Physics 113 - October 2, 2012

- Exam 1 - Thursday, Oct. 4 0800 Hoyt
- Q+A session - 6:15 pm, Wed. Oct 3, 115 Harkness
- We will have normal lecture on Thursday
Last Week

\[ |F_{fr}^1| = \mu_k |N| \]

Friction

\[ |F_{fr}^1| \leq \mu_s |N| \]

Look for indication of "threshold"

Force of friction opposes the motion

\[ \vec{v} = 0 \]

Force of friction opposes the net force
Circular Motion

\[ |\vec{a}_c| = \frac{|\vec{V}|^2}{R} \]

\[ F = ma \]

Centripetal Force

\[ F_c = ma_c = \frac{mv^2}{r} \]
Work = (Force)(Distance moved along direction of that Force)

- or-

Work = (Magnitude of force component along Direction of Movement)(Distance Moved)

Energy = Ability to do work

Energy = Work

1 Joule = 1 Newton-meter

Woohoo! 😊
you can have negative work!!
Scalar ("dot") Product

\[ \vec{A} \cdot \vec{B} = |\vec{A}| |\vec{B}| \cos \theta \]

= \vec{B} \cdot \vec{A}

Two vectors \( \rightarrow \) a number

\[ \vec{A} \cdot \vec{B} = A_x B_x + A_y B_y + A_z B_z \]

projects out magnitude of one vector along other and multiplies it by mag. of the other.
\[ dw = \vec{F} \cdot d\vec{s} = |\vec{F}| |d\vec{s}| \cos \theta \]

\[ \mathbf{w} = \int_i^F dw = \int_i^F \vec{F} \cdot d\vec{s} \]
Climber or backpack mass \( m \)

\[
\int \vec{F} \cdot \vec{ds} = \int_{1}^{2} \vec{F} \cdot \vec{ds} + \int_{2}^{3} \vec{F} \cdot \vec{ds} + \int_{3} \vec{F} \cdot \vec{ds}
\]

What is the work done by the climber on the backpack in each segment and in total?

\[
\int \vec{F} \cdot \vec{ds} = \int_{F}^{H} \vec{F} \cdot \vec{ds} = \int_{Mg}^{h} \vec{F} \cdot \vec{ds} = Mg \int_{1}^{h} ds = Mg h
\]
Total work = $Mg \Delta h + 0 + (-Mg \Delta h) = 0$

Net change in height is zero

Conservative system

Gravitation is conservative force
Starting from rest, frictionless

\[ F = ma \]

\[ W = Fd \]

\[
\begin{align*}
\text{constant equations} \\
\frac{v^2}{v_o^2} + 2ad \\
\frac{v^2}{2ad} = 2Fd \\
\text{Work done} \\
\text{Work} = \frac{1}{2} MV^2
\end{align*}
\]
Kinetic Energy $= \frac{1}{2}mv^2$

of motion

\[ F = Mg \]

let it drop

\[ h \]

\[ mg \]

what is $v$ at this point?
\begin{align*}
V^2 & = V_0^2 + 2ah \\
V^2 & = 2gh \\
\frac{1}{2}mv^2 & = \frac{1}{2}m 2gh = mgh \\
\text{Work} & \\
\text{KE} & \\
\text{PE} & = mgh \\
\text{KE} & = \frac{1}{2}mv^2
\end{align*}
Conservative force

\[ \sum E_i = \sum E_f \]

Energy Conservation
Spring

$$F \propto x - x_0$$

$$F = k(x - x_0)$$

$l = \text{natural length}$

$x_0 = \text{natural position}$

Restoring force back to natural position

$$\vec{F} = -k(x - x_0)$$