

Wheels 1

Wheels

Wheels 2

Question:

- The light turns green and you're in a hurry. Will your car accelerate faster if you skid your wheels and "burn rubber" or if you just barely avoid skidding your wheels?

Wheels 3

Observations About Wheels

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

Wheels 4

Friction

- Opposes relative motion of two surfaces
- Acts to bring two surfaces to one velocity
- Consists of a matched pair of forces:
 - Obj_1 pushes Obj_2 while Obj_2 pushes Obj_1
 - Equal magnitudes, opposite directions
- Comes in two types: static and sliding

Wheels 5

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

Wheels 6

Frictional Forces

- Increase when you:
 - push the surfaces more tightly together
 - roughen the surfaces
- Peak static force 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 distance)
 - No work and no wear
- Sliding friction (distance traveled)
 - Work and wear
 - 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

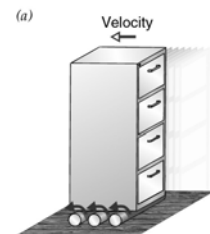
- Kinetic: energy of motion
- Potential: stored in forces between objects
 - Gravitational
 - Elastic
 - Magnetic
 - Electric
 - Electrochemical
 - Chemical
 - Nuclear

Types of Energy

- Ordered Energy
 - Organized in chunks (e.g. work)
- Disordered Energy
 - Fragmented (e.g. thermal energy)
- Sliding friction disorders energy
 - Converts work into thermal energy

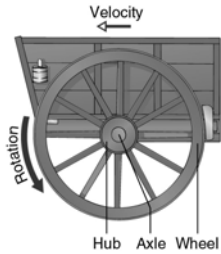
Rollers

- Eliminate sliding friction at roadway
- Are inconvenient because they keep popping out from under the object



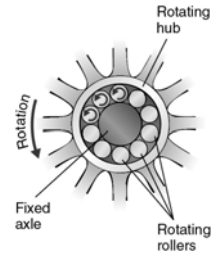
Wheels

- Eliminate sliding friction at roadway
- Are convenient because they don't pop out
- Wheel hubs still have sliding friction



Bearings

- Eliminate sliding friction in wheel hub
- Behave like automatically recycling rollers



Summary about Wheels

- Sliding friction wastes energy
 - Wheels eliminate sliding friction
 - A vehicle with wheels coasts well
- Free wheels are turned by static friction with the ground
- Powered wheels use static friction with the ground to propel the vehicle