Name _____ Date _____

Conservation of Energy: Tracking Every Joule on Sleds, Swings and Roller Coasters

Directions: In number questions, type only the number; the unit is shown next to the box. A question that uses a formula or a value for gravity describes a model: give the answer that model predicts.

1. In this model, a roller coaster car's energy is gravitational potential energy, kinetic energy, or thermal energy and sound made by friction and air resistance. The car is released from rest at the top of the first hill with 150,000 joules of gravitational potential energy compared with the bottom. At the bottom, it has 135,000 joules of kinetic energy. How many joules became thermal energy and sound? Type your answer without a comma.

_____ J

2. Gravitational potential energy = mass × gravity × height. In this model, use 10 N/kg for gravity. A 40-kilogram crate sits at the top of a loading ramp, 3 meters above the ground. How much gravitational potential energy does the crate have compared with the ground? Type your answer without a comma.

_____ J

3. Kinetic energy = ½ × mass × speed^2. A 30-kilogram box slides across a smooth floor at 4 meters per second without rolling or spinning. In this model, what is the box's kinetic energy?

_____ J

4. A sled is released from rest at the top of an icy hill with 2,400 joules of gravitational potential energy compared with the bottom. On the way down, friction with the snow and the push of the air transfer 400 joules to thermal energy and sound. In this model, how much kinetic energy does the sled have at the bottom? Type your answer without a comma.

_____ J

5. Kinetic energy = ½ × mass × speed^2, and gravitational potential energy = mass × gravity × height. In this model, use 10 N/kg for gravity, ignore air resistance and treat the ball as not spinning. A 0.2-kilogram ball is thrown straight up at 10 meters per second. How high does it rise above the point where it leaves the thrower's hand?

_____ m

6. A child stops pumping her legs on a swing, and each swing gets a little lower until she comes to rest. What happened to the swing's energy?

A. It was transferred, mostly as thermal energy and a little sound, to the air, the chains and the hooks the swing hangs from, and the total amount of energy stayed the same.

B. It was all stored in the swing as gravitational potential energy at the lowest point.

C. It was used up, so there is now less energy in the world.

D. Gravity destroyed a little of it on every swing.

7. Rosa's hockey stick hits a puck that was resting on the ice, and the puck slides away fast. Which statement best describes the energy?

A. No energy moved, because the puck already had that kinetic energy while it was at rest.

B. Energy was transferred from the moving stick to the puck, so the puck's kinetic energy increased.

C. The puck created new energy at the moment it was hit.

D. The puck's kinetic energy came from the cold ice under it.

8. A bike rider on a flat road squeezes the brakes, and the bike slows to a stop. Which two statements are true?

☐ A. The brakes destroyed the bike's kinetic energy.

☐ B. The bike's kinetic energy became gravitational potential energy.

☐ C. Most of the bike's kinetic energy became thermal energy in the brake pads, the wheels and the air.

☐ D. The total amount of energy stayed the same.

☐ E. The bike gained kinetic energy while it slowed down.

9. On a cold morning, Luis rubs his palms together quickly, and they feel warmer. Which statement best explains this?

A. Friction transfers the kinetic energy of his moving hands into thermal energy, so his skin warms up.

B. His hands warm up because rubbing takes energy away from them.

C. Rubbing makes new energy out of nothing.

D. Rubbing pushes the cold out of his hands.

10. A roller coaster car is pulled to the top of its first hill and released from rest, with no motor to help it after that. Why can't a later hill on the track be as tall as the first one?

A. The car gains energy on every drop, so later hills must be lower to slow it down.

B. Some energy is transferred to thermal energy and sound along the way, so the car never again has as much motion energy and stored energy as it had at the start.

C. Gravity pulls harder on the car as the ride goes on.

D. The car uses up all of its energy on the first drop.