Homework 4 chapter 4

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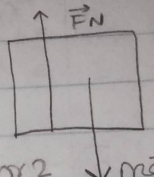
chapter-4
Homework-4 [10, 11, 24, 33, 35]

Q10] a] The 20.0kg box resting on the table has the free-body diagram. Its weight is $mg = (20.0\,kg)(9.80\,m/s^2) = \boxed{196\,N}$



So the normal force is also $\boxed{196\,N}$

b] Free body diagrams are shown for both boxes. $\vec{F}_{12}$ is the force on box 1 due to box 2. Newton's 3rd law. $\vec{F}_{N2}$ is the force of the table on box 2.

$\Sigma F_1 = F_{N1} - m_1 g = 0$

$F_{N1} = m_1 g = (10.0\,kg)(9.80\,m/s^2) = \boxed{98.0\,N}$

$\Sigma F_2 = F_{N2} - F_{21} - m_2 g = 0$

$F_{N2} = F_{21} + m_2 g = 98.0\,N + (20.0\,kg)(9.80\,m/s^2) = \boxed{294\,N}$

Q11] Average force is mass times the average acceleration for the pellet $v_0 = 0$, $v = 125\,m/s$, and $x - x_0 = 0.800\,m$

$a_{avg} = \frac{v^2 - v_0^2}{2(x - x_0)} = \frac{(125\,m/s^2) - 0}{2(0.800\,m)} = 9766\,m/s^2$

$F_{avg} = m a_{avg} = (9.26 \times 10^{-3}\,kg)(9766\,m/s^2) = \boxed{89.8\,N}$

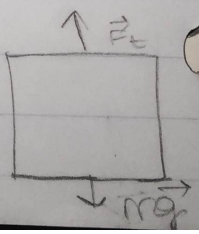
Q24] Newtons second law

$\Sigma F = F_T - mg = ma \rightarrow$

$a = \frac{F_T - mg}{m} = \frac{21,750\,N - (2125\,kg)(9.80\,m/s^2)}{2125\,kg}$

$= \boxed{0.4353\,m/s^2}$

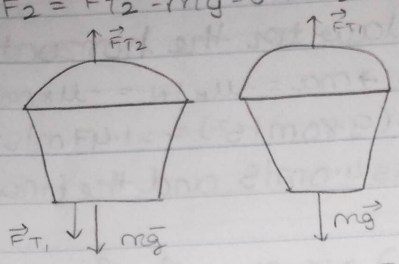
$\approx \boxed{0.44\,m/s^2}$



33] a] buckets are in rest so acceleration is 0, Newtons second law

$\Sigma F_1 = F_{T_1} - mg = 0 \rightarrow F_{T_1} = mg = (3.2\,kg)(9.80\,m/s^2) = \boxed{31\,N}$

$\Sigma F_2 = F_{T_2} - mg = 0 \rightarrow F_{T_2} = F_{T_1} + mg = 2mg = 2(3.2\,kg)(9.80\,m/s^2) = \boxed{63\,N}$



b] $\Sigma F_1 = F_{T_1} - mg = ma \rightarrow F_{T_1} = mg + ma = (3.2\,kg)(9.80\,m/s^2 + 1.25\,m/s^2) = 35.36\,N = \boxed{35\,N}$

$\Sigma F_2 = F_{T_2} - F_{T_1} - mg = ma \rightarrow F_{T_2} = F_{T_1} + mg + ma = 2F_{T_1} = \boxed{71\,N}$

35] y direction = forward

x direction = right

Newtons second law for the x direction

$\Sigma F_x = F_{Ax} + F_{Bx} = 0 \rightarrow -F_A \sin 48° + F_B \sin 32° = 0 \rightarrow$

$F_B = \frac{F_A \sin 48°}{\sin 32°} = \frac{(4500\,N)\sin 48°}{\sin 32°} = \boxed{6311\,N = 6300\,N}$

Sum of all y components

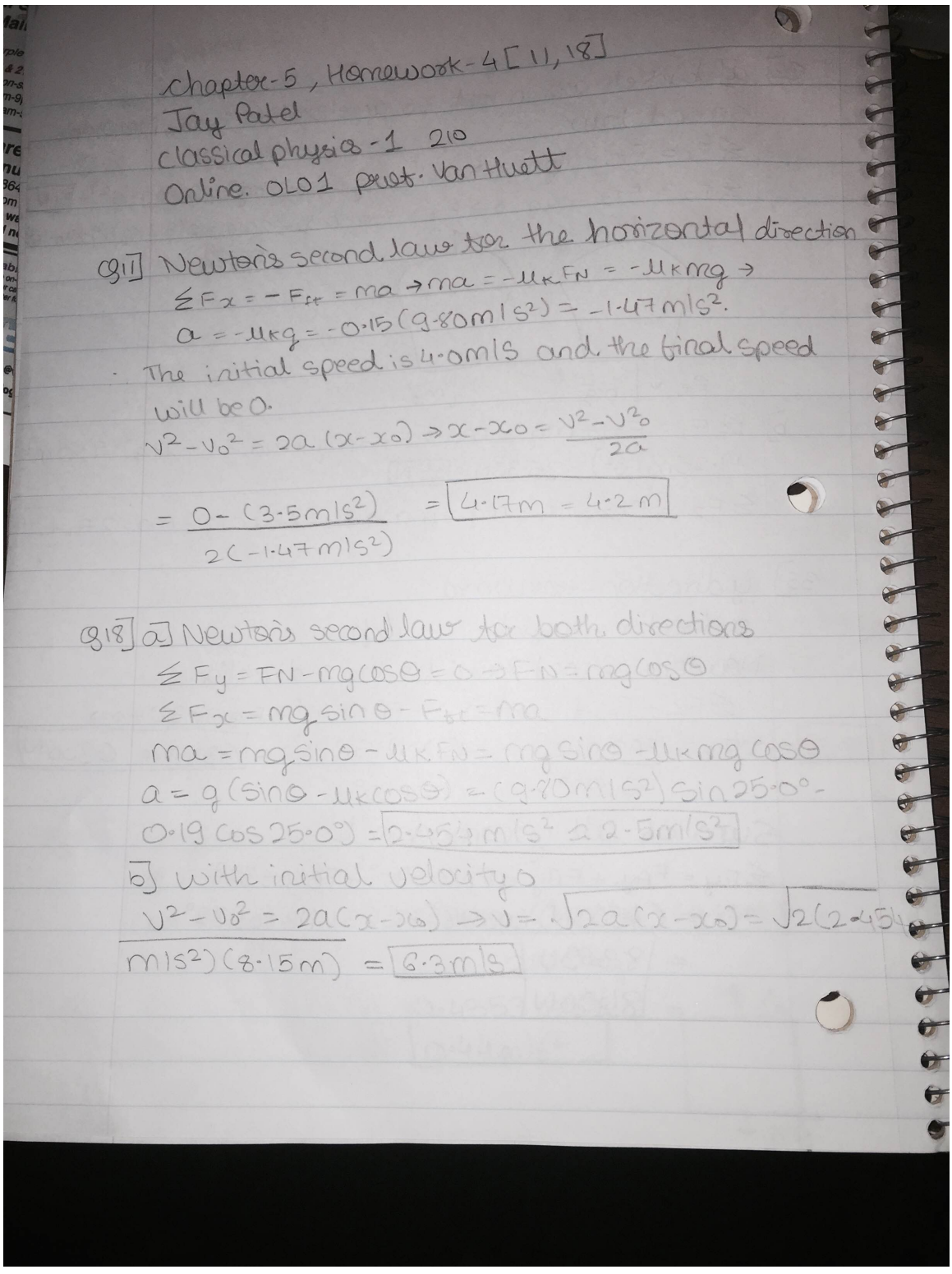
$\Sigma F_y = F_{Ay} + F_{By} = F_A \cos 48° + F_B \cos 32°$

$= (4500\,N)\cos 48° + (6311\,N)\cos 32°$

$= \boxed{8363\,N}$

$= \boxed{8400\,N}$

Homework 4 chapter 5



Chapter-5, Homework-4 [11, 18]
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Q11] Newtons second law for the horizontal direction

$\Sigma F_x = -F_{kf} = ma \rightarrow ma = -\mu_k F_N = -\mu_k mg \rightarrow$

$a = -\mu_k g = -0.15(9.80 m/s^2) = -1.47 m/s^2.$

The initial speed is 4.0 m/s and the final speed will be 0.

$v^2 - v_0^2 = 2a(x - x_0) \rightarrow x - x_0 = \frac{v^2 - v_0^2}{2a}$

$= \frac{0 - (3.5 m/s^2)}{2(-1.47 m/s^2)} = \boxed{4.17 m = 4.2 m}$

Q18] a] Newtons second law for both directions

$\Sigma F_y = F_N - mg\cos\theta = 0 \rightarrow F_N = mg\cos\theta$

$\Sigma F_x = mg\sin\theta - F_{kf} = ma$

$ma = mg\sin\theta - \mu_k F_N = mg\sin\theta - \mu_k mg\cos\theta$

$a = g(\sin\theta - \mu_k\cos\theta) = (9.80 m/s^2)\sin 25.0° - 0.19\cos 25.0°) = \boxed{2.45 m/s^2 \approx 2.5 m/s^2}$

b] with initial velocity 0

$v^2 - v_0^2 = 2a(x - x_0) \rightarrow v = \sqrt{2a(x - x_0)} = \sqrt{2(2.45 m/s^2)(8.15 m)} = \boxed{6.3 m/s}$