key Level I Physics Pd 2

Dynamics Test

AT Dynamics(10)

Solve the following problems showing ALL work and CIRCLING your answers. Each is worth 5 points.

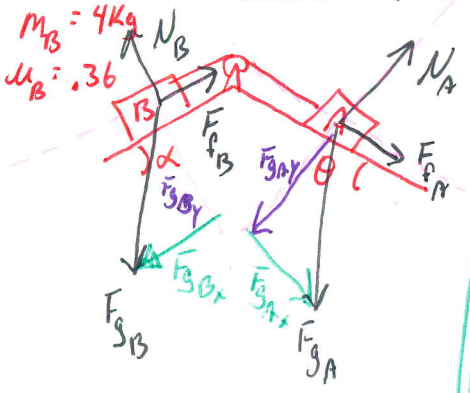
1) A 5 kg object is at rest on the table. The only forces acting on the object is gravity and the upward normal force of the table. Determine the weight of the object.

$F_g = mg = (5kg)(9.8 m/s^2) = 49 N$

2) A box weighing 35N is initially on an incline that slopes downward to the right. The angle with the incline and the horizontal is 25 degrees. This box has a coefficient of friction of 0.2 with the incline surface. A rope is attached to the box that runs to the top of the incline, over a pulley, and down an incline on the other side. The end of the rope is attached to another box of mass 4 kg. The 4 kg box is initially at rest on an incline that slopes downward to the left at a 30-degree angle. The 4 kg box has a coefficient of friction of 0.36 with the surface of the incline. Will the boxes accelerate beyond the initial condition? Determine the acceleration, including the direction of the acceleration.

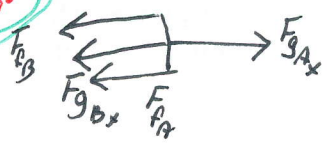
$F_{g_A} = 35N$
$\mu_A = .2$

$m_B = 4Kg$
$\mu_B = .36$



$\theta = 25°$
$\alpha = 30°$

Switch Direction of Friction To Test If It will Go To the Right



$$\Sigma F_{x_{(AB)}} = F_{g_A}\sin\theta - F_{g_B}\sin\alpha - F_{f_B} - F_{f_A} = m_{(A+B)}a$$

[moving Left]

$$F_{g_A}\sin\theta - m_B g\sin\alpha - \mu_B N_B - \mu_A N_A = m_{(AB)}a$$

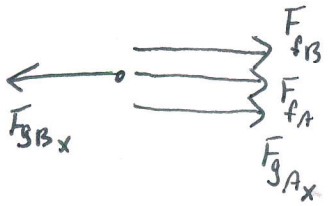
$$F_{g_A}\sin\theta - m_B g\sin\alpha - \mu_B F_{g_B}\cos\alpha - \mu_A F_{g_A}\cos\theta = m_{(A+B)}a$$

$$\frac{(35N)\sin(25°) - (4Kg)(9.8m/s^2)\sin(30°) - (.36)(4Kg)\cos(30°) - (.2)35N}{7.6Kg}$$

$a = -1.63 m/s^2$ --

Once Again, Can't Accel Due To Friction

a = Zero



$$\Sigma F_{x_{BA}} = F_{f_B} + F_{f_A} + F_{g_{A_x}} - F_{g_{B_x}} = m_{(A+B)}a$$

$$\mu_B N_B + \mu_A N_A + F_{g_A}\sin\theta - F_{g_B}\sin\alpha = m_{(A+B)}a$$

$$\Sigma F_{y_A} = N_A - F_{g_{A_y}} = 0$$

$$N_A = F_{g_A}\cos\theta$$

$$\Sigma F_{y_B} = N - F_{g_{B_y}} = 0$$

$$N_B = F_{g_B}\cos\alpha$$

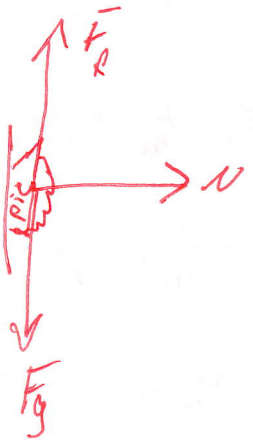
$$\mu_B F_{g_B}\cos\alpha + \mu_A F_{g_A}\cos\theta + F_{g_A}\sin\theta - F_{g_B}\sin\alpha = m_{(A+B)}a$$

$$\mu_B m_B g\cos\alpha + \mu_A F_{g_A}\cos\theta + F_{g_A}\sin\theta - m_B g\sin\alpha = m_{(A+B)}a$$

$$\frac{(.36)(4Kg)(9.8m/s^2) + (.2)(35N)\cos(25°) + (35N)\sin(25°) - (4Kg)(9.8m/s^2)\sin(30°)}{[4Kg + 3.6Kg]} = a = 2.06 m/s^2$$

Can't Accel Due To Friction

3) "Splating" someone in the face with a pie is a classic bit of slap-stick humor… Image the scenario…a "Whipped Cream" pie is sitting on a table. Someone picks up the pie because someone desperately needs it smacked in his or her face. As the person picks up the pie, they begin to accelerate the pie forward and at the same time tilt the pie toward the person's face. Ultimately. The pie will be tilted forward until the contact surface of the bottom of the pie plate and the person's hand will be perpendicular to the horizontal. Figure that the coefficient of friction between the pie plate and the person's hand is 0.83. Determine the least amount of forward acceleration that will prevent the pie from sliding down the person's hand prior to smacking the other person in the face with the pie. The pie will have a mass of 1.4 kg and the bottom of the pie plate will be 9 inches in diameter. (1in=2.54 cm)



$$\Sigma F_x = N = ma$$

$$\Sigma F_y = F_p - F_g = 0$$

$$\mu N = F_g$$

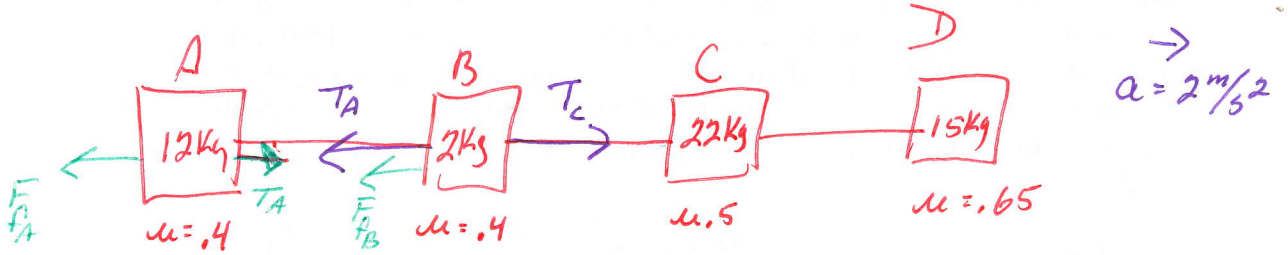
$$\mu ma = mg$$

$$\mu a = g$$

$$a = \frac{g}{\mu} = \frac{9.8\ m/s^2}{.83} = 11.8\ m/s^2$$

$2\ m/s^2$ to the right

4) There are 4 boxes. Box A has a mass 12 kg and is resting on a surface with a coefficient of friction of 0.4. To the right of box A is box B. Box B has mass of 2 kg and a coefficient of friction on the surface it is sitting on of 0.4. To the right of box B is Box C. Box C has a mass of 22 kg and a coefficient of friction of 0.5. To the right of Box C is Box D, Box D has a mass of 15 kg and coefficient of friction of 0.65. Determine the tension in the string between box B and box C.



~~$\Sigma F_{A_x} = T_A = ma$~~

$\Sigma F_{A_y} = T_A - F_{f_A} = m_A a$

$T_A = m_A a + F_{f_A}$

$T_A = m_A a + \mu_A N_A$

$T_A = m_A a + \mu_A m_A g$

$T_A = m_A [a + \mu_A g]$

$T_A = (12kg)[2\ m/s^2 + (.4)(9.8\ m/s^2)]$

$T_A = 71\ N$

$\Sigma F_{B_x} = T_C - T_A - F_{f_B} = m_B a$

$T_C = T_A + F_{f_B} + m_B a$

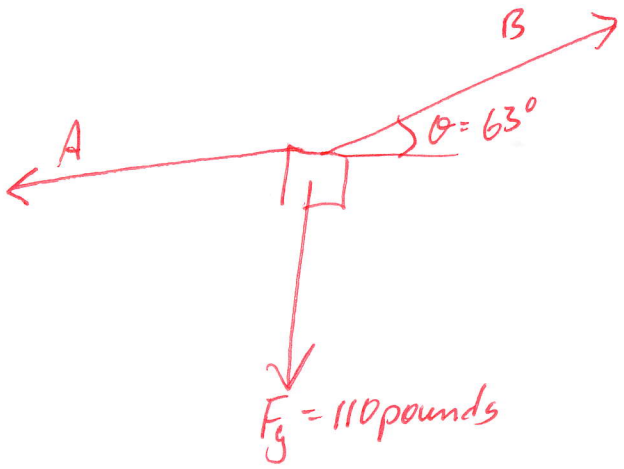
$T_C = T_A + \mu_B N_B + m_B a$

$T_C = T_A + (.4) m_B g + m_B a$

$T_C = 71N + (.4)(2kg)(9.8\ m/s^2) + (2kg)(2\ m/s^2)$

$T_C = 82.8\ N$

5) Two ropes support a 110-pound box. One rope goes from the box, horizontally to the left to be attached to a wall. We will call this rope "A." Rope "B" runs to the Right ~~left~~, only angles upward at 63 degrees from the horizontal. Determine the tension in each rope, in pounds, knowing that the box is stationary.



$\Sigma F_y = B_y - F_g = ma$

$B\sin\theta - F_g = 0$

$B\sin\theta = F_g$

$B = \frac{F_g}{\sin\theta}$

$B = \frac{110 \text{ pounds}}{\sin(63^\circ)}$

$B = 123.5 \text{ pounds}$

543.4 N

$\Sigma F_x = B_x - A = ma$

$B\cos\theta - A = 0$

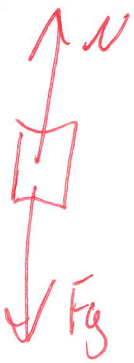
$B\cos\theta = A$

$(123.5 \text{ pounds})\cos(63^\circ) = A$

$56 \text{ pounds} = A$

246.4 N

6) A 65 kg person is in an elevator. If the elevator is accelerating upward at 3 m/s^2, determine how heavy the person will feel.



$\Sigma F_y = N - F_g = ma$

$N = ma + F_g$

$N = ma + mg$

$N = m(a+g)$

$N = (65kg)(3 m/s^2 + 9.8 m/s^2)$

$N = 832 N$

7) A 65 kg person is in an elevator. If the elevator is moving downward at 3 m/s, what is the mass of the person?

65kg