

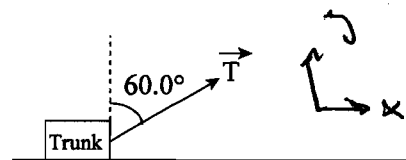
EXAM 3

Name: _____

Student ID #: _____

TA (circle one): Golda Kamdem Matthew Michael Paul

- A. [22 pts.] A trunk of 34.0 kg is sitting on a horizontal surface. A tension of $\vec{T} = 250$ N is applied to a trunk at an angle of 60.0° down from vertical. The coefficient of kinetic friction between the trunk and the surface is $\mu_k = 0.600$. See drawing. If the trunk moves a distance of 12.0 m to the right across the surface, find the work done by each actual force the trunk feels. Make sure you include the name of the force with each work you are calculating



1. NORMAL FORCE: $W_{FN} = 0$
2. WEIGHT: $W_W = 0$
3. TENSION: $W_T = T \Delta x \cos 30^\circ = (250\text{N})(12\text{m})(0.866) = \boxed{2600\text{J}}$
4. KINETIC FRICTION: FIRST FIND F_N
 $\sum F_y = 0 = F_N + T \cos 60^\circ - W = 0$ $F_N = (34\text{kg})(9.8\text{m/s}^2) - (250\text{N})(0.5) = 208\text{N}$
 $F_k = \mu_k F_N = (0.6)(208\text{N}) = 125\text{N}$
 $W_{F_k} = F_k \Delta x \cos 180^\circ = -(125\text{N})(12\text{m}) = \boxed{-1500\text{J}}$

- B. A top is a toy that is made to spin on its pointed end by pulling on a string that is wrapped around the body of the top. The string has a length of 75.0 cm and is wrapped around the top at a place where the radius is 2.00 cm. The thickness of the string is negligible. Someone pulls on the free end of the string in such a way the top undergoes a uniform angular acceleration during the 2.25 s it takes for the string to fully unwind from the top.

1. [8 pts.] During the time the string unwinds, how many rotations has the top made?
 $\# \text{ ROT} = \frac{\text{STRING LENGTH}}{2\pi r} = \frac{75\text{cm}}{(2\pi)(2\text{cm})} = \boxed{5.97 \text{ ROT.}}$

NOTE: $\# \text{ RAD} = (5.97 \text{ ROT})(2\pi \text{ rad/ROT}) = 37.5 \text{ RAD}$

2. [8 pts.] What is the constant angular acceleration of the top during the time the string is unwinding? USE $\theta = \theta_0 + \omega_0 t + \frac{1}{2} \alpha t^2$ $\omega_0 = 0, \Delta \theta = 37.5 \text{ RAD}$
 $\alpha = \frac{2\Delta\theta}{t^2} = \frac{(2)(37.5 \text{ rad})}{(2.25\text{s})^2} = \boxed{14.8 \text{ rad/s}^2}$

3. [8 pts.] At the instant the string is fully unwound, what is the angular speed of the top?
 $\omega = \omega_0 + \alpha t = 0 + (14.8 \text{ rad/s}^2)(2.25\text{s})$
 $\omega = \boxed{33.3 \text{ rad/s}}$