Ramps

Question:

Can a ball ever push downward on a table with a force greater than the ball's weight?

Observations About Ramps

- Lifting an object straight up is often difficult
- Pushing the object up a ramp is usually easier
- The ease depends on the ramp's steepness
- Shallow ramps require only gentle pushes
- You seem to get something for nothing
- How does distance figure in to the picture?

Type of Force

- Support force
  - Prevents something from penetrating a surface
  - Points directly away from that surface

Physics Concept

- Net Force
  - The sum of all forces on an object.
  - Determines object's acceleration.

Newton's Third Law

For every force that one object exerts on a second object, there is an equal but oppositely directed force that the second object exerts on the first object.

Experiment:

If you push on a friend who is moving away from you, how will the force you exert on your friend compare to the force your friend exerts on you?

1. You push harder
2. Your friend pushes harder
3. The forces are equal in magnitude

Forces Present:

1. On ball due to gravity (its weight)
2. On ball due to support from table
3. On table due to support from ball

   All three forces have the same magnitude for the stationary ball

Forces Present:

1. On ball due to gravity (its weight)
2. On ball due to support from table ⎤
3. On table due to support from ball ⎦ — Pair

Forces Present:

1. On earth due to gravity from the ball ⎤
2. On ball due to gravity from the earth ⎦ — Pair
3. On ball due to support from table ⎤
4. On table due to support from ball ⎦ — Pair

- Since the ball doesn't accelerate, 2 and 3 must cancel perfectly

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Two Crucial Notes:

- While the forces two objects exert on one another must be equal and opposite, the net force on each object can be anything.
- Each force within an equal-but-opposite pair is exerted on a different object, so they don't cancel directly.
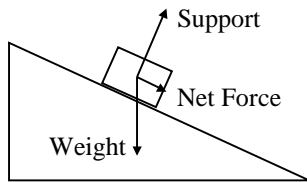
Physical Quantities

- Energy
  - A conserved quantity
  - The capacity to do work
- Work
  - The mechanical means of transferring energy.
  - work = force · distance
    (where force and distance are in the same direction)

Work Lifting Ball

- Going straight up:
  - Force is large
  - Distance is small

$$\text{work} = \text{force} \cdot \text{distance}$$

Forces on a Ramp

Support

Net Force

Weight

Work Lifting Ball

- Going up ramp:
  - Force is small
  - Distance is large

$$\text{work} = \text{force} \cdot \text{distance}$$

Work Lifting Ball

- Going straight up:

$$\text{work} = \text{force} \cdot \text{distance}$$

- Going up ramp:

$$\text{work} = \text{force} \cdot \text{distance}$$

- The work is the same, either way!

Physics Concept

- Mechanical Advantage
  - Doing the same amount of work
  - Redistributing force and distance