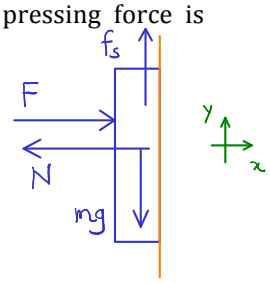
Physics 203 - Summer Quiz 3 Jun. 8, 2015

Name :_____

Time: 15 minutes. Make sure you show all the procedures of computation: answers without procedures will not receive any credits. Answers must be expressed with SI units.

1. A person is pressing a framed picture (mass = 1.10kg) against wall so that it doesn't fall down. The coefficient of static friction between the picture and the wall is 0.66. When the pressing force is perpendicular to the wall, what is the minimum magnitude of the force?



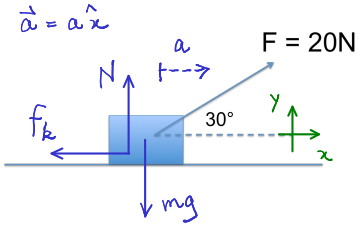
We want to find F_{min} so that the picture does not slide,

i.e. f_s needed so $f_s \le \mu_s N$.

$$x: F - N = 0 \rightarrow N = F$$
$$y: f_s - mg = 0 \rightarrow f_s = mg$$

$$f_s \le \mu_s N$$
$$mg \le \mu_s F$$
$$\frac{1}{\mu_s} mg \le F \rightarrow F_{min} = \frac{mg}{\mu_s} = 16.3\ \text{N}.$$

2. An object (m = 2.0kg) is being pulled by F = 20N which is headed up by 30 to the horizontal line as shown. When the kinetic friction coefficient is 0.3, find the acceleration of it. Show all calculation.



$$x: F\cos 30^\circ - f_k = ma \quad \text{(i)}$$
$$y: F\sin 30^\circ + N - mg = 0 \quad \text{(ii)}$$
$$f_k = \mu_k N \quad \text{(iii)}$$

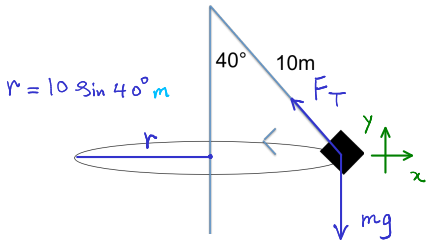
3 eqns, 3 unknowns f_k, N, a

(i), (iii) $\rightarrow$ $F\cos 30^\circ - \mu_k N = ma$ (iv)

1·(iv) + μ_k·(ii) $\rightarrow$ $F(\cos 30^\circ + \mu_k \sin 30^\circ) - \mu_k mg = ma$

$$\rightarrow a = \frac{F}{m}(\cos 30^\circ + \mu_k \sin 30^\circ) - \mu_k g = 7.2\ \frac{\text{m}}{\text{s}^2}.$$

3. A "swing" ride consists of a chair (10kg) is swung in a circle by 10.0m cable attached to the vertical rotating pole, making an angle 40° to the vertical line.



$$x: -F_T \sin 40^\circ = -m a_c \rightarrow F_T \sin 40^\circ = m\frac{v^2}{r} = m\frac{v^2}{10\sin 40^\circ} \quad \text{(i)}$$
$$y: F_T \cos 40^\circ - mg = 0 \quad \text{(ii)}$$

To be clear we've used F_T because T is used for the period of motion sometimes.

a) Find the tension. (hint: apply Newton's law to its y-directional motion.)

$$\text{(ii)} \rightarrow F_T = \frac{mg}{\cos 40^\circ} = 128\ \text{N}.$$

b) Find the speed of the chair.

$$\text{(i)} \rightarrow v^2 = \frac{F_T \cdot 10\sin^2 40^\circ}{m} = 53\ \frac{\text{m}^2}{\text{s}^2} \rightarrow v = 7.3\ \frac{\text{m}}{\text{s}}.$$