

AP Review # 15

2. (12 points, suggested time 25 minutes)

A new kind of toy ball is advertised to “bounce perfectly elastically” off hard surfaces. A student suspects, however, that no collision can be perfectly elastic. The student hypothesizes that the collisions are very close to being perfectly elastic for low-speed collisions but that they deviate more and more from being perfectly elastic as the collision speed increases.

- (a) Design an experiment to test the student’s hypothesis about collisions of the ball with a hard surface. The student has equipment that would usually be found in a school physics laboratory.
- What quantities would be measured?
 - What equipment would be used for the measurements, and how would that equipment be used?
 - Describe the procedure to be used to test the student’s hypothesis. Give enough detail so that another student could replicate the experiment.
- (b) Describe how you would represent the data in a graph or table. Explain how that representation would be used to determine whether the data are consistent with the student’s hypothesis.
- (c) A student carries out the experiment and analysis described in parts (a) and (b). The student immediately concludes that something went wrong in the experiment because the graph or table shows behavior that is elastic for low-speed collisions but appears to violate a basic physics principle for high-speed collisions.
- Give an example of a graph or table that indicates nearly elastic behavior for low-speed collisions but appears to violate a basic physics principle for high-speed collisions.
 - State one physics principle that appears to be violated in the graph or table given in part (c)i. Several physics principles might appear to be violated, but you only need to identify one.

Briefly explain what aspect of the graph or table indicates that the physics principle is violated, and why.

- a) i) measure the height of the ball when it's dropped + when it rebounds back.
ii) use a meterstick to measure the heights.
iii) 1. Hold the ball above the ground. measure the height using a meterstick.
2. Drop the ball
3. Using the meterstick, measure the height the ball bounces back to.
4. Repeat the procedure increasing the drop height.

Scored together

(i) overall plan

(i) plausible plan

(i) specify equipment + variables

(i) various height/speed trials

b) Graph the rebound height vs the drop height.

If the slope = 1 the ball's bounces are elastic.

If the slope < 1, then some energy was "lost"

to other types/objects.

If the slope decreases as the drop height increases, then the student was correct that it

deviates more at high speeds.

(1) describe correct plot

(1) describe how compare

(1) compare height low v

(1) address hypothesis

c) i) If the student graphed h_{rebound} vs h_{drop}

+ the slope was greater than 1

for large drop heights, it would appear the ball gained mechanical energy from nowhere, which violates the laws of physics.

(1) draw a graph w/ low v elastic

(1) draw graph w/ high v violate

ii) It would appear to violate the conservation

of energy. If the slope is greater than 1 then the rebound height is greater

than the drop height, showing it gained energy during contact with the floor, which it shouldn't.

(1) describe how violate

(1) explain why it violates