University of Virginia

Department of Physics

Physics 606: How Things Work II

Lecture #7 Slides:

Wheels

Wheels

Question:

You are in a tremendous hurry and you want your car to accelerate as quickly as possible when the light turns green. Tire damage is not an issue. Will you accelerate faster if you "burn rubber" (skid your wheels) or if you just barely avoid skidding your wheels?

Observations About Wheels

- Without wheels, objects slide to a stop
- Friction is responsible for the stopping effect
- Friction seems to make energy disappear
- Wheels eliminate friction, or so it seems
- Wheels can also propel vehicles, but how?

Friction

- Opposes the relative motion of two surfaces
- Acts to bring two surfaces to one velocity
- Consists of a matched pair of forces:
  - Object one pushes on object two
  - Object two pushes on object one
  - Forces have equal magnitudes, opposite directions
- Comes in two types: static and sliding

Types of Friction

- Static Friction
  - Acts to prevent objects from starting to slide
  - Forces can vary from zero to an upper limit
- Sliding Friction
  - Acts to stop objects that are already sliding
  - Forces have fixed magnitudes

Frictional Forces

- Increase when you:
  - push the surfaces more tightly together
  - roughen the surfaces
- Peak static force is greater than sliding force
  - Surface features can interpenetrate better
  - Friction force drops when sliding begins

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Friction and Wear

- Static friction
  - No work is done (no distance)
  - No wear occurs
- Sliding friction
  - Work is done (distance in the direction of force)
  - Wear occurs
  - Work is turned into thermal energy

Conserved Quantity

- Energy
  - A directionless (scalar) quantity
  - Can't be created or destroyed
  - Transferable between objects via work
  - Can be converted from one form to another

Forms of Energy

- Kinetic – energy of motion
- Potential – energy stored in forces between objects
  - Gravitational
  - Elastic
  - Magnetic
  - Electric
  - Electrochemical
  - Chemical
  - Nuclear

Types of Energy

- Ordered Energy
  - Organized in chunks
  - Example: Work
- Disordered Energy
  - Fragmented
  - Example: Thermal energy
- Sliding friction disorders energy
  - Converts work into thermal energy