Dynamics Module 4 – Lecture 7

$$\frac{1}{2}mv_1^2 + mgh_1 + \frac{1}{2}k(\Delta x_1)^2 + U_{1-2}$$

$$= \frac{1}{2}mv_2^2 + mgh_2 + \frac{1}{2}k(\Delta x_2)^2$$

Example

Required: Maximum additional deformation of the spring.

Given:
- Spring is used to stop a 150 lb package going down a 20° incline
- Spring stiffness is 150 lb/in
- Spring held by a cable so it is initially compressed 4.0 inches
- Speed of package is 20 ft/sec when package is 30 ft from the spring
- Package pushed with 40 lb force at 30° from package over first 10 ft
- Coefficient of kinetic friction is 0.20

Diagram:
- Spring with initial compression 4.0 inches
- Force of 40 lb applied at 30°
- Speed of 20 ft/sec
- 150 lb package
- 30 ft incline
- Friction coefficient of 0.20
- Spring constant k = 150 lb/in
- Distance from spring to package 30 ft
Solution

- 40 lb at 30°
- 150 lb at 20°
- 20 ft/s
- 30 ft
- $\mu_k = 0.20$
- $k = 150 \text{ lb/in}$
- $x_0 = 4.0 \text{ in}$

Diagram:

- Mass labeled with 40 lb at 30°
- Mass labeled with 150 lb at 20°
- Cable with 20 ft/s
distance 30 ft
- Friction coefficient $\mu_k = 0.20$
- Spring constant $k = 150 \text{ lb/in}$
- Displacement $x_0 = 4.0 \text{ in}$
Conservation of Energy

For the SPECIAL CASE in which all forces doing work are CONSERVATIVE (and heat is neither added nor subtracted), total mechanical energy is conserved.

\[
\frac{1}{2}mv_1^2 + mgh_1 + \frac{1}{2}k(\Delta x_1)^2 = \frac{1}{2}mv_2^2 + mgh_2 + \frac{1}{2}k(\Delta x_2)^2
\]

Conservation of Energy

The ______________ equation is a fundamental statement derived directly from ____________________________.

The conservative form of the ___________ equation is a ______________.

Do NOT assume that energy is ____________.

If even one ______________ force is doing work, energy is NOT ______________.