Stuff that may help!

$$\Delta x = \left[\frac{v_{x_0} + v_x}{2}\right]\Delta t$$

$$\Delta x = v_{x_0}\Delta t + \tfrac{1}{2}a_x \Delta t^2$$

$$v_x = v_{x_0} + a_x \Delta t$$

$$v_x^2 = v_{x_0}^2 + 2a_x \Delta x$$

$$\vec{v}_{ave} = \frac{\Delta \vec{r}}{\Delta t}$$

$$\vec{a}_{ave} = \frac{\Delta \vec{v}}{\Delta t}$$

$$\sin\theta = \frac{A_y}{|\vec{A}|}$$

$$\cos\theta = \frac{A_x}{|\vec{A}|}$$

$$\tan\theta = \frac{A_y}{A_x}$$

$$|\vec{A}| = \sqrt{A_x^2 + A_y^2}$$

$$g = 9.8m/s^2$$

$$\Delta y = \left[\frac{v_{y_0} + v_y}{2}\right]\Delta t$$

$$\Delta y = v_{y_0}\Delta t + \tfrac{1}{2}a_y \Delta t^2$$

$$v_y = v_{y_0} + a_y \Delta t$$

$$v_y^2 = v_{y_0}^2 + 2a_y \Delta y$$

$$g = 9.8m/s^2$$

$$ax^2 + bx + c = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$m \rightarrow 10^{-3}$$

$$k \rightarrow 10^3$$

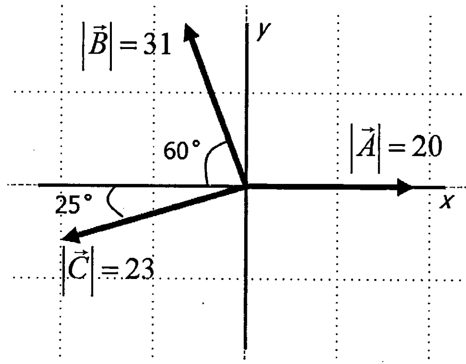
$$1m = 3.28ft$$

Test 1
PHYS 2211
Principles of Physics I
TEST 1

45

Name Charles Jakson

Show all work in the spaces provided. If the work is not shown you will not get credit. You will also need to have the correct units for all answers to get full credit.



1) Using the vectors above do the following:

a) Write the three vectors above in unit vector notation. (6 pts)

$A_x = 20 \quad A_y = 0$

$B_x = |\vec{B}| \cos(60°) \quad B_y = |\vec{B}| \sin(60°)$
$B_x = (31)\cos(60°) \quad B_y = (31)\sin(60°)$
$B_x = -15.5 \quad B_y = 26.847$

$C_x = |\vec{C}|\cos(25°) \quad C_y = -|\vec{C}|\sin(25°)$
$C_x = (23)\cos(25°) \quad C_y = (23)\sin(25°)$
$C_x = -20.845 \quad C_y = -9.72$

$\boxed{\vec{A} = 20\hat{i}} \quad \boxed{\vec{B} = -15.5\hat{i} + 26.847\hat{j}} \quad \boxed{\vec{C} = -20.845\hat{i} - 9.72\hat{j}}$

b) What is $\vec{R} = \vec{A} + \vec{B} - \vec{C}$ in unit vector notation? (5 pts)

$\vec{R} = \vec{A} + \vec{B} - \vec{C} = [20\hat{i}] + [-15.5\hat{i} + 26.847\hat{j}] - [-20.845\hat{i} - 9.72\hat{j}]$

$\vec{R} = [20 - 15.5 + 20.845]\hat{i} + [0 + 26.847 + 9.72]\hat{j}$

$\boxed{\vec{R} = 25.345\hat{i} + 36.567\hat{j}} \approx 25\hat{i} + 37\hat{j}$

c) What is the Magnitude and direction of $\vec{R}$? (4 pts)

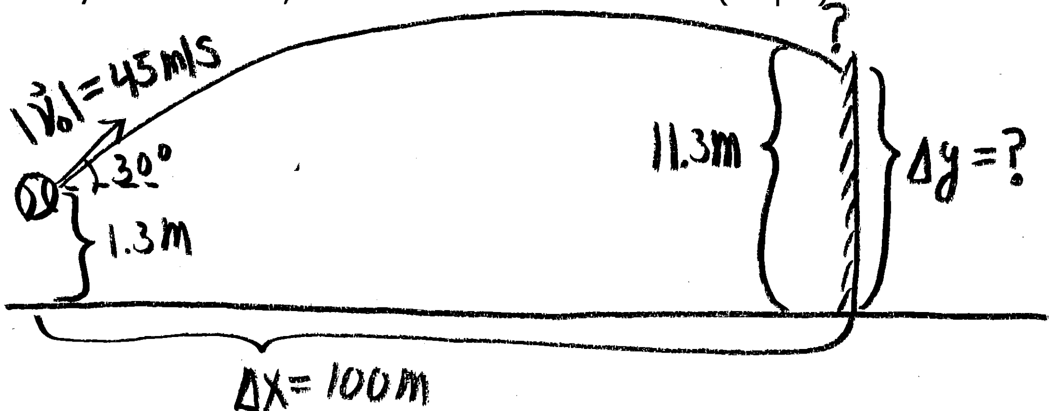
$|\vec{R}| = \sqrt{R_x^2 + R_y^2} \qquad \theta = \tan^{-1}\left(\frac{R_y}{R_x}\right)$

$|\vec{R}| = \sqrt{(25.345)^2 + (36.567)^2} \qquad \theta = \tan^{-1}\left(\frac{36.567}{25.345}\right)$

$\boxed{|\vec{R}| = 44.49 \approx 44.5} \qquad \boxed{\theta = 55.27° \approx 55°}$

Test 1

2) A baseball is hit as it comes in 1.3 m over the plate. The blast sends it off at an angle of 30° above the horizontal with a speed of 45.0 m/s. The outfield fence is 100 m away and 11.3 m high. Ignoring aerodynamic effects, will the ball clear the fence? (10 pts)



$V_x = |\vec{V}_0| \cos(30°)$
$V_x = (45 \text{ m/s}) \cos(30°)$
$V_x = 38.97$ m/s

$V_{y_0} = |\vec{V}_0| \sin(45°)$
$V_{y_0} = (45 \text{ m/s}) \sin(30°)$
$V_{y_0} = 22.5$ m/s

$\Delta X = V_x t$
$t = \frac{\Delta X}{V_x}$
$t = \frac{100 \text{ m}}{38.97 \text{ m/s}}$
$t = 2.566$ s

$\Delta y = V_{y_0} t + \frac{1}{2} a_y t^2$
$\Delta y = (22.5 \text{ m/s})(2.566\text{s}) + \frac{1}{2}(-9.8 \text{ m/s}^2) \cdot (2.566\text{s})^2$
$\Delta y = 57.74\text{M} - 32.26\text{M}$
$\boxed{\Delta y = 25.48\text{m}} + 1.3\text{m} = 26.78\text{m}$
yes it Clears fence!

Test 1

3) A baseball is hit so that it travels straight upward after being struck by the bat. A fan observes that it takes $3.00\,s$ for the ball to reach its maximum height. Find:

a) its initial velocity (5 pts)

$$\cancel{v_y}^{\,0} = v_{y_0} + a_y t$$

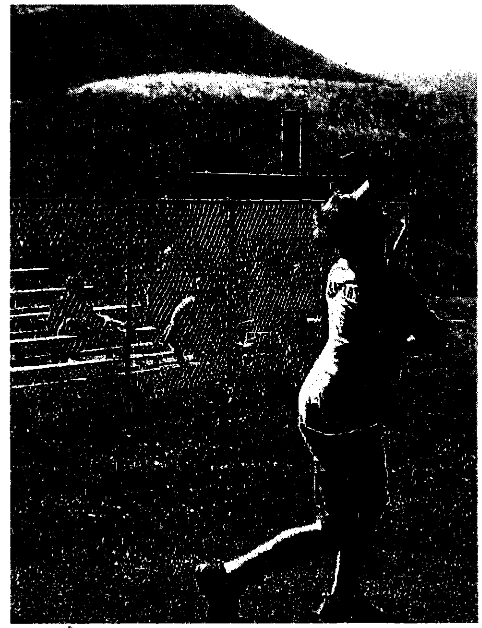
$$v_{y_0} = -a_y t$$

$$v_{y_0} = -(-9.8\,m/s^2)(3s)$$

$$v_{y_0} = 29.4\,m/s$$

$v_y = 0$

$? = v_{y_0}$



$t = 3s$

$\Delta y = ?$

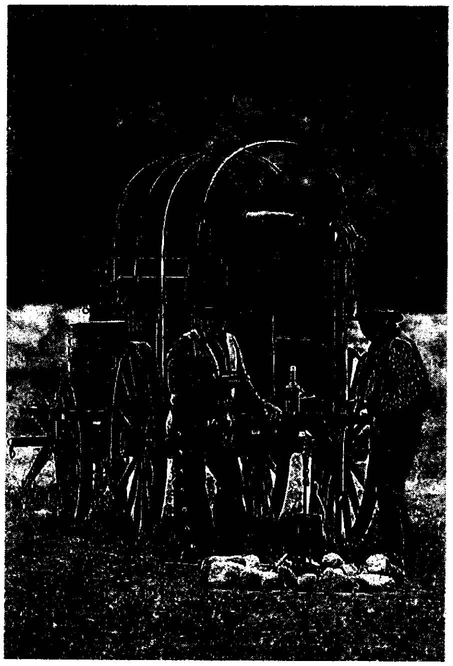
b) the height it reaches (5 pts)

$$\Delta y = v_{y_0} t + \frac{1}{2} a_y t^2$$

$$\Delta y = (29.4\,m/s)(3s) + \frac{1}{2}(-9.8\,m/s^2)(3s)^2$$

$$\Delta y = 88.2m - 44.1m$$

$$\Delta y = 44.1m$$



4) A daring ranch hand sitting on a tree limb wishes to drop vertically onto a horse galloping under a tree. The constant speed of the horse is $10.0\,m/s$ and the distance from the limb to the level of the saddle is $3.00\,m$.

x $v_h = 10\,m/s$ $3\,m = \Delta y$

a) What must be the horizontal distance between the saddle and the limb when the ranch hand makes his move? (5 pts)

$$\Delta x = v_x t$$

$$\Delta x = (10\,m/s)(.782s)$$

$$\boxed{\Delta x = 7.8\,m}$$

b) How long is he in the air? (5 pts)

$$\Delta y = \cancel{v_{y_0} t}^{\,0} + \tfrac{1}{2} a_y t^2$$

$$\Delta y = \tfrac{1}{2} a_y t^2$$

$$t = \sqrt{\frac{2\Delta y}{a_y}}$$

$$t = \sqrt{\frac{2(-3m)}{-9.8\,m/s^2}}$$

$$\boxed{t = .782s}$$

Stuff that may help!

Name Charles Jobson

$$\Delta x = \left[\frac{v_{x_0} + v_x}{2}\right] t$$

$$\Delta x = v_{x_0}\Delta t + \tfrac{1}{2} a_x t^2$$

$$v_x = v_{x_0} + a_x t$$

$$v_x^2 = v_{x_0}^2 + 2a_x \Delta x$$

$$\sum \vec{F} = m\vec{a}$$

$$\Delta y = \left[\frac{v_{y_0} + v_y}{2}\right] t$$

$$\Delta y = v_{y_0} t + \tfrac{1}{2} a_y t^2$$

$$v_y = v_{y_0} + a_y t$$

$$v_y^2 = v_{y_0}^2 + 2a_y \Delta y$$

$$g = 9.8 m/s^2$$

$$|\vec{A}| = \sqrt{A_x^2 + A_y^2}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

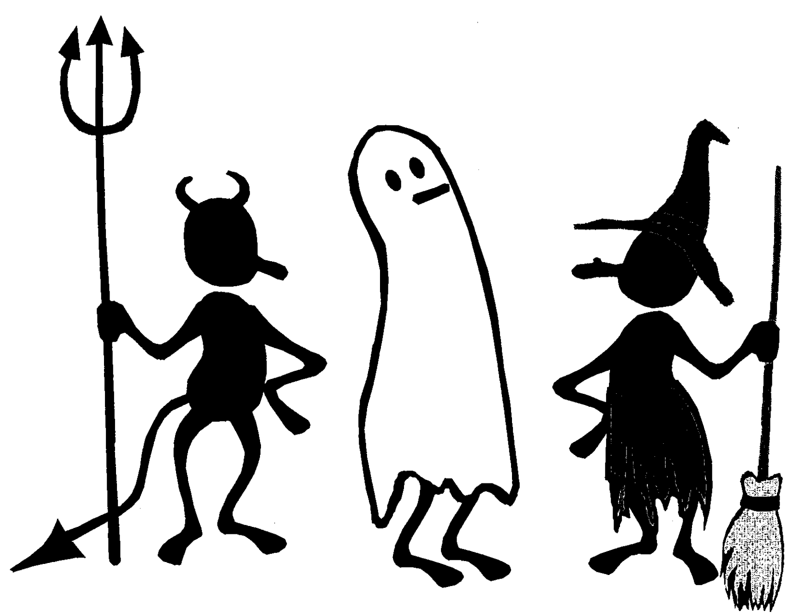
$$\sin\theta = \frac{A_y}{|\vec{A}|}$$

$$\cos\theta = \frac{A_x}{|\vec{A}|}$$

$$\tan\theta = \frac{A_y}{A_x}$$

$$F_k = \mu_k N$$

$$F_s \le \mu_s N$$

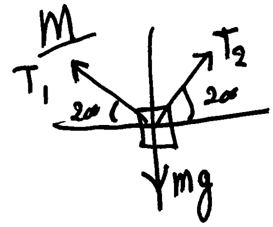


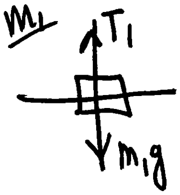
PHYS 2211
Principles of Physics I
TEST 2

45

For full credit:

1) Show all your work
2) Draw and label a neat Free Body Diagram(s).
3) Include units for all quantities.

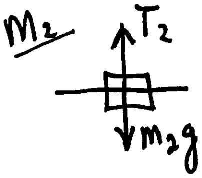




$\sum F_y = 0$

$T_1 - m_1 g = 0$

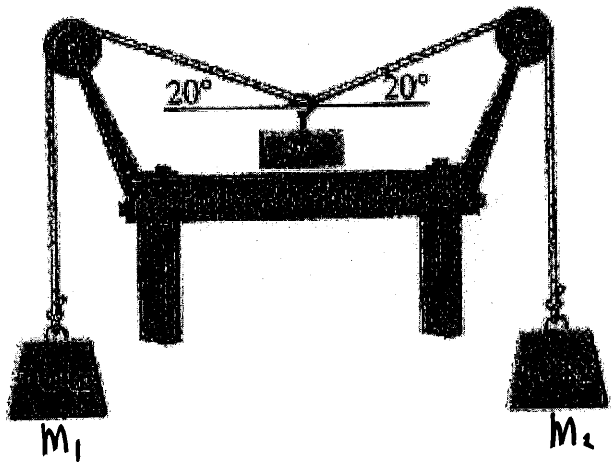
$T_1 = m_1 g$



$\sum F_y = 0$

$T_2 - m_2 g = 0$

$T_2 = m_2 g$



1) Determine the weight of the mass m seen above. Assume the pulleys and ropes are all essentially weightless. (10 pts)

m

$\sum F_x = 0$

$-T_1 \cancel{\cos(20°)} + T_2 \cancel{\cos(20°)} = 0$

$T_1 = T_2 = T$

$\sum F_y = 0$

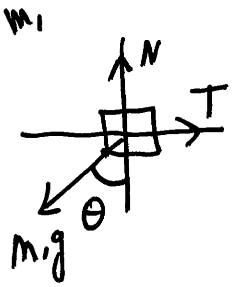
$T_1 \sin(20°) + T_2 \sin(20°) - mg = 0$

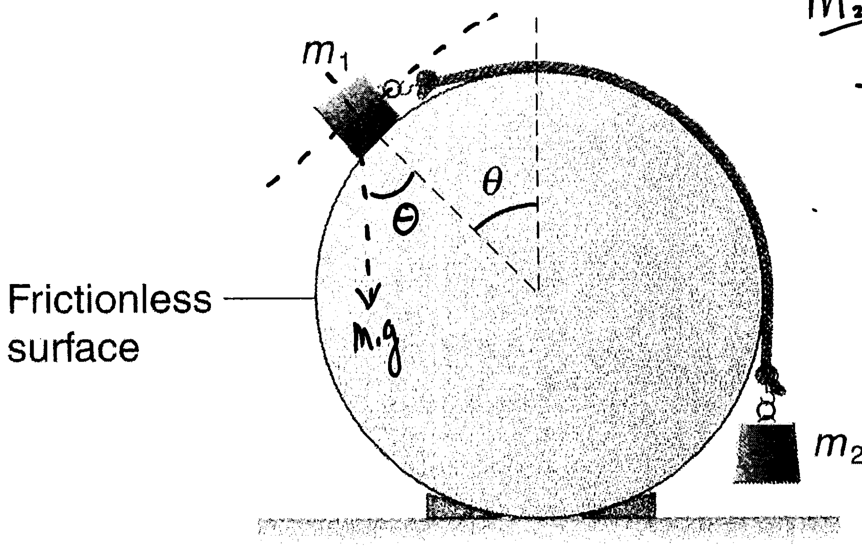
$2T\sin(20°) = mg$

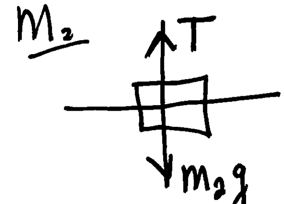
$mg = 2(m_1 g)\sin(20°)$

$mg = 2(1\,kg)(9.8\,m/s^2)\sin(20°)$

$mg = 6.7\,N$







$\Sigma F_y = 0$

$T - m_2 g = 0$

$T = m_2 g$

2) A mass m_1 lies on a fixed, smooth cylinder. An ideal cord attached to m_1 passes over the cylinder to mass m_2 as shown above. If the system is in equilibrium and $m_1 = 40\ kg, m_2 = 10\ kg$ find θ. (11 pts)

<u>for M1</u>

$\Sigma F_y = 0$

$N - mg\cos\theta = 0$

$N = mg\cos\theta$

$\Sigma F_x = 0$

$T - m_1 g\sin\theta = 0$

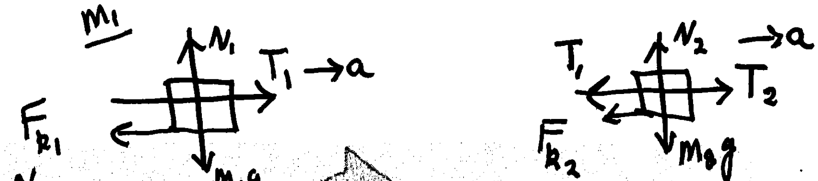
$m_2 \cancel{g} - m_1 \cancel{g}\sin\theta = 0$

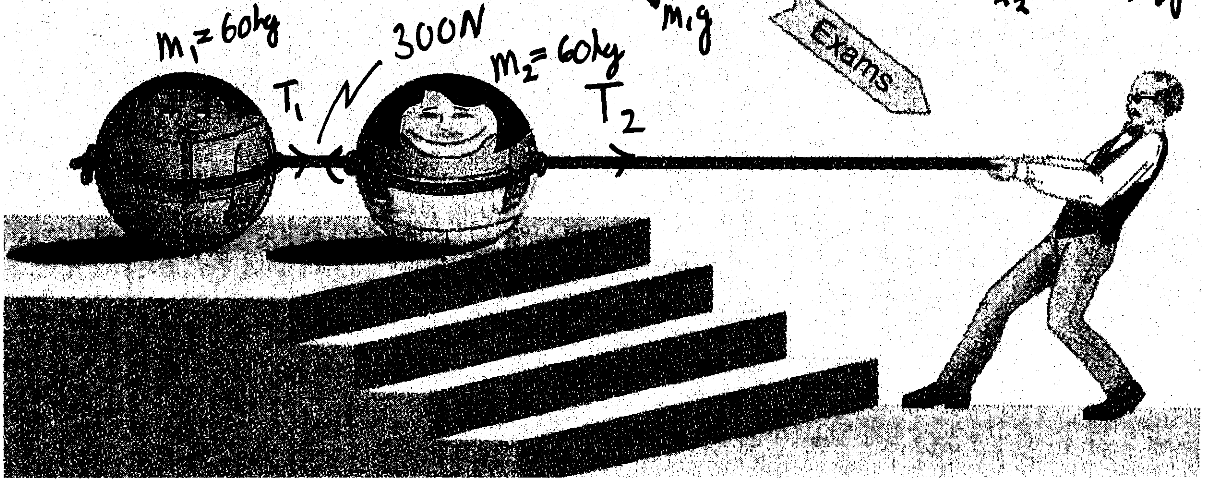
$\sin\theta = \frac{m_2}{m_1}$

$\theta = \sin^{-1}\left(\frac{m_2}{m_1}\right)$

$\theta = \sin^{-1}\left(\frac{10kg}{40kg}\right)$

$\theta = 14.5^{\circ}$ //





3) Two spherical students of identical $60\ kg$ mass are dragged by Professor Mediocratus to a final exam in classics as indicated above. The coefficient of kinetic friction for the students on the floor is 0.30. The tension in the rope between the students is $300\ N$.

a) What is the acceleration of the students? (6 pts)

m_1

$\sum F_y = 0$

$N_1 - m_1 g = 0$

$N_1 = m_1 g$

$\sum F_x = m a_x$

$T_1 - F_{k1} = m_1 a$

$a = \dfrac{T_1 - \mu_k m_1 g}{m_1}$

m_2

$\sum F_y = 0$

$N_2 - m_2 g = 0$

$N_2 = m_2 g$

$\sum F_x = m a_x$

$\boxed{T_2 - T_1 - F_{k2} = m_2 a}$

$a = \dfrac{300N - (.3)(60kg)(9.8m/s^2)}{60kg}$

$\boxed{a = 2.06 m/s^2}$

b) What is the tension in the rope between the leading student and the Professor? (6 pts)

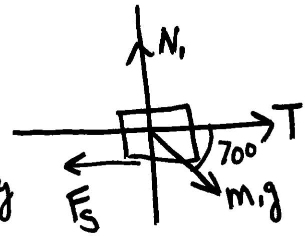
$T_2 = T_1 + F_{k2} + m_2 a$

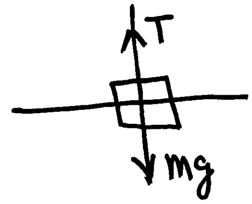
$T_2 = T_1 + \mu_k m_2 g + m_2 a$

$T_2 = 300N + (.3)(60kg)(9.8m/s^2) + (60kg)(2.06m/s^2)$

$\boxed{T_2 = 600N}$

m_1

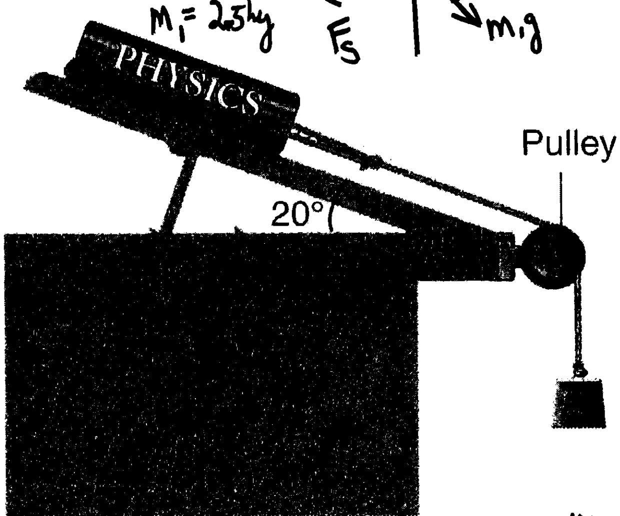




$\Sigma F_y = 0$

$T - mg = 0$

$T = mg$



4) An ideal physics text of mass $2.5\ kg$ is placed on a rough inclined plane as shown. The coefficients of static and kinetic friction for the text on the plane are 0.50 and 0.20 respectively. An ideal string is attached to the text and passes over an ideal pulley to another mass m.

a) What is the maximum mass of m that can be attached to the cord before the text starts to slip? (6 pts)

m_1

$\Sigma F_y = 0$

$N - m_1 g\, Sin(70°) = 0$

$N_1 = m_1 g\, Sin(70°)$

$\Sigma F_x = 0$

$T - F_s + m_1 g\, Cos(70°) = 0$

$mg - F_s + m_1 g\, Cos(70°) = 0$

$mg - \mu_s m_1 g\, Sin(70°) + m_1 g\, Cos(70°) = 0$

$m = m_1 [\mu_s Sin(70°) - Cos(70°)]$

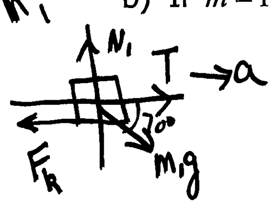
$m = (2.5kg)[(.5)Sin(70°) - Cos(70°)]$

$m = (2.5kg)[.4698 - .3420]$

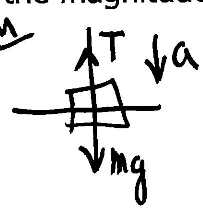
$m = \cancel{3.166kg}\ \cancel{3.2kg}\ .3195 \approx .32kg$

b) If $m = 10\ kg$, determine the magnitude of the acceleration of the text. (6 pts)

m_1



m



$\Sigma F_y = ma_y$

$T - mg = -ma$

$T = mg - ma$

$\Sigma F_y = 0$

$N_1 - m_1 g\, Sin(70°) = 0$

$N_1 = m_1 g\, Sin(70°)$

$\Sigma F_x = ma_x$

$T + m_1 g\, cos(70°) - F_k = m_1 a_x$

$mg - ma + m_1 g\, Cos(70°) - \mu_k N_1 = m_1 a$

$(m + m_1)a = mg + m_1 g\, Cos(70°) - \mu_k m_1 g\, Sin(70°)$

$$a = g\,\frac{[m + m_1 Cos(70°) - \mu_k m_1 Sin(70°)]}{m + m_1}$$

$$a = (9.8 m/s^2)\,\frac{[10kg + (2.5kg)Cos(70°) - (.2)(2.5kg)Sin(70°)]}{12.5\ \cancel{3.5}kg}$$

$a = \cancel{3.879 m/s^2} \approx \cancel{3.9 m/s^2}\ 8.14 m/s^2$

STUFF THAT MAY HELP!

Name Charles John

$$\Delta x = \left[\frac{v_{x_0} + v_x}{2}\right]t$$

$$\Delta x = v_{x_0}\Delta t + \tfrac{1}{2}a_x t^2$$

$$v_x = v_{x_0} + a_x t$$

$$v_x^2 = v_{x_0}^2 + 2a_x \Delta x$$

$$\sum \vec{F} = m\vec{a}$$

$$\vec{v}_{ave} = \frac{\Delta \vec{r}}{\Delta t}$$

$$\vec{a}_{ave} = \frac{\Delta \vec{v}}{\Delta t}$$

$$W = Fd\cos\theta$$

$$W = \Delta KE$$

PHY

$$KE = \tfrac{1}{2}mv^2$$

$$PE_g = mgh$$

$$PE_s = \tfrac{1}{2}kx^2$$

$$\Delta KE + \Delta PE = W_f$$

$$\sin\theta = \frac{A_y}{|\vec{A}|}$$

$$\cos\theta = \frac{A_x}{|\vec{A}|}$$

$$\tan\theta = \frac{A_y}{A_x}$$

$$F_k = \mu_k N$$

$$F_s \le \mu_s N$$

$$\Delta y = \left[\frac{v_{y_0} + v_y}{2}\right]t$$

$$\Delta y = v_{y_0}t + \tfrac{1}{2}a_y t^2$$

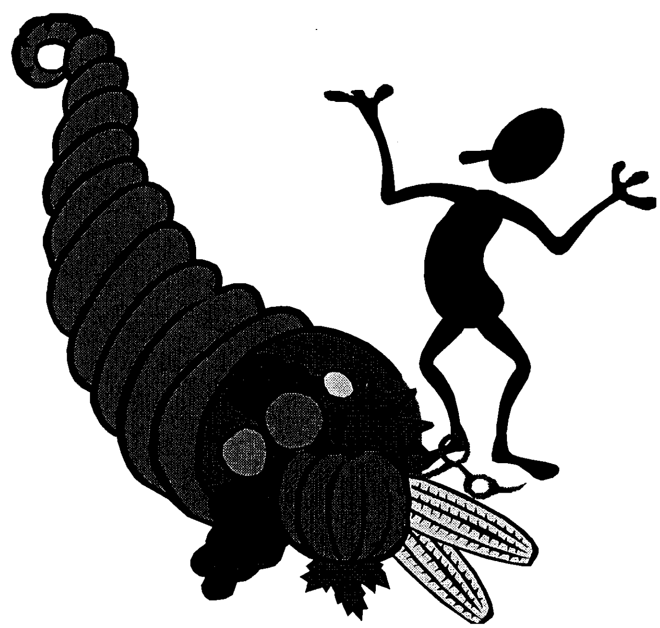
$$v_y = v_{y_0} + a_y t$$

$$v_y^2 = v_{y_0}^2 + 2a_y \Delta y$$

$$g = 9.8 m/s^2$$

$$|\vec{A}| = \sqrt{A_x^2 + A_y^2}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

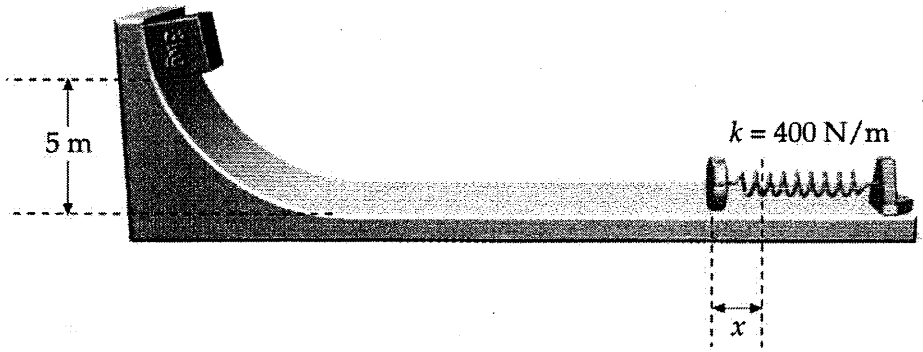


PHYS 2211

PHYS 2211
Principles of Physics I
TEST 3

Name________________________________

Show all work in the spaces provided.
Unless otherwise directed you must use energy considerations.



1) The 3 kg object see above is released from rest at a height of 5 m on a curved frictionless ramp. At the foot of the ramp is a spring of force constant k=400 N/m. The object slides down the ramp and onto the spring compressing it a distance x before coming momentarily to rest.
   a) What is the distance x? (7 pts)

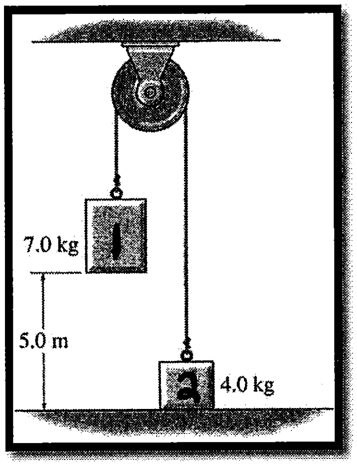
$$\cancel{\Delta KE}^{\to 0} + \Delta PE = 0$$
$$\Delta PE_g + \Delta PE_s = 0$$
$$\cancel{PE_{g_f}}^{\to 0} - PE_{g_i} + PE_{s_f} - \cancel{PE_{s_i}}^{\to 0} = 0$$
$$-mgh + \tfrac{1}{2}kx^2 = 0$$
$$x = \sqrt{\frac{2mgh}{k}} = \sqrt{\frac{2(3\,kg)(9.8\,m/s^2)(5\,m)}{400\,N/m}} = .86\,m$$

   b) What is the work done by gravity? (3 pts)

$$W = \Delta PE = \cancel{PE_f}^{\to 0} - PE_i$$
$$W = -mgh$$
$$W = -(3\,kg)(9.8\,m/s^2)(5\,m) = -147\,J$$

   c) What is the work done by the spring? (3 pts)

$$W = \Delta PE$$
$$W = PE_f - \cancel{PE_i}^{\to 0}$$
$$W = \tfrac{1}{2}kx^2 = \tfrac{1}{2}(400\,N/m)(.86\,m)^2 = 147\,J$$



2) The masses shown above are connected by a massless string over a frictionless, massless pulley and are released from rest. find:

a) The velocity of the 7.0 kg mass just before it hits the floor. (5 points)

$$\Delta KE + \Delta PE = 0$$

$$KE_{1f} - \cancel{KE_{1i}}^{0} + KE_{2f} - \cancel{KE_{2i}}^{0} + \cancel{PE_{1f}}^{0} - PE_{1i} + PE_{2f} - \cancel{PE_{2i}}^{0} = 0$$

$$\tfrac{1}{2} m_1 v_f^2 + \tfrac{1}{2} m_2 v_f^2 - m_1 g h + m_2 g h = 0$$

$$\tfrac{1}{2} v_f^2 (m_1 + m_2) = m_1 g h - m_2 g h$$

$$v_f = \sqrt{\frac{2gh(m_1 - m_2)}{(m_1 + m_2)}} = \sqrt{\frac{2(9.8\,m/s^2)(5m)(3kg)}{11kg}}$$

$$v_f = 5.2\,m/s$$

b) The maximum height reached by the 4.0 kg mass. (5 points)

$v_i = 5.2\,m/s$

$? = h$

$$\Delta KE + \Delta PE = 0$$

$$\cancel{KE_f}^{0} - KE_i + PE_f - \cancel{PE_i}^{0} = 0$$

$$-\tfrac{1}{2} m_2 v_i^2 + m_2 g h = 0$$

$$h = \frac{v_i^2}{2g} = \frac{(5.2\,m/s)^2}{2(9.8\,m/s^2)} \approx 1.36\,m$$

c) The fraction of the system's initial mechanical energy lost when the 7.0 kg mass comes to rest on the floor? (5 points)

$$\frac{\tfrac{1}{2} m_1 v^2}{m_1 g h} = \frac{v^2}{2gh} = \frac{(5.2\,m/s)^2}{2(9.8\,m/s^2)(5m)} = .28 \approx 28\%$$

3) An 8.00 kg block travels on a rough, horizontal surface and collides with a spring. The speed of the block *just before* the collision is 4.00 m/s. As the block rebounds to the left with the spring uncompressed, its speed as it leaves the spring is 3.00 m/s. If the coefficient of kinetic friction between block and surface is 0.400.

a) What is the energy lost due to friction while the block is in contact with the spring? (5 pts)

$$W = \Delta KE$$

$$W = KE_f - KE_i$$

$$W = \tfrac{1}{2} m v_f^2 - \tfrac{1}{2} m v_i^2$$

$$W = \tfrac{1}{2} m [v_f^2 - v_i^2]$$

$$W = \tfrac{1}{2}(8kg)[(3m/s)^2 - (4m/s)^2]$$

$$W = -28J$$

b) What is the maximum distance the spring is compressed? (5 pts)

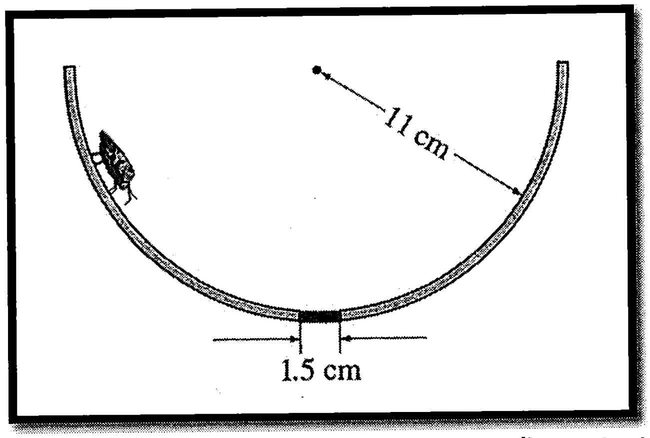
$$W = F \cdot d \cancel{\cos\theta}^{-1}$$

$$W = -Fd$$

$$W = -\mu_k mgd$$

$$d = \frac{W}{-\mu_k mg} = \frac{-28J}{-(.4)(8kg)(9.8m/s^2)} = .89m$$

$$x = \tfrac{1}{2} d = .446m$$



4) A bug slides back and forth in a hemispherical bowl of 11 cm radius, starting from rest at the top, as shown above. The bowl is frictionless except for a 1.5 cm wide sticky patch at the bottom, where the coefficient of friction is 0.61. How many times does the bug cross the sticky region? (10 points)

$$\Delta KE + \Delta PE = W_f$$

$$\cancel{KE_f}^{\,0} - \cancel{KE_i}^{\,0} + \cancel{PE_f}^{\,0} - PE_i = W_f$$

$$-mgh = Fd\cancel{\cos\theta}^{\,-1}$$

$$+\cancel{m}\cancel{g}h = +\mu_k \cancel{m}\cancel{g} d$$

$$d = \frac{h}{\mu_k} = \frac{.11\text{m}}{.61} = .18\text{m}$$

$$\#\ \text{of tim} = \frac{.18\text{m}}{.015\text{m}} = 12 \,/\!/$$