

### 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.
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### Collisions with Stationary, Rigid Surfaces

- Approaching object has kinetic energy.

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- Some energy is lost to thermal energy.

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- Lively balls lose little, dead balls lose much.

### Coefficient of Restitution

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- Ratio of outgoing to incoming speeds.

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

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- 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.

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- 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.

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

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- 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.

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- 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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