Physics First I Cycle 5 Lesson 3

OBJECTIVE: Distinguish between elastic and inelastic collisions. Use conservation of momentum to solve collision problems.

VOCAB: collision, elastic collision, inelastic collision

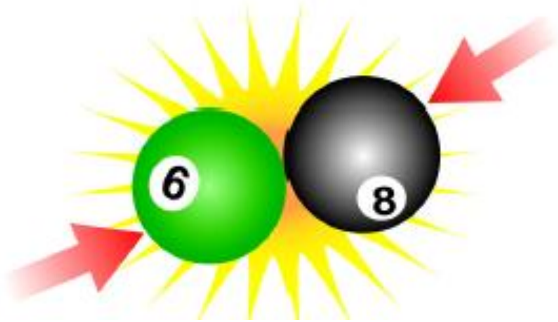
CLASSWORK:

p. 80 “Understanding Vocabulary” #11-13
p. 81 “Reviewing Concepts” #24-27
p. 82 “Solving Problems” #16(a-d), #17

Elastic and Inelastic Collisions

In an elastic collision, objects bounce off each other without losing any kinetic energy. The total kinetic energy before the collision is the same as the total kinetic energy after the collision.

In an inelastic collision, objects change shape or stick together and the total kinetic energy of the system decreases. The energy is not destroyed but is transformed into other forms such as shape changes or heat.

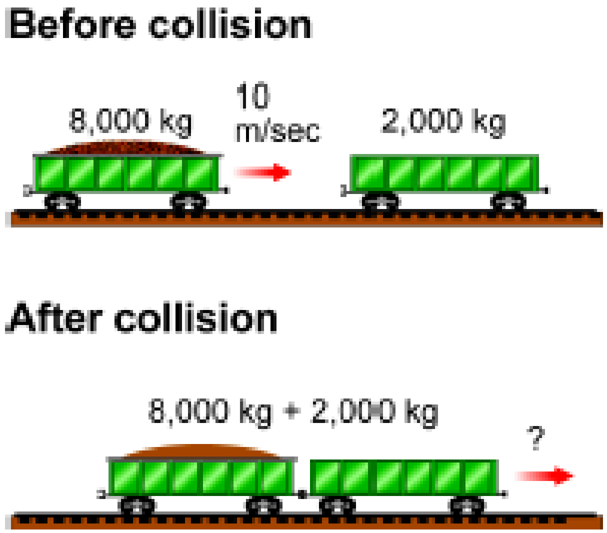


Elastic Collision

Inelastic Collision

Momentum Conservation in Collisions

Momentum is conserved in both **elastic** and **inelastic** collisions. This means that **the total momentum** of the system is the **same before** the collision and **after** the collision.



DISCUSS: Is this collision **elastic** or **inelastic**? Why?

Momentum Conservation in an Inelastic Collision

What is the initial momentum?

8000*10 + 0*2000 = 80,000 N*sec

What is the final momentum?

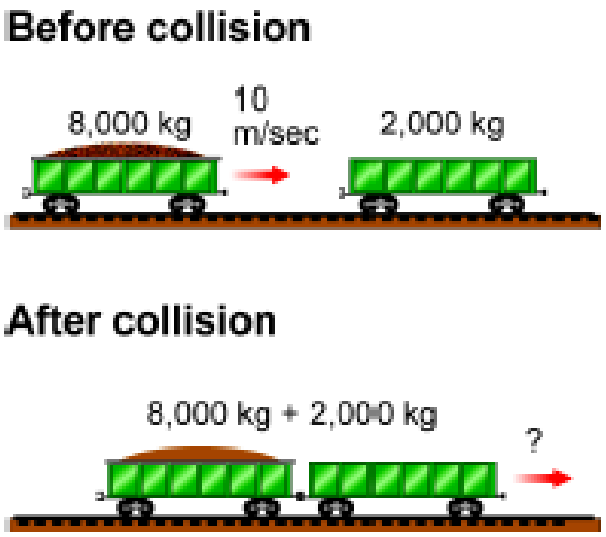
Also 80,000 N*sec (kg*m/sec)

What is the final velocity?

MV = 80,000 kg*m/sec

M = 8000 + 2000 = 10,000 kg

V = 80,000/10,0000 = 8 m/sec



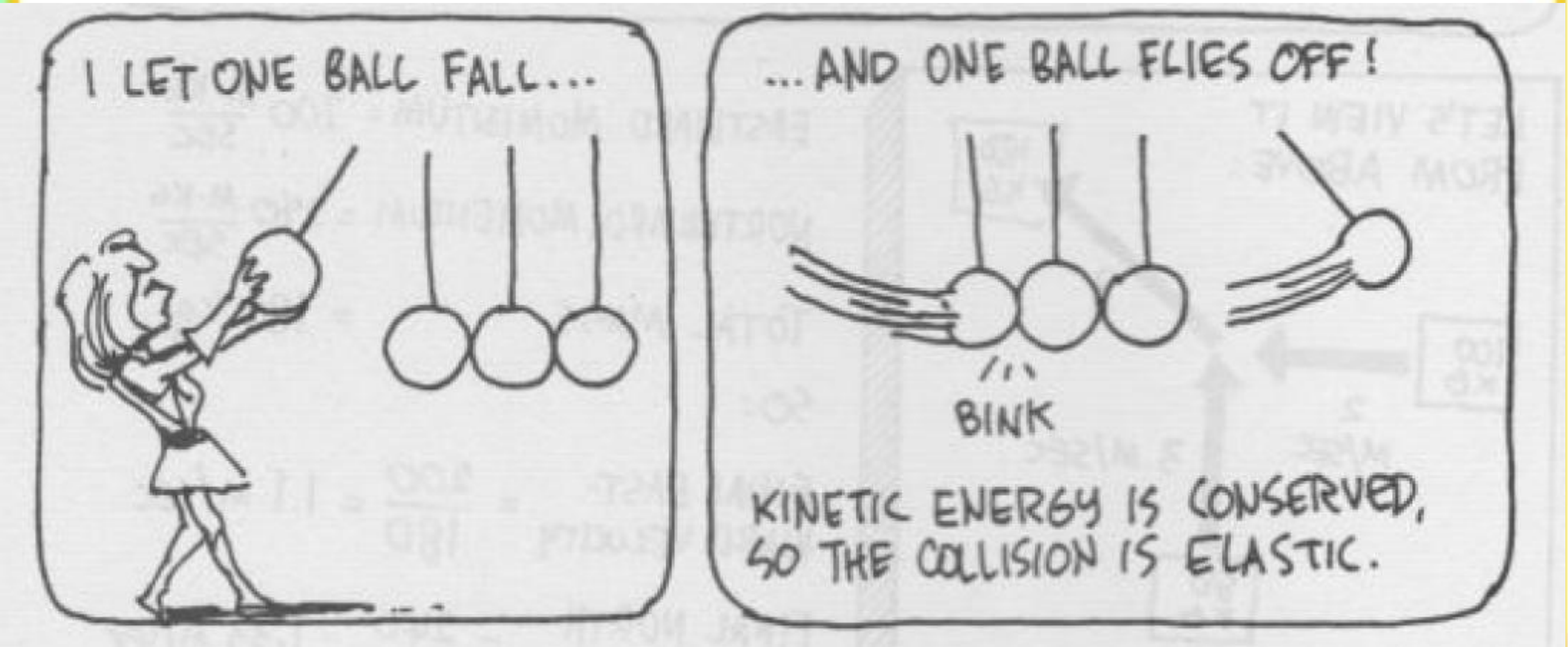
Find velocity after collision

One more thing: Was E_k conserved here?

Initial Ek = ½ * 8000 kg * (10 m/sec)^2 = 400,000 J
Final Ek = ½ * 10,000 kg * (8 m/sec)^2 = 320,000 J

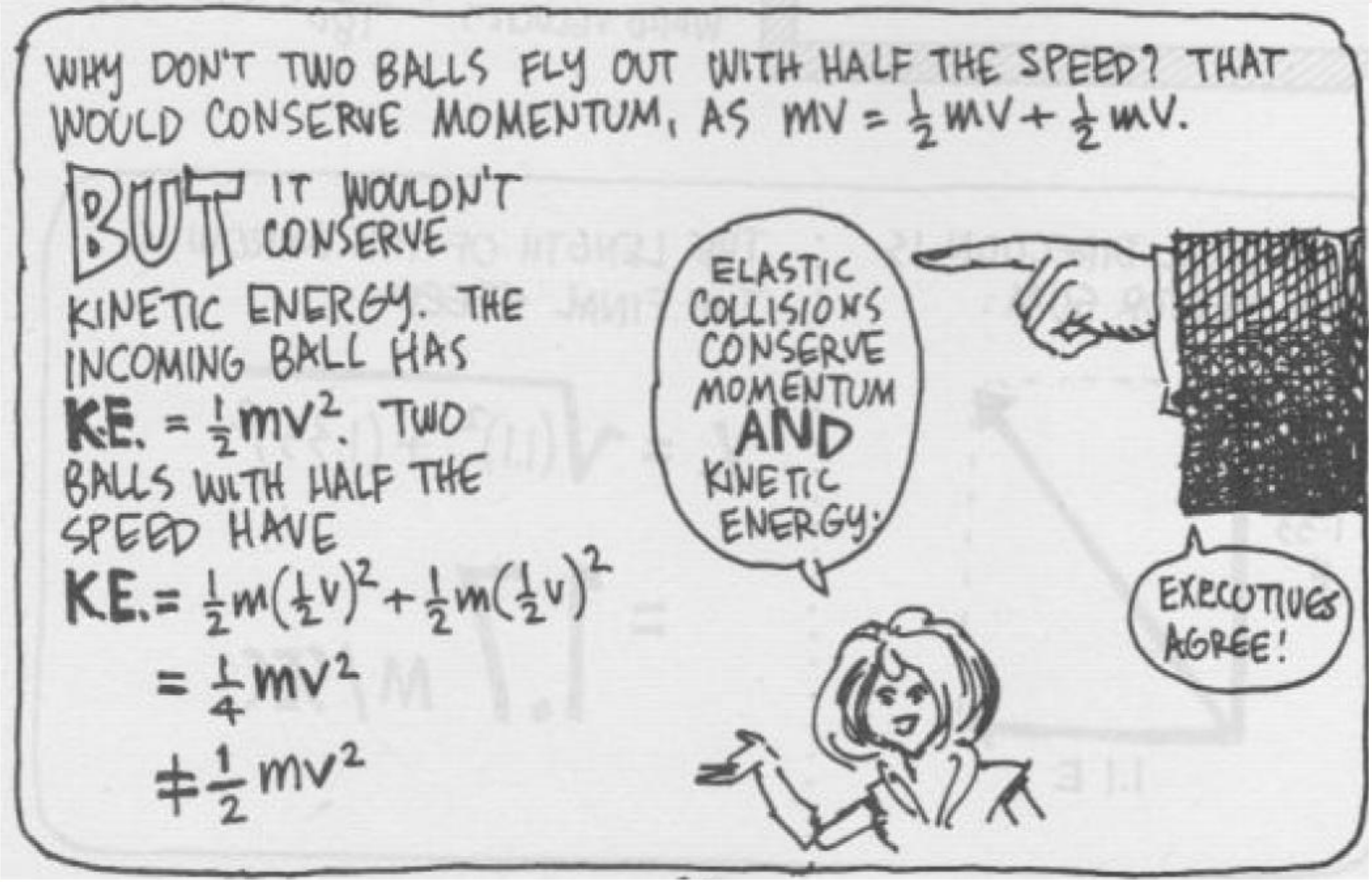
Discuss: where did the missing 80,000 J go?

Kinetic Energy is conserved in Elastic Collisions

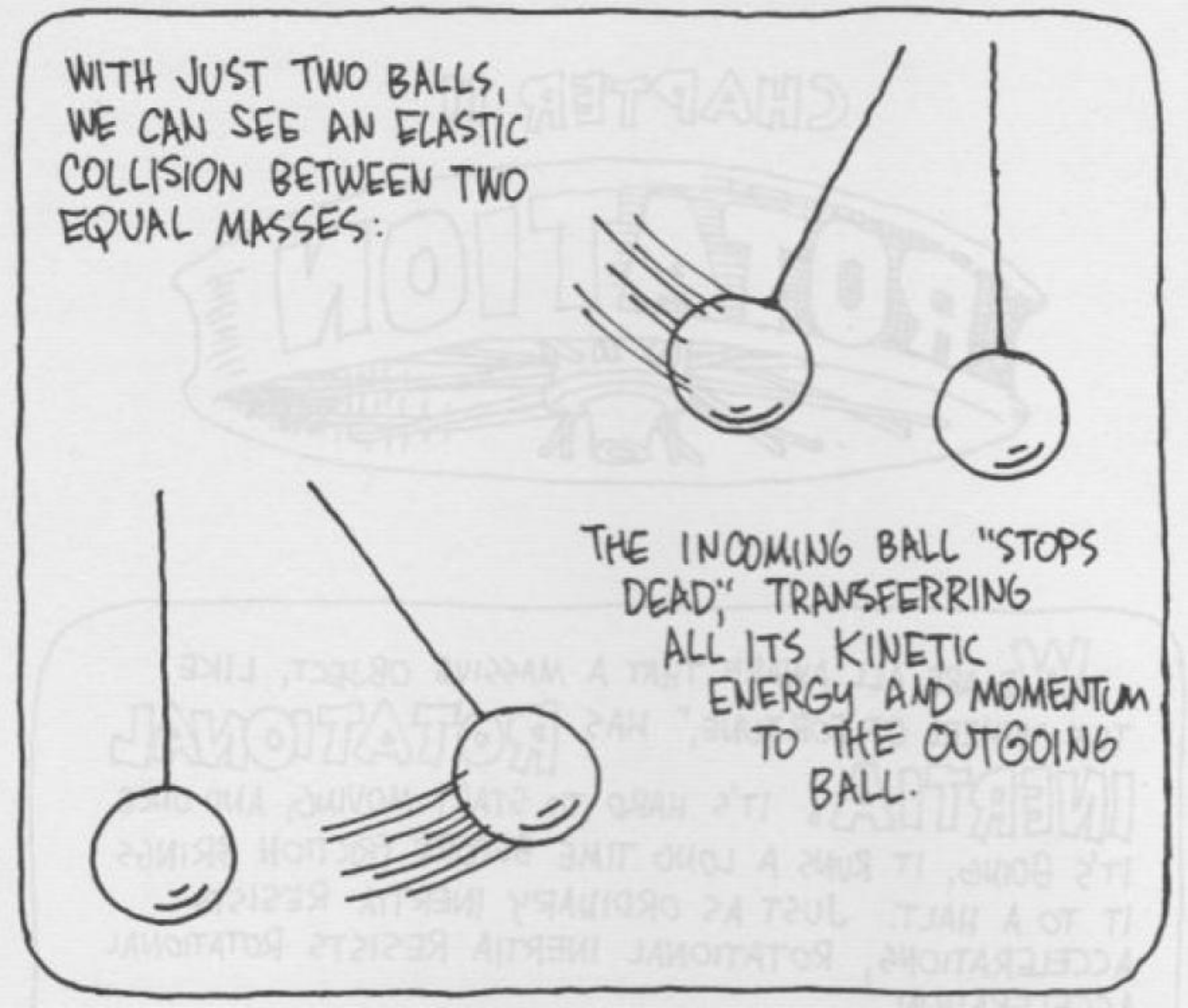


DISCUSS: Do you ever get 2 balls flying off, with half the velocity of the original? This would conserve <u>momentum</u> just as well. So why doesn't it ever happen?

Kinetic Energy is conserved in Elastic Collisions

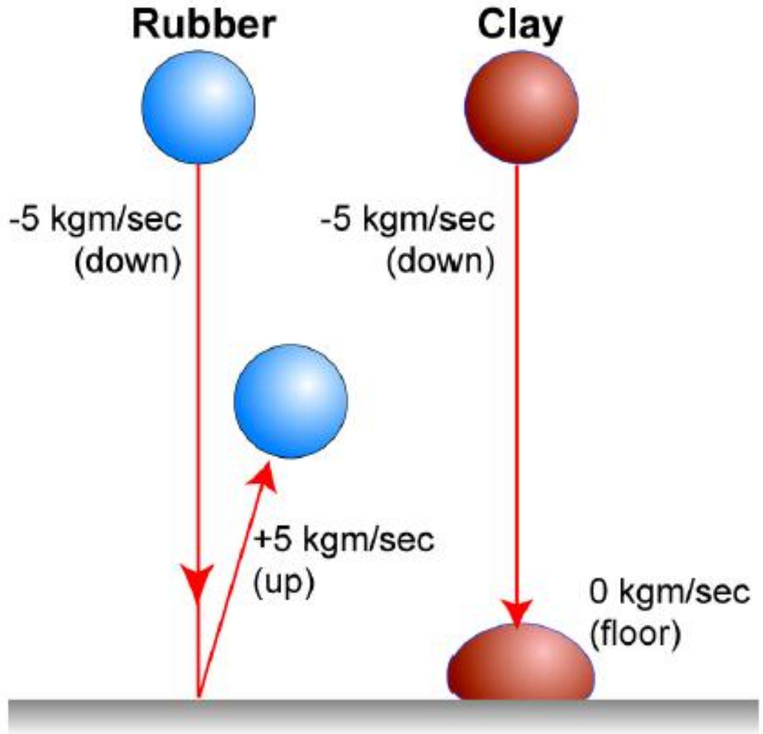


Kinetic Energy is conserved in Elastic Collisions



Forces in Collisions

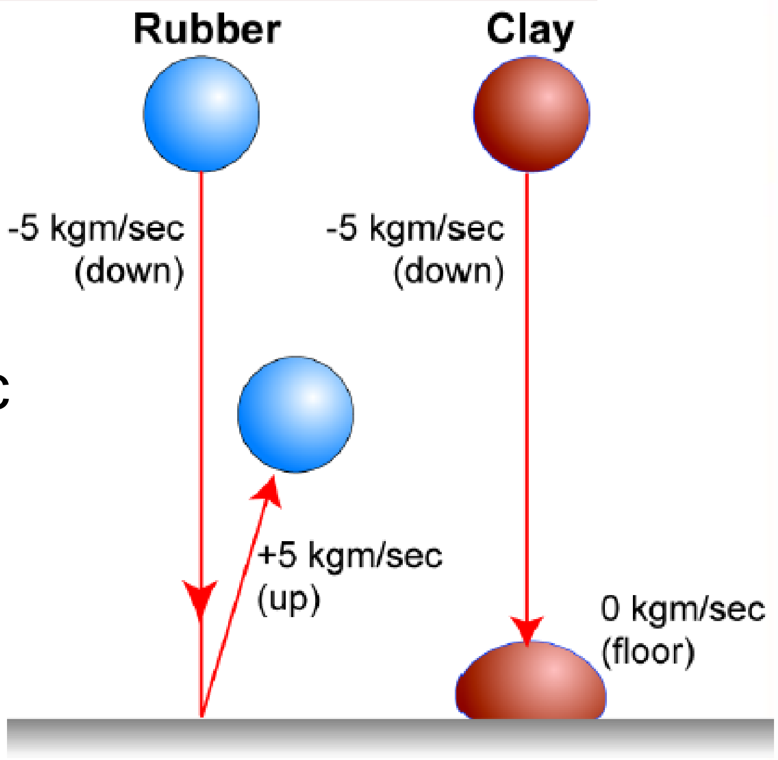
A rubber ball and a clay ball both are dropped to the floor, with equal momenta.



DISCUSS: Which exerts a greater force on the floor, the rubber ball or the clay ball?

Forces in Collisions

How much impulse does each ball give to the floor?



Clay Ball: what is ΔP?

$\Delta P = 0 - (-5 \text{ kg*m/sec}) = 5 \text{ N*sec}$

Rubber Ball: what is ΔP?

$\Delta P = 5 \text{ kg*m/sec} - (-5 \text{ kg*m/sec})$

$= 5 + 5 = 10 \text{ N*sec}$

Assuming time of collision T is the same for both:

$F*T = \Delta P$ so $F = \Delta P/T$. $\Delta P_{rubber} > \Delta P_{clay}$

The rubber ball applies more force to the floor than the clay ball!