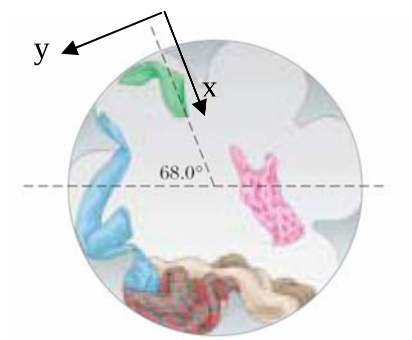
Name___________________________________

Physics 120 Quiz #4, February 2, 2007

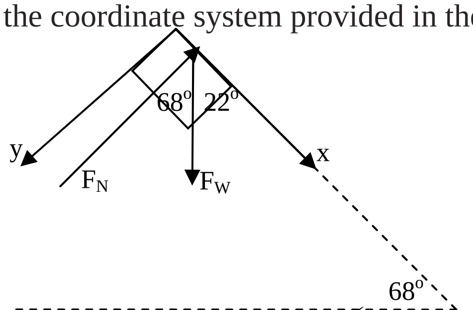
Please circle the best choice to question 1. For the problems, the parts have the points shown.

1. How much work is done *by gravity* when a box of mass 5kg is lifted through a height of 1m?
   a. 49J (b.) -49J c. 49N/m d. -49N/m

2. In a home laundry dryer, a cylindrical tub containing wet clothes is rotated steadily about a horizontal axis as shown below. The clothes are made to tumble so that they will dry uniformly. The rate of rotation of the smooth-walled tub is chosen so that a small piece of cloth will lose contact with the tub when the cloth is at an angle of 68.0° above the horizontal.



a. Draw a free body diagram showing all of the forces that act on the piece of cloth at this 68° angle and write equations for the sum of the forces from your diagram. Use the coordinate system provided in the figure. (4)



$$\sum F_x: \quad mg\cos 22 = ma_x = m\frac{v^2}{R} \qquad \left(\text{Or}: \sum F_x: \quad mg\sin 68 = ma_x = m\frac{v^2}{R}\right)$$

$$\sum F_y: \quad -F_N + mg\sin 22 = ma_y \qquad \left(\text{Or}: \sum F_y: \quad -F_N + mg\cos 68 = ma_y\right)$$

b. What will be the *speed* of the cloth when it looses contact with the dryer and begins to fall, if the radius of the tub is 0.330 m? (3)

$$mg\cos 22 = m\frac{v^2}{R} \rightarrow v = \sqrt{Rg\cos 22} = \sqrt{0.33m \times 9.8\tfrac{m}{s^2} \times \cos 22} = 1.73\tfrac{m}{s}$$

c. How many revolutions per minute does the tub make at this speed? (1)

$$v = \frac{2\pi R}{T} \rightarrow T = \frac{2\pi R}{v} = \frac{2\pi \times 0.33m}{1.73\frac{m}{s}} = 1.2s \;\; per \;\; revolution.$$

$$\#rpm = \frac{1rev}{1.2s} \times \frac{60s}{1\min} = 50rpm$$

Motion in the x-direction

$x_f = x_i + v_{ix}t + \frac{1}{2}a_x t^2$

$v_{fx} = v_{ix} + a_x t$

$v_{fx}^2 = v_{ix}^2 + 2a_x \Delta x$

$F_x = ma_x$

Motion in the y-direction

$y_f = y_i + v_{iy}t + \frac{1}{2}a_y t^2$

$v_{fy} = v_{iy} + a_y t$

$v_{fy}^2 = v_{iy}^2 + 2a_y \Delta y$

$F_y = ma_y$

Vectors

$\text{magnitude of a vector} = \sqrt{v_x^2 + v_y^2}$

$\text{direction of a vector} \rightarrow \phi = \tan^{-1}\left(\frac{v_y}{v_x}\right)$

Useful Constants

$g = 9.8 \frac{m}{s^2}$

$\text{Quadratic Equation}: ax^2 + bx + c = 0; \quad \text{solutions}: x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Forces

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

$\vec{F}_s = -k\Delta\vec{x}$

$F_c = m\frac{v^2}{r}$

Work - Energy

$W = \int_{r_1}^{r_2} \vec{F} \cdot d\vec{r} = \Delta KE$

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

$PE_g = mgy$

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