بسم الله الرحمن الرحيم

King Saud University
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Phys 145 (General Physics)
Chapter 4: Work, Energy and Power (Part 2)
Week n° 6

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Chapter 4: Work, Energy and Power (Second part)

- **We will learn in this second part of chapter 4:**
- Dissipative Forces
- Power

Non conservative forces

A force is non conservative if the work it does on an object depends on the path taken by the object between its final and starting points.

Kinetic friction is an examples of non conservative forces

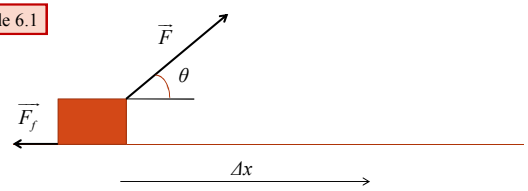
$$W(\vec{F_f}) = \vec{F_f}.\vec{\Delta x} = F_f \Delta x \cos(180°) = -F_f \Delta x$$

Dissipative force

Work can be done by friction. The energy lost to friction by an object goes into heating both the object and its environment.

Some energy may be converted into sound.

Example 6.1



$$W(\vec{F_f}) = \vec{F_f}.\vec{\Delta x} = F_f \Delta x \cos(180°) = -F_f \Delta x$$

Dissipative force

Example 6.2

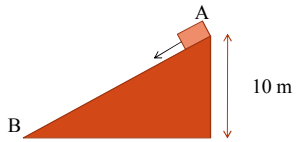
At the bottom, the velocity of the 10 kg object is only 10 m/s. Calculate the lost energy by friction.

$$TME_A = TME_B + lost\_E$$

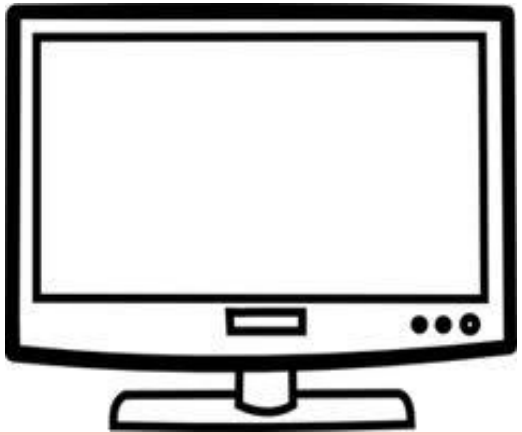
$$mgh = \frac{1}{2}mv^2 + lost\_E$$

$$lost\_E = m\left(gh - \frac{1}{2}v^2\right)$$

$$lost\_E = 10\times\left(10\times 9.8 - \frac{1}{2}10^2\right) = 10\times(98-50) = 480\ \text{J}$$



Video 01 of week 06: Dissipative forces



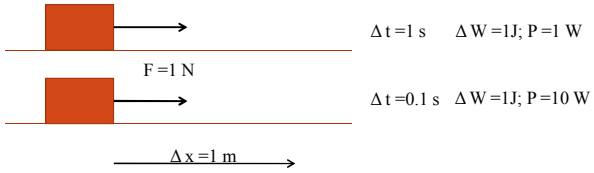
Power

- When an amount of work ΔW is done in a time Δ t, the **average power** is defined as the average rate of doing work.

$$\overline{P} = \frac{\Delta W}{\Delta t}$$

- The S.I. power unit is a joule per second, which is called a watt (W).

Example 6.2



Power

The **instantaneous power** P is found by considering smaller and smaller time intervals:

$$P = \frac{dW}{dt}$$

The work done by a force acting through a small displacement Δx in a short time Δt is $W = F.\Delta x$. Dividing by Δt gives the power:

$$P = \frac{F\Delta x}{\Delta t}$$

Since is the velocity v is $\Delta x/\Delta t$, the power is also given by:

$$P = F.v$$

Thus the power is the force times the velocity.

Video 01 of Week 06: Power

Summary of week 06

The work done by a friction force is: $W(\overrightarrow{F_f}) = -F_f \Delta x$

The average power is: $\overline{P} = \frac{\Delta W}{\Delta t}$

The instantaneous power is: $P = \frac{dW}{dt}$

The instantaneous power can also be written as: $P = F.v$

Quiz for week 06