key Level I Physics pd:3

Dynamics

AT Dynamics (16)

Directions: Solve the following problems. Show all work and circle your answers. This test is worth 50 points.

1) Determine the weight of a 5 kg object.

$W = mg$

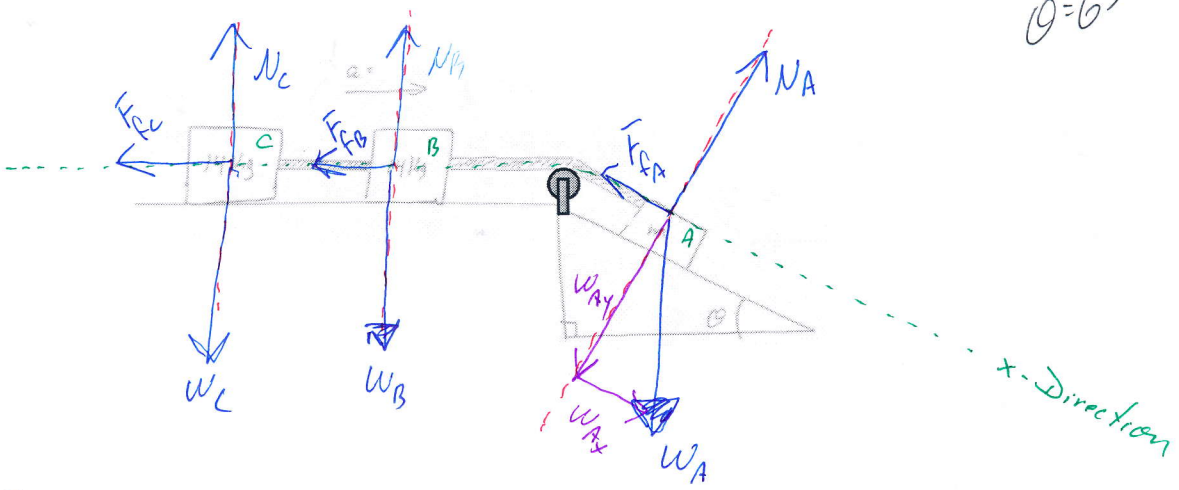
$W = (5kg)9.8 m/s^2$

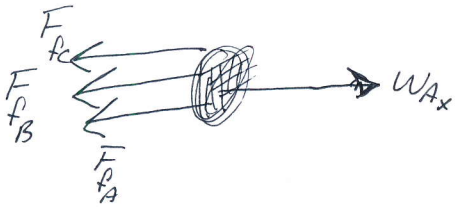
$W = 49N$

Direction Optional

2) All boxes have a coefficient of static friction of 0.8 and a coefficient of kinetic friction of 0.3. Determine the mass of the box on the incline for the boxes to accelerate at 3 m/s^2

$\theta = 63^0$





Each Box Will Be "Viewed" Independently To Determine Friction

$\Sigma F_{y_C} = N - W_C = 0$

$N = m_C g$

$\Sigma F_{y_B} = N_B - W_B = 0$

$N_B = m_B g$

$\Sigma F_{y_A} = N_A - W_{Ay} = 0$

$N_A = m_A g \cos\theta$

$\Sigma F_x = W_{Ax} - F_{f_C} - F_{f_B} - F_{f_A} = m_{ABC} a$

$m_A g \sin\theta - \mu N_C - \mu N_B - \mu N_A = m_{ABC} a$

$m_A g \sin\theta - \mu m_C g - \mu m_B g - \mu m_A g \cos\theta = (m_{ABC}) a$

$$m_A = \frac{m_{(ABC)} a + \mu m_C g + \mu m_B g + \mu m_A g \cos\theta}{g \sin\theta}$$

$$m_A = \frac{(m_A + m_B + m_C) a + \mu m_C g + \mu m_B g + \mu m_A g \cos\theta}{g \sin\theta}$$

$m_A g \sin\theta = m_A a + m_B a + m_C a + \mu m_C g + \mu m_B g + \mu m_A g \cos\theta$

$m_A g \sin\theta - m_A a - \mu m_A g \cos\theta = m_B a + m_C a + \mu m_C g + \mu m_B g$

$m_A (g \sin\theta - a - \mu g \cos\theta) = m_B a + m_C a + \mu m_C g + \mu m_B g$

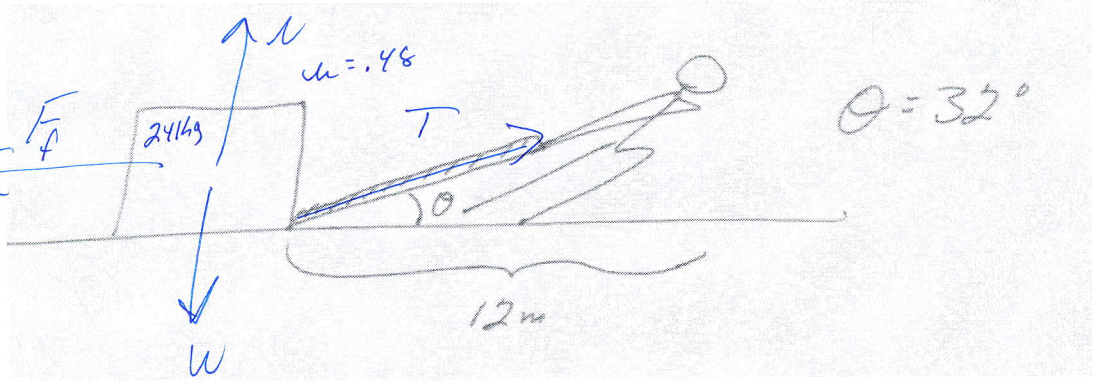
$$m_A = \frac{m_B a + m_C a + \mu m_C g + \mu m_B g}{(g \sin\theta - a - \mu g \cos\theta)} = \frac{(14kg)(3 m/s^2) + (14kg)(3 m/s^2) + (.3)(14kg)(9.8 m/s^2)}{(9.8 m/s^2 \sin 63^0 - 3 m/s^2 - (.3)(9.8 m/s^2) \cos 63^0)}$$

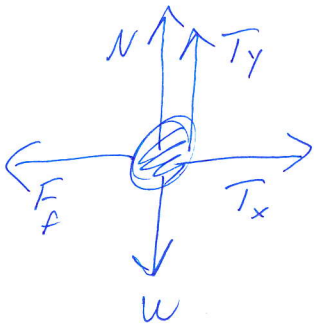
Since $m_B = m_C$ ∴ $m_B + m_C = 2m_B$ or $2m_C$

$$= m_A = \frac{2m_B a + 2\mu m_B g}{(g \sin\theta - a - \mu g \cos\theta)} = \frac{2m_B (a + \mu g)}{(g \sin\theta - a - \mu g \cos\theta)} = \frac{2(14kg)(3 m/s^2 + (.3)(9.8 m/s^2))}{(9.8 m/s^2 \sin 63^0 - 3 m/s^2 - (.3)(9.8 m/s^2) \cos 63^0)}$$

37.8 kg (81.1 kg)

3)The box is being pulled at a constant 2 m/s, and it has a mass of 24 kg. The coefficient of kinetic friction is 0.48 and the coefficient of static friction is 0.55. Determine the tension in the rope. Even though the diagram does not show it, assume all of the forces act at a point.





$\Sigma F_x = T_x - F_f = 0$

$T\cos\theta - \mu N = 0$

$T\cos\theta = \mu N$

$\Sigma F_y = T_y + N - W = 0$

$T\sin\theta + N = W$

$W - T\sin\theta = N$

$T\cos\theta = \mu(W - T\sin\theta)$

$T\cos\theta = \mu mg - T\mu\sin\theta$

$T\cos\theta + T\mu\sin\theta = \mu mg$

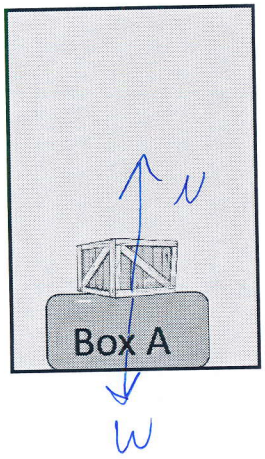
$$T = \frac{\mu mg}{(\cos\theta + \mu\sin\theta)}$$

$$T = \frac{(.48)(24kg)(9.8\,m/s^2)}{[\cos 32° + (.48)(\sin 32°)]}$$

$T = 102.4\,N$

4) Both box A and the wooden crate in the diagram are in an elevator (The shaded box). The wooden crate weighs 658 pounds, and box A weighs 598 pounds. Determine the force exerted on the wooden crate by Box A when the elevator accelerates upward at $2m/^{s}$.

$(658 \text{ pounds})\left(\frac{4.4\,N}{1\,lb}\right) = 2895\,N$



$\Sigma F_y = N - W = ma$

$N = ma + W$

$N = ma + mg$

$N = m(a + g)$

$N = (295\,kg)(2\,m/s^2 + 9.8\,m/s^2)$

$N = 3481\,N = 791\,lb$

~~$W = mg$~~

$W = mg$

$\frac{2895\,N}{9.8\,m/s^2} = m$

$295\,kg = m$

5) Determine the mass of a 220 pound person.

$(220\,lb)\left(\frac{4.4\,N}{1\,lb}\right) = 968\,N$

$\frac{968\,N}{9.8\,m/s^2} = 98\,kg$