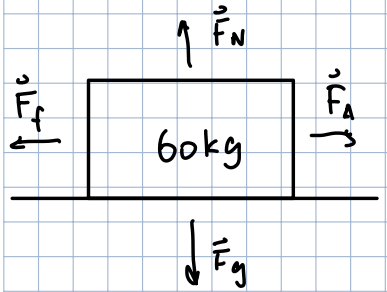
Example 1

Moxie is a spacesuit (58kg) is sitting on a 2kg sled on a flat, snowy field. What horizontal force must be used so she accelerates from rest to 2.6m/s in 4.2s. The coefficient of friction between snow and sled is 0.16m



② Force

V

$\vec{F}_{Net} = \vec{F}_N + \vec{F}_g$

$60(0) = \vec{F}_N + 60(9.81)$

$\vec{F}_N = 588.6\,N[U]$

H

$\vec{F}_{Net} = \vec{F}_f + \vec{F}_A$

$(60)0.619[R] = 94.176[L] + \vec{F}_A$

$\vec{F}_A = 131.32\,N[R]$

① Kinematics

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

$\vec{V}_f = 2.6\,m/s\,[R]$

$t = 4.2\,s$

$\vec{F}_f = \mu\vec{F}_N$

$\vec{F}_f = 0.16\,(588.6)$

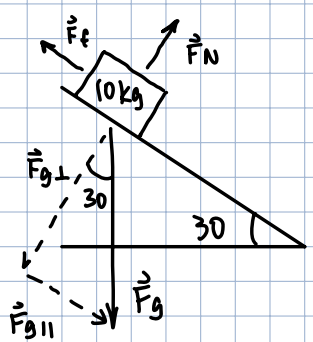
$\vec{F}_f = 94.176\,N[L]$

$$\vec{a} = \frac{\vec{V}_f - \vec{V}_i}{t} = \frac{2.6-0}{4.2} = 0.619\,m/s^2[R]$$

Calculate the acceleration of the block:

a) with no friction

b) if u = 0.2



$\vec{F}_{g\perp} = 10(9.81)\cos 30 = 84.96["D"]$

$\vec{F}_{g11} = 10(9.81)\sin 30 = 49.05["R"]$

⊥

$\vec{F}_{Net} = \vec{F}_{g\perp} + \vec{F}_N$

$10(0) = 85["D"] + \vec{F}_N$

$\vec{F}_N = 85\,N["U"]$

$\vec{F}_f = \mu\vec{F}_N = 0.2(85) = 17.0\,N["L"]$

11

$\vec{F}_{Net} = \vec{F}_{g11}$

$10\,\vec{a} = 49.05N["R"]$

$\vec{a} = 4.91\,m/s^2["R"]$

b)

$\vec{F}_{Net} = \vec{F}_{g11} + \vec{F}_f$

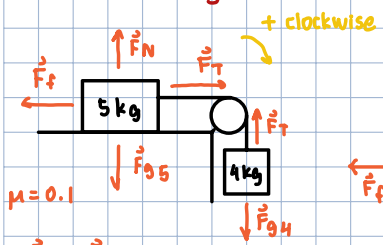
$10\,\vec{a} = 49.05N["R"] + 17["L"]$

$\vec{a} = 3.21\,m/s^2["R"]$

Example 3

Find the acceleration of the blocks and tension on string if u = 0.1

Grade 11 way

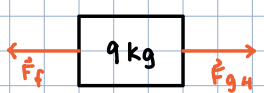


$\vec{F}_N = \vec{F}_{g5}$

$\vec{F}_f = \mu\vec{F}_N = \mu\vec{F}_{g5} = 0.1 \cdot 5 \cdot 9.81$

$= 4.91\,[ccw]$

Whole system



$\vec{F}_{Net} = \vec{F}_f + \vec{F}_{g4}$

$9\vec{a} = 4.91\,[ccw] + 4(9.81)\,[cw]$

$\vec{a} = 3.82 m/s^2\,[cw]$

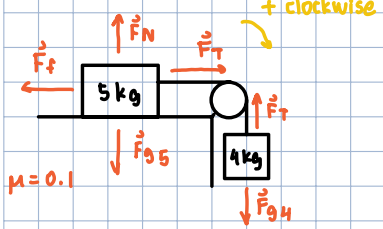
4 kg :

$\vec{F}_{Net} = \vec{F}_T + \vec{F}_{g4}$

$4(3.82)[cw] = \vec{F}_T + 4(9.81)[cw]$

$\vec{F}_T = 23.96\,N[ccw]$

Grade 12 way



cw

5 kg

$\vec{F}_{Net} = \vec{F}_T + \vec{F}_f$

$5\vec{a} = \vec{F}_T - 4.91$ ①

4 kg

$\vec{F}_{Net} = \vec{F}_T + \vec{F}_{g4}$

$4\vec{a} = -\vec{F}_T + 39.2$ ②

① + ②

$5\vec{a} = \vec{F}_T - 4.91$

$+4\vec{a} = -\vec{F}_T + 39.2$

$9\vec{a} = 34.3$

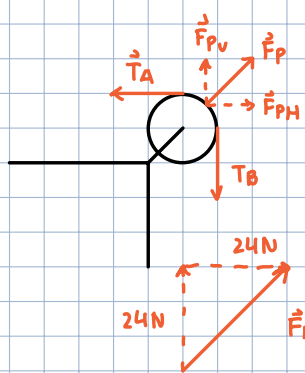
$\vec{a} = 3.81 m/s^2\,[cw]$

Sub $\vec{a}$ into ①

$5(3.81) = \vec{F}_T - 4.91$

$\vec{F}_T = 24\,N\,[cw, ccw]$

What force is the pulley (massless and frictionless) acting on system?



V

$\vec{F}_{Net} = T_B + \vec{F}_{PV}$

$0 = 24[D] + \vec{F}_{PV}$

$\vec{F}_{PV} = 24N[U]$

H

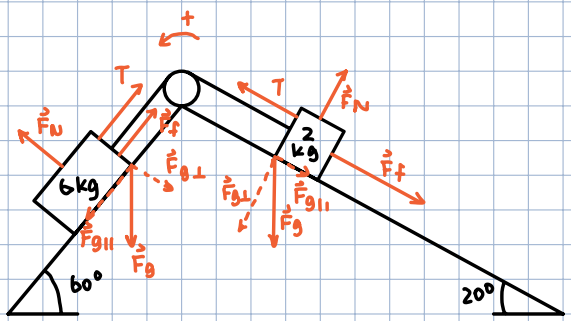
$\vec{F}_{Net} = T_A + \vec{F}_{PH}$

$0 = 24[L] + \vec{F}_{PH}$

$\vec{F}_{PH} = 24N[R]$

Angled Ramp Example 1

Find: a, T and Fp if u = 0.1



⊥ | ||

6 kg

$\vec{F}_{Net} = \vec{F}_N + \vec{F}_{g\perp}$

$0 = \vec{F}_N + 6(9.81)\cos 60\,[-]$

$\vec{F}_N = 29.43\,N\,[+]$

$\vec{F}_{Net} = T + \vec{F}_f + \vec{F}_{g11}$

$6\vec{a} = -T - 2.94 + 6 \cdot 9.81 \cdot \sin 60$

$6\vec{a} = -T + 48.03$ ①

$\vec{F}_f = \mu \vec{F}_N$

$= 0.1(29.4)$

$= 2.94\,N\,[cw]$

2 kg

$\vec{F}_{Net} = \vec{F}_N + \vec{F}_{g\perp}$

$0 = \vec{F}_N + 2(9.81)\cos 20\,[-]$

$\vec{F}_N = 18.4\,N$

$\vec{F}_{Net} = T + \vec{F}_f + \vec{F}_{g11}$

$2a = T - 1.84 - 2 \cdot 9.81 \sin 20$

$2a = T - 8.55$ ②

$\vec{F}_f = \mu \vec{F}_N$

$= 0.1(18.4)$

$= 1.84\,N\,[cw]$

① + ②

$6\vec{a} = -T + 48$

$+2\vec{a} = T - 8.55$

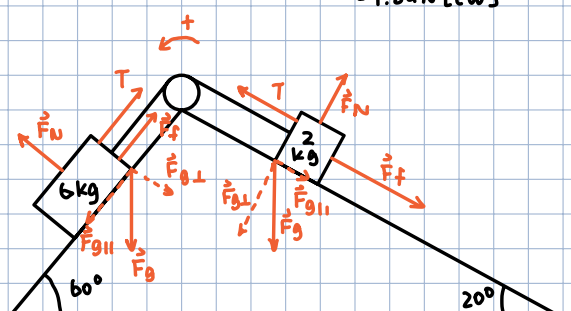
$8\vec{a} = 39.4$

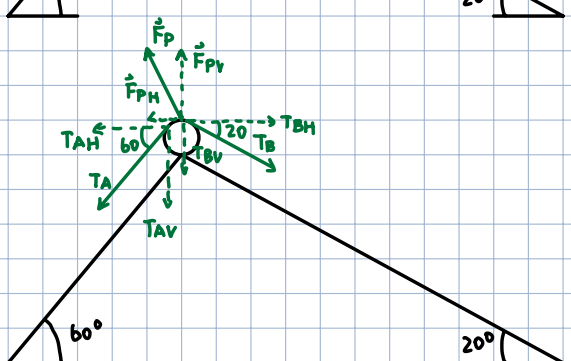
$\vec{a} = 4.94\,m/s^2\,[ccw]$

Sub into ②

$2(4.94) = T - 8.55$

$T = 18.4\,N\,[cw, ccw]$





V

$\vec{F}_{Net} = \vec{F}_{PV} + T_{AV} + T_{BV}$

$0 = \vec{F}_{PV} - T_A \sin 60 - T_B \sin 20$

$0 = \vec{F}_{PV} - 18.4 \sin 60 - 18.4 \sin 20$

$0 = \vec{F}_{PV} - 22.2$

$\vec{F}_{PV} = 22.2\,N\,[U]$

H

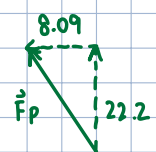
$\vec{F}_{Net} = \vec{F}_{PH} + T_{AH} + T_{BH}$

$0 = \vec{F}_{PH} - T_A \cos 60 + T_B \cos 20$

$0 = \vec{F}_{PH} - 18.4 \cos 60 + 18.4 \sin 20$

$0 = \vec{F}_{PH} + 8.09$

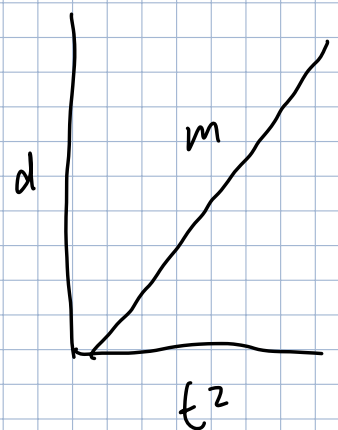
$\vec{F}_{PH} = 8.09\,N\,[L]$



$\vec{F}_P = \sqrt{22.2^2 + 8.90^2}$

$= 23.6\,N\,[U20°L]$

$\tan\theta = \frac{8.09}{22.2}$ $\theta = 20°$



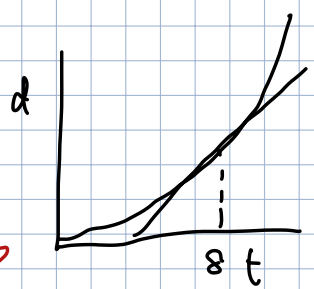
$d = m t^2$

$\% = \frac{th - meas}{th}$

$d = \cancel{v_i t}^{0} + \frac{1}{2} a t^2$

$d = \frac{1}{2} a t^2$

$th = 9.81$



slope = v_{inst} (8)