

Question:

If you place a tennis ball on top of a basketball and drop this stack on the ground, how high will the tennis ball bounce?

1. To approximately its original height.
2. Much higher than its original height.
3. Much less than its original height.

Collisions with Stationary, Rigid Surfaces

- Approaching object has kinetic energy.

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- Bouncing object has elastic potential energy.

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- Rebounding object has kinetic energy.

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- Some energy is lost to thermal energy.

Collisions with Stationary, Rigid Surfaces

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- Bouncing object has elastic potential energy.
- Rebounding object has kinetic energy.
- Approaching energy is “collision” energy.
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- Some energy is lost to thermal energy.
- Lively balls lose little, dead balls lose much.

Coefficient of Restitution

- Measure of a ball’s liveliness.

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- Measure of a ball’s liveliness.
- Ratio of outgoing to incoming speeds.

$$\text{Coefficient of Restitution} = \frac{\text{Outgoing Speed}}{\text{Incoming Speed}}$$

Collisions with Stationary Surfaces

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- Work is proportional to dent distance.
- Surface stores part of collision energy.

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- Work is proportional to dent distance.
- Surface stores part of collision energy.
- Surface returns part of rebound energy.

Collisions with Stationary Surfaces

- Both object and surface dent during bounce.
- Work is proportional to dent distance.
- Surface stores part of collision energy.
- Surface returns part of rebound energy.
- Surface liveliness or deadness is important.

Collisions with Moving Surfaces

- Incoming speed becomes approaching speed.

Collisions with Moving Surfaces

- Incoming speed becomes approaching speed.
- Outgoing speed becomes separating speed.

Collisions with Moving Surfaces

- Incoming speed becomes approaching speed.
- Outgoing speed becomes separating speed.
- Coefficient of Restitution becomes:

$$\text{Coefficient of Restitution} = \frac{\text{Separating Speed}}{\text{Approaching Speed}}$$

Ball and Bat – Part 1

- Ball approaches home plate at 100 km/h.

Ball and Bat – Part 1

- Ball approaches home plate at 100 km/h.
- Bat approaches pitcher at 100 km/h.

Ball and Bat – Part 1

- Ball approaches home plate at 100 km/h.
- Bat approaches pitcher at 100 km/h.
- Approaching speed is 200 km/h.

Ball and Bat – Part 2

- Approaching speed is 200 km/h.

Ball and Bat – Part 2

- Approaching speed is 200 km/h.
- Baseball's Coefficient of Restitution is 0.55.

Ball and Bat – Part 2

- Approaching speed is 200 km/h.
- Baseball's Coefficient of Restitution is 0.55.
- Separating speed is 110 km/h.

Ball and Bat – Part 3

- Separating speed is 110 km/h.

Ball and Bat – Part 3

- Separating speed is 110 km/h.
- Bat approaches pitcher at 100 km/h.

Ball and Bat – Part 3

- Separating speed is 110 km/h.
- Bat approaches pitcher at 100 km/h.
- Ball approaches pitcher at 210 km/h.

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