PHYS 1211, Fall 2012

Test #2

October 4, 2012

2:00 pm– 3:15 pm

1. __________
2. __________
3. __________
4. __________

Name ____________________

ID ____________________

Total ________

NOTE: This test consists of one set of conceptual questions and three problems. In working the problems, you <u>must show all of your calculations</u> and your reasoning clearly to receive credit. Be sure to include units in your solutions when required.

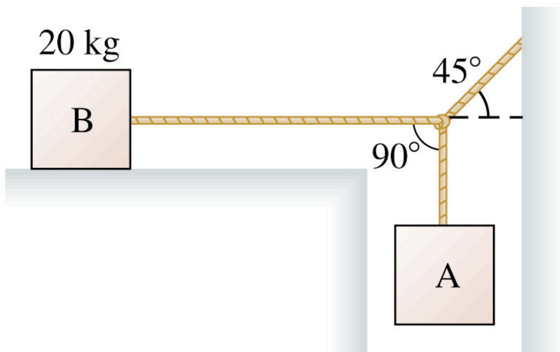
1. Conceptual questions (10 points, no calculations required). State whether the following statements are ***True*** or ***False***.

a) The center of mass of a system consisting of two objects with masses m_1 and m_2 is closer to object 1, if $m_1 >> m_2$.

b) A person who weights 60 pounds (about 27 kg) on the Earth would weigh 10 pounds (about 4.5 kg) on the Moon.

c) The two forces of a Newton's 3^{rd} law pair always act on different objects.

2. In the figure, block B rests on a surface for which the static and kinetic coefficients of friction are 0.60 and 0.40, respectively. The ropes are massless. What is the maximum mass of block A for which the system is in equilibrium? **(**30 points)



3. A satellite is placed in equatorial orbit above Mars, which has a radius of 3397 km and a mass of 6.40×10^{23} kg. The mission of the satellite is to observe the Martian climate from an altitude of 488 km. a) Draw a free-body diagram of the satellite assuming there is no atmospheric drag. b) If the satellite has a mass of 2000 kg, what is the magnitude of the force on the satellite due to Mars? c) What is the radial acceleration of the satellite? d) What is the orbital period and orbital speed of the satellite? (30 points)

4. A 2000 kg Cadillac car entered an intersection, heading north at 3.0 m/s, when it was struck by a 1000 kg eastbound Volkswagen. The cars stick together and slid, leaving skid marks angled 35º north of east. How fast was the Volkswagen going just before the impact? (30 points)

Equations

$\rho = M/V$

$v_{xf} = v_{xi} + a_x(t_f - t_i)$ $\qquad$ $v_{yf} = v_{yi} + a_y(t_f - t_i)$

$x_f = x_i + \frac{1}{2}(v_{xi} + v_{xf})(t_f - t_i)$ $\qquad$ $y_f = y_i + \frac{1}{2}(v_{yi} + v_{yf})(t_f - t_i)$

$x_f = x_i + v_{xi}(t_f - t_i) + \frac{1}{2}a_x(t_f - t_i)^2$ $\qquad$ $y_f = y_i + v_{yi}(t_f - t_i) + \frac{1}{2}a_y(t_f - t_i)^2$

$v_{xf}^2 = v_{xi}^2 + 2a_x(x_f - x_i)$ $\qquad$ $v_{yf}^2 = v_{yi}^2 + 2a_y(y_f - y_i)$

$\cos\theta = x/h$ $\qquad$ $\sin\theta = y/h$ $\qquad$ $\tan\theta = y/x$ $\qquad$ $h = \sqrt{x^2 + y^2}$

$\Delta x = x_f - x_i$ $\qquad$ $\bar{v}_x = \dfrac{x_f - x_i}{t_f - t_i}$ $\qquad$ $\bar{\mathbf{a}} = \dfrac{\mathbf{v}_f - \mathbf{v}_i}{t_f - t_i}$

$v_x = \lim_{\Delta t \to 0} \dfrac{\Delta x}{\Delta t} = \dfrac{dx}{dt}$ $\qquad$ $a_x = \lim_{\Delta t \to 0} \dfrac{\Delta v_x}{\Delta t} = \dfrac{dv_x}{dt}$

$az^2 + bz + c = 0$ $\qquad$ $z = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$\Sigma\vec{F} = m\vec{a}$ $\qquad$ $\vec{F}_g = -mg\hat{j}$ $\qquad$ $|F_G| = \dfrac{Gm_1m_2}{r^2}$

$f_S^{\max} = \mu_S n$ $\qquad$ $f_k = \mu_k n$

$a_r = v^2/r$ $\qquad$ $T = 2\pi r/v = 2\pi r^{3/2}/\sqrt{GM}$

$s = r\theta$ $\qquad$ $\omega_{avg} = \dfrac{\theta_f - \theta_i}{t_f - t_i}$ $\qquad$ $\omega = \lim_{\Delta t \to 0} \dfrac{\Delta\theta}{\Delta t} = \dfrac{d\theta}{dt}$

$\alpha_{avg} = \dfrac{\omega_f - \omega_i}{t_f - t_i}$ $\qquad$ $\alpha = \lim_{\Delta t \to 0} \dfrac{\Delta\omega}{\Delta t} = \dfrac{d\omega}{dt}$ $\qquad$ $T = \dfrac{2\pi}{\omega}$

$v_t = r\omega$ $\qquad$ $\vec{v}' = \vec{v} - \vec{v}_o$ $\qquad$ $\vec{r}' = \vec{r} - \vec{v}_o t$

$\vec{p} = m\vec{v}$ $\qquad$ $\vec{J} = \vec{F}_{avg}\Delta t$ $\qquad$ $\vec{J} = \int_{t_i}^{t_f} \vec{F}dt = \vec{p}_f - \vec{p}_i$

$x_{cm} = \dfrac{\sum m_i x_i}{\sum m_i}$ $\qquad$ $\vec{v}_{cm} = \dfrac{\sum m_i \vec{v}_i}{\sum m_i}$ $\qquad$ $\sum \vec{F}_{ext} = \dfrac{d\vec{p}}{dt}$

$\int t^n dt = \dfrac{t^{n+1}}{n+1}$ $\qquad$ $(n \neq -1)$ $\qquad$ $\int t^{-1} dt = \ln t$

$g = 9.80\ \text{m/s}^2 = 32.2\ \text{ft/s}^2$ $\qquad$ $G = 6.67\text{x}10^{-11}\ \text{Nm}^2/\text{kg}^2$