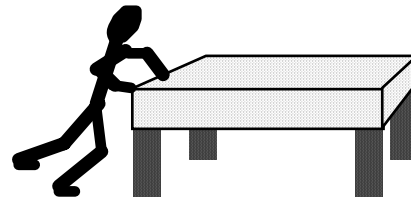


PHY100S – The Magic of Physics Test Answers

Question 1: If you went to the moon you would discover that:

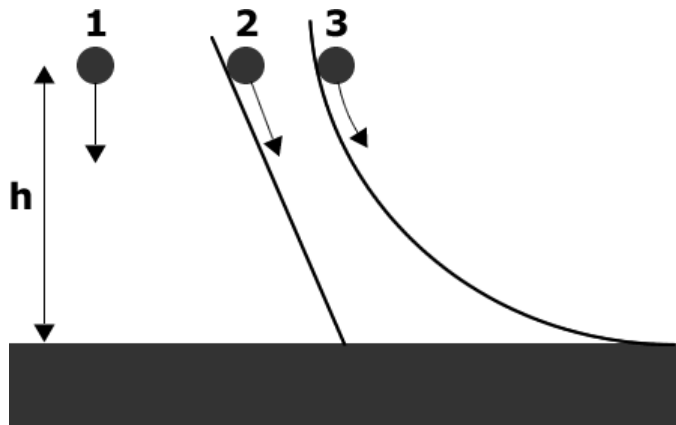
- A. It really is made of cheese.
- B. Your weight would be increased.
- C. Both your weight and your mass would be reduced.
- D. Your mass would be reduced, but not your weight.
- E. Your weight would be reduced, but not your mass. **CORRECT**

Question 2: Mary pushes horizontally on a large, heavy table which is standing alone in the middle of a room, and notes that the table does not move despite the fact that she is pushing on it (see diagram to the right). Why doesn't the table move?



- A. A frictional force is also exerted by the floor on the table, and this force is equal and opposite to the pushing force. **CORRECT**
- B. The table exerts a force on Mary, and this force is equal and opposite to the pushing force.
- C. Very massive objects, such as the table, are difficult to set into motion because of their large inertia.
- D. The force of gravity pulls downward on the table, and this force cancels the pushing force.
- E. The table pushes back on Mary with a force that is even larger than Mary's pushing force.

Question 3: Three children, represented by circles and labeled 1, 2 and 3, are initially at rest the same height h above the ground. Child 1 falls straight down. Children 2 and 3 slide down frictionless slides shaped as shown. Air resistance is negligible. At the bottom, which child has the **smallest** speed?



- A. Child 1
- B. Child 2
- C. Child 3
- D. They all have the same speed at the bottom. **CORRECT**
- E. It depends on the masses of the children.

Question 4: Suppose you viewed a movie that was running backwards. You would see lots of odd things happening: streams would flow uphill, and so forth. If these odd "backward-moving" things actually happened in nature, which principle or principles of physics would be violated?

- A. Newton's law of motion.
- B. The Second Law of Thermodynamics. **CORRECT**
- C. Both of the above.
- D. The principle of Conservation of Energy.
- E. All of the above.

Question 5: The planetary model of the atom must be wrong because:

- A. Gravity is too weak to hold the atom together.
- B. The Plum Pudding Model of the atom fits the data better.
- C. Like charges repel each other, so the electric force can not hold the atom together.
- D. The electrons would radiate all their energy away. **CORRECT**
- E. The planetary model of the atom is correct.

Question 6: The original purpose of the Michelson-Morley experiment was to show or measure:

- A. That nothing goes faster than light.
- B. That light has the same speed for all observers.
- C. The predictions of Einstein's theory of relativity.
- D. That the ether does not exist
- E. Earth's speed through the ether. **CORRECT**

LONG ANSWER TOPIC 1

A Jack-In-The-Box has a clown figure with a spring inside. Initially the clown is inside a closed box. When the top of the box is opened the clown pops up, jiggles around for a while, and eventually coming to rest as shown. Discuss all the transformations of energy from when the clown is inside the closed box until it ends up at rest after the box is opened.



Initially all the energy is **elastic** and stored in the spring.

You may also say that the clown has **gravitational energy**, although this is not required

As soon as the box is opened, some energy is being converted into **thermal energy** throughout all the subsequent motions.

When the box is opened, the clown shoots upwards. During his upward motion the elastic energy is also converted into **kinetic energy**, and **gravitational energy**.

The clown overshoots the height where he will eventually end up. The spring is stretched beyond its rest value, so the kinetic energy of the clown is converted back into **elastic energy** of the spring and **gravitational energy**.

The clown then oscillates up and down and perhaps back and forth. Here **kinetic**, **elastic** and some **gravitational** energy are being converted into **thermal energy**.

When he ends up at rest, most of the total energy has been converted to **gravitational** and **thermal** forms.

The weight of the clown causes the spring to be a little bit compressed at the end, so there is also a little **elastic** energy being stored in the spring.

LONG ANSWER TOPIC 2

Objects emit electromagnetic radiation because of their internal thermal energy. The total energy of this radiation increases as the temperature of the object increases. The maximum energy output occurs at a wavelength that decreases as the temperature of the object increases. Discuss these temperature dependencies of the emitted radiation in terms of what the atoms and molecules of the object are doing.

The atoms and molecules are vibrating, and this oscillation of charges causes the emission of electromagnetic waves.

As the temperature of the object increases, the amplitude of oscillation of the atoms and molecules increases, so the total energy emitted as radiation increases.

As the temperature of the object increases, the frequency of the oscillation of the atoms and molecules also increases.

The frequency of the radiation is equal to the frequency of the oscillating charge that caused it.

Thus the frequency of the maximum of the spectrum of electromagnetic radiation increases.

But if the frequency increases, the wavelength decreases.