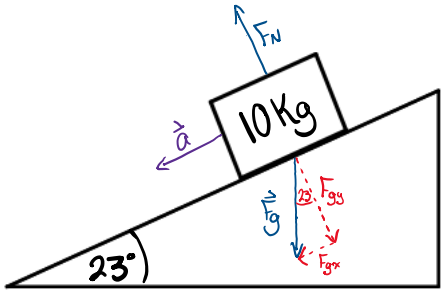
Lesson 2.3A – Inclined Planes & Pulleys

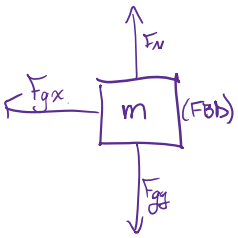
Unit 2: Dynamics and Equilibrium

Ignoring Friction

Example 1: Find the acceleration of a 10 Kg block sliding down a plane at a 23° inclination.



* F_{net} causing acceleration is due to the components of F_g in the direction of the plane



y-direction

$F_{net_y} = 0$

$\therefore F_N = F_{gy}$

x-direction

$F_{net_x} = m\vec{a}_x$

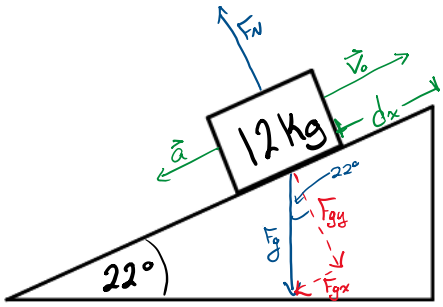
$F_{gx} = m\vec{a}_x$

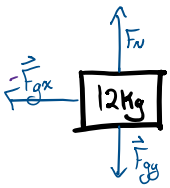
$mg\sin\theta = m\vec{a}_x$ * mass is irrelevant.

$\vec{a}_x = 9.8\sin(23)$

$= 3.83 m/s^2$

Example 2: A 12 Kg block is given an initial push up a 22° frictionless ramp, resulting in a velocity of 16 m/s. how far up the ramp will it travel?





find $\vec{a}_x$

$\vec{F}_{net} = m\vec{a}_x$

$-\vec{F}_{gx} = ma_x$

$\vec{a}_x = -\frac{mg\sin\theta}{m}$

$\vec{a}_x = -9.8\sin(22)$

$= -3.67 m/s^2$

find d_x

$\vec{V}_o = 16 m/s$

$\vec{V} = 0 m/s$

$\vec{a} = -3.67 m/s^2$

$V^2 = V_o^2 + 2\vec{a}d$

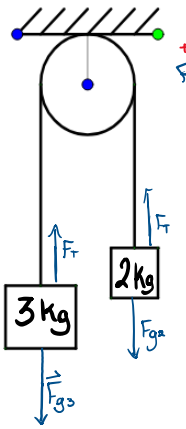
$\vec{d}_x = \frac{V^2 - V_o}{2\vec{a}}$

$= \frac{0 - 16^2}{2(-3.67)}$

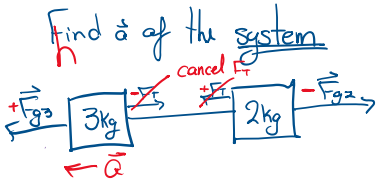
$d_x = 34.9 m$ or $35 m$

here we are going to practice rearranging equations.

Example 3: Find the tension in the rope and the acceleration of the system.



Find $\vec{a}$ of the system



$\vec{F}_{net} = m_T\vec{a}$

$\vec{F}_{g3} - F_{g2} = m_T\vec{a}$

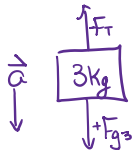
$m_3g - m_2g = m_T\vec{a}$

$\frac{g(m_3 - m_2)}{m_T} = \vec{a}$

$\vec{a} = \frac{9.8(3-2)}{5}$

$= 1.96 m/s^2$ down from m_3

Find F_T using 1 of the masses



$\vec{F}_{net} = m_3\vec{a}$

$m_3g - F_T = m_3\vec{a}$

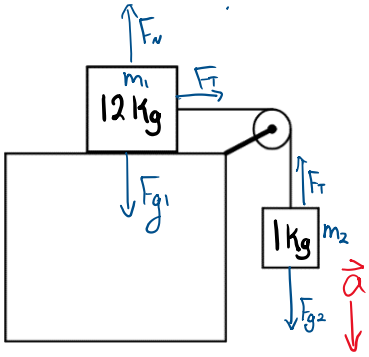
$F_T = m_3g - m_3a$

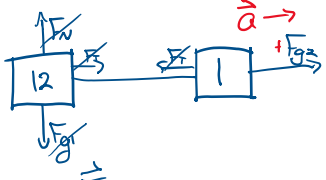
$F_T = m_3(g-a)$

$= 3(9.8-1.96)$

$F_T = 23.5N$

Example 4: Find the force of tension in the rope and acceleration of the system.





$\vec{F}_{net} = m_T\vec{a}$

$m_2g = (m_1 + m_2)\vec{a}$

$1(9.8) = (12+1)\vec{a}$

$\vec{a} = \frac{9.8}{13} = 0.754 m/s^2$ down

$\vec{F}_{net} = m_2\vec{a}$

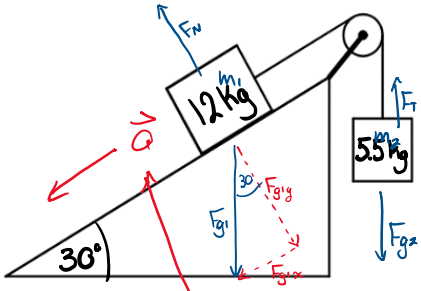
$m_2g - F_T = m_2\vec{a}$

$1(9.8) - F_T = 1(0.754)$

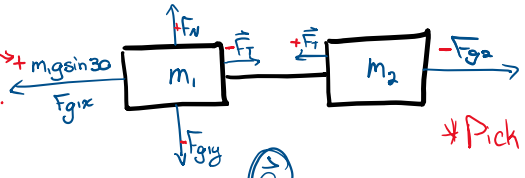
$F_T = 9.8 - 0.754$

$\vec{F}_T = 9.05N$

Example 5: Find the force of tension in the rope and acceleration of the system.



We make a guess → if $\vec{a}$ is neg, we were backwards.



*Pick the simplest mass

$\vec{F}_{net} = m_T\vec{a}$

$F_{g1x} - F_{g2} = m_T\vec{a}$

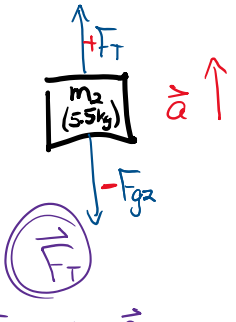
$m_1g\sin 30 - m_2g = (m_1 + m_2)\vec{a}$

$12(9.8)\sin 30 - 5.5(9.8) = (12+5.5)\vec{a}$

$4.9 = 17.5\vec{a}$

$\vec{a} = 0.28 m/s^2$

*since $\vec{a}$ is (+), we guessed correctly!



$\vec{F}_{net} = m_2\vec{a}$

$F_T - F_{g2} = m_2\vec{a}$

$F_T = m_2\vec{a} + m_2g$

$= m_2(\vec{a} + \vec{g})$

$= 5.5(0.28 + 9.8)$

$F_T = 55.4N$ or $55N$

Assignment: WS 2.3 – Incline Planes and Pulleys (no friction) **AND** BC Science Physics 12 Pg. 57 #1-4