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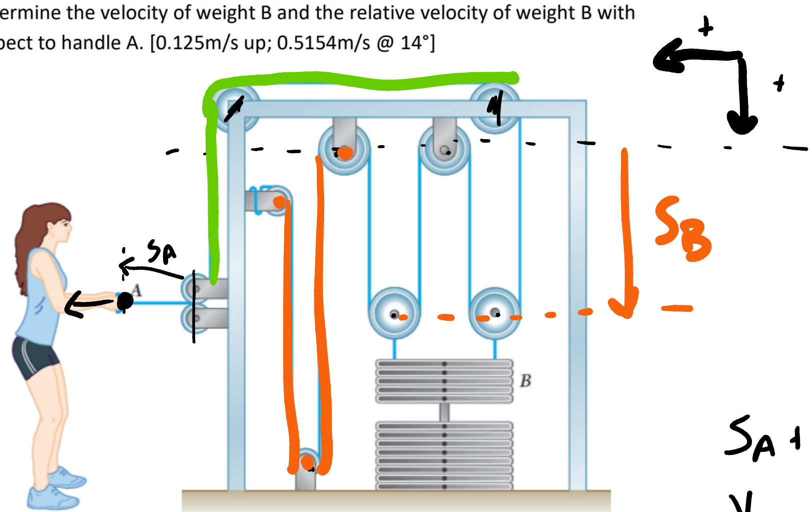
An athlete pulls handle A to the left with a constant velocity of 0.5 m/s. Determine the velocity of weight B and the relative velocity of weight B with respect to handle A. [0.125m/s up; 0.5154m/s @ 14°]



$$S_A + 4S_B = l$$

$$V_A + 4V_B = 0$$

$$V_B = -\frac{V_A}{4} = \frac{-.5}{4} = (-)1.25$$

$$= 1.25\hat{j}\uparrow$$

$$V_{B/A} = V_B - V_A = -1.25\hat{j} - 0.5\hat{i}$$

$$V_B = -1.25\hat{j}$$

$$V_A = 0.5\hat{i}$$

$$|V_{B/A}| = \sqrt{(-1.25)^2 + (.5)^2}$$

$\hat{j}$ $\hat{i}$

$$= .5154$$

$$\theta = \tan^{-1}\left(\frac{1.25}{.5}\right) = 14°$$

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$\Sigma F = 0$

$\Sigma \bar{F} = m\bar{a}$ (vector)

x-y coordinate

$\Sigma F_x = ma_x$

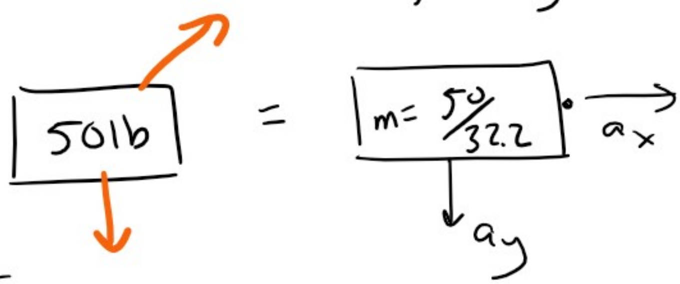
$\Sigma F_y = ma_y$

$(\Sigma F_z = ma_z)$

N-T coordinate

$$\Sigma \bar{F} = m\bar{a}$$

pay attention to mass [Kg]
weight [lb]

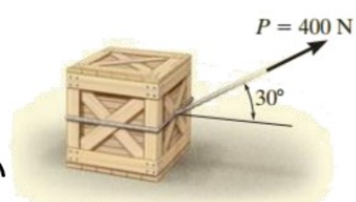


$+\downarrow \Sigma F_y = ma_y$

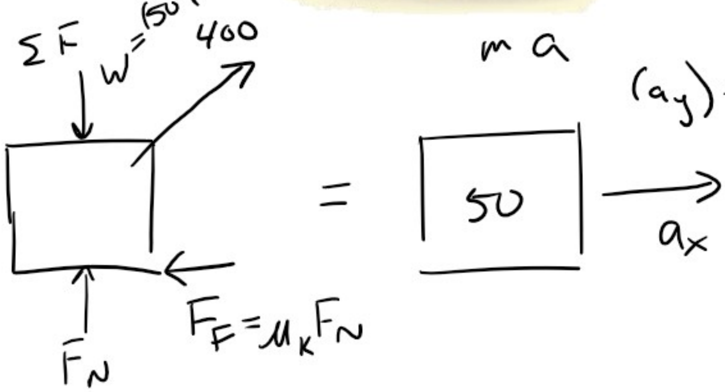
$50 + \ldots = \frac{50}{32.2} a_y$

Example 1

The 50 kg crate shown rests on a horizontal surface where the coefficient of friction is $\mu_k = 0.3$. If the crate is subjected to a 400N towing force as shown, determine the velocity of the crate in 3s after starting from rests



FBD



$(a_y) = 0$ stays on ground

$\Sigma F_x = ma_x$

$+\uparrow \Sigma F_y = ma_y$

0,

$\Sigma F_x = ma_x$

$400\cos 30 - \mu_k F_N = 50\, a_x$

$400\cos 30 - (.3)(290.5) = 50\, a_x$

$a_x = 5.19\ m/s^2$

$+\uparrow \Sigma F_y = ma_y$

$F_N - 490.5 + 400\sin 30 = \cancel{50}(0)$ 0

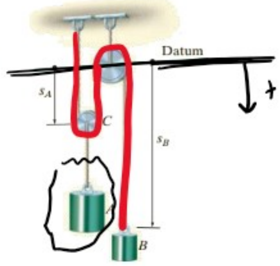
$F_N = 290.5N$

$V_f = \cancel{V_0}^{0} + at$

$= 5.19(3) = 15.6\ m/s$

Example 2

The 100 kg block A is released from rest. If the masses of the pulley and the cord are neglected, determine the velocity of the 20 kg block B in 2s

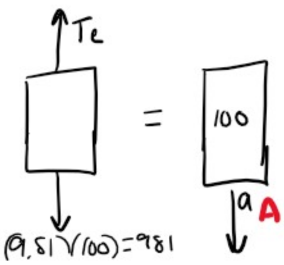


$2S_A + S_B = l$

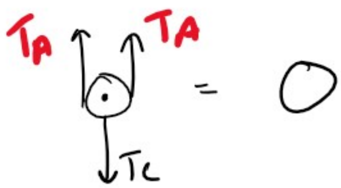
$2V_A + V_B = 0$

$2A_A + A_B = 0 \quad (1) \qquad A_B = -2A_A$

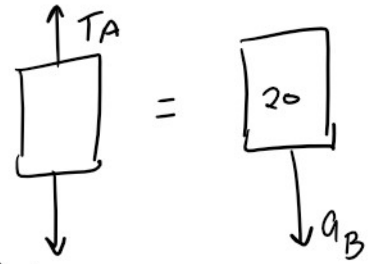
Block A



Point c



Block B



(2)

$+\downarrow \Sigma F_y = ma_y$

$981 - T_c = (100)(A_A)$

(3) → (2)

$981 - 2T_A = 100 A_A$

$981 - 2(196.2 + 40A_A) = 100 A_A$

$981 - 392.4 - 80A_A = 100A_A$

$A_A = 3.27 \ m/s^2$

(3) $\downarrow \Sigma F_y = ma_y$

$-2T_A + T_c = 0$

$T_c = 2T_A$

(4) $W = (20)(9.81)$

196.2

$\downarrow \Sigma F_y = ma_y$

$196.2 - T_A = 20(A_B)$

$196.2 - T_A = 20(-2A_A)$ (1) → (2)

$196.2 - T_A = -40A_A$

$T_A = 196.2 + 40A_A$

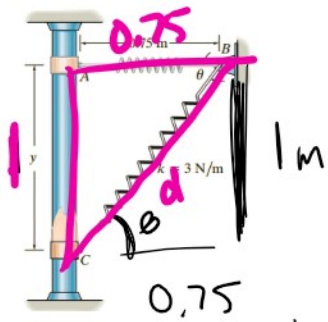
$A_B = -2(3.27) = -6.54 \ m/s^2$

$V_f = V_o + a_B t$

$= 0 + (-6.54)(2) = -13.1 \ m/s$

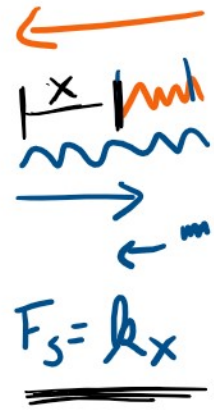
Example 3

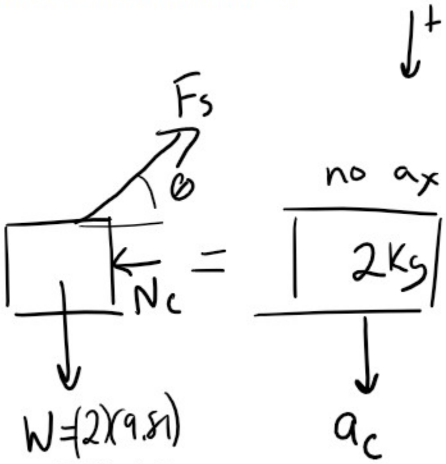
A smooth 2 kg collar is attached to a spring having a stiffness k = 3 N/m and an unstretched length of 0.75m. If the collar is released from rest at A, determine its acceleration and the normal force of the rod on the collar at the instant y = 1m.



0,75

$$\theta = \tan^{-1}\left(\frac{1}{.75}\right) = 53.1^\circ$$





$$W = (2)(9.81) = 19.62$$

$$\xrightarrow{+} \Sigma F_x = m a_x$$

$$-N_c + F_s \cos\theta = 0$$

$$N_c = 1.5\cos(53.1) = 0.9\,N$$

$$+\downarrow \Sigma F_y = m a_y$$

$$19.62 - F_s \sin\theta = 2a_c$$

$$19.62 - 1.5\sin(53.1) = 2a_c$$

$$a_c = 9.21\,m/s^2 \downarrow$$

$$F_s = Kx = (3)(.5) = 1.5\,N$$

$$d = \sqrt{1^2 + .75^2} = 1.25$$

$$x = d - .75 = .5$$