Answers

Physics Notes
Astronomy: Formation of the Solar System

Purpose: To understand how and why a cloud of "dust and frozen gasses" would turn into a solar system like ours.

1. Gravity is a force of attraction. Things which have gravity are pulled together. Anything which has mass has gravity. Does dust have gravity? yes

2. Does ice have gravity? yes

3. A cloud of dust and ice (a **nebula**) is floating freely in space. According to your answers to questions one and two, what will the particles in this cloud do? Pull together; contract

4. a. When a slowly-turning figure skater pulls in her arms, what happens? spinning speeds up
   b. What would happen to a slowly-turning nebula of dust and frozen gas if it suddenly began to contract (Contract means shrink or pull-together)? Spin faster

5. a. When a pizza guy throws a spinning pizza in the air, what shape does it make? disc
   b. If a water balloon is spinning rapidly, what shape will it make? disc
   c. If a cloud of dust and gas were spinning rapidly in the middle of space, what shape do you think it would make? disc
   d. If the pizza guy himself began to spin at a rate of 3500 rpm, what shape would he begin to make? disc

6. a. What sort of "force" "pulls" the equator of the water balloon outward as it spins? — momentum of H_2O molecules "tries" to propel them in a straight line, so they push against the wall of the balloon
   b. What keeps the water in the water balloon from flying out into the room? ← Elastic Force of balloon
   c. As a nebula spins, what keeps the dust and gasses from flying freely into space? gravity

7. When you squeeze a lot of air molecules into a small space:
   a. are you causing the molecules to speed up or slow down?
   b. will the temperature of the air decrease or increase?

8. What would happen to the temperature inside a cloud of dust and gas if the cloud began to compress itself into a smaller space? increases

9. The sun's energy comes from nuclear fusion. During nuclear fusion, the nuclei (the centers) of four hydrogen atoms become fused together to make one helium atom. However, since four hydrogen atoms have more mass than one helium atom, some mass is lost during this process. That lost mass turns into an incredible amount of energy. **For example, if the matter in seven average paper clips were turned completely into energy, that energy would be equivalent to the burning of 20,000,000 kg of coal.**
   a. In order for nuclei to fuse, atoms need to hit each other with great force.
   a. Should atoms be better able to fuse when they are moving fast or slowly?
   b. In this shrinking cloud of dust and gas, which part of the cloud probably became the hottest? (outside, or the center)
   c. In which part of the cloud did nuclear fusion probably begin?
   center, because that's where atoms were hot/fast enough

10. Suppose you have a swirling, disk-shaped cloud of dust and gas. Suppose the cloud is very hot in the center. Where do you think the most frozen gas would survive, near the center or near the edge of the cloud?

11. Scientists think the planets were formed in the same manner that a snowball gets bigger as it rolls down a hill. Imagine specs of dust floating freely in space. First two specs of dust collide and stick together. Then another spec of dust sticks to the first two. Then another spec of dust attaches to the growing ball of dust. What force could make those floating specs of dust stick together? [look back at #s 1, 2, and 3, if you need a hint.] Gravity

12. Eventually a swirling cloud of dust and gas can turn into a sun surrounded by planets. All of the planets have rocky parts, but only the outer planets have extremely thick layers of gas surrounding their rocky cores. Explain why the inner planets are rocky while the outer planets have a lot of gas. Gases near sun had been "burned away"

13. If the sun in the middle of these swirling planets were to expand so that it covered up some of the inner planets, what might happen to the outer, gas-covered planets?

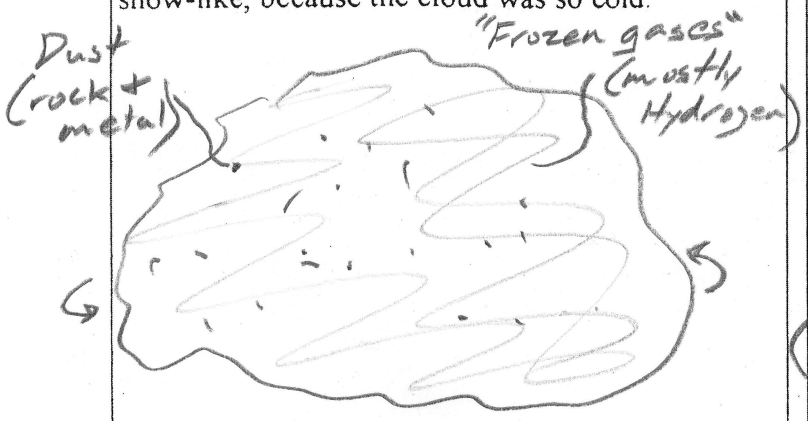
Their outer gas layers might be "burned away," revealing their rocky cores.

Answers

5

Summary of Solar System History

10 Billion years ago (approximately), the solar system was a giant, slowly rotating cloud of dust and gas. Actually, the "gas" was frozen and snow-like, because the cloud was so cold.



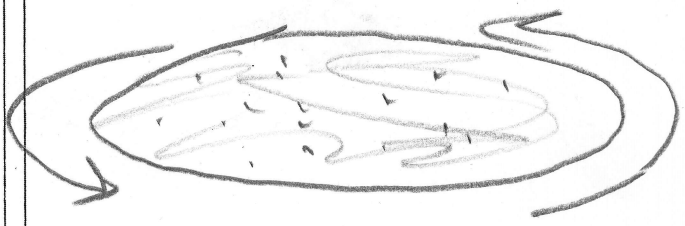
1st

The cloud began to shrink because: gravity pulled it together

The cloud began to spin more rapidly because: it contracted (shrank)

The cloud became disc-shaped because: momentum kept equatorial material from falling inward

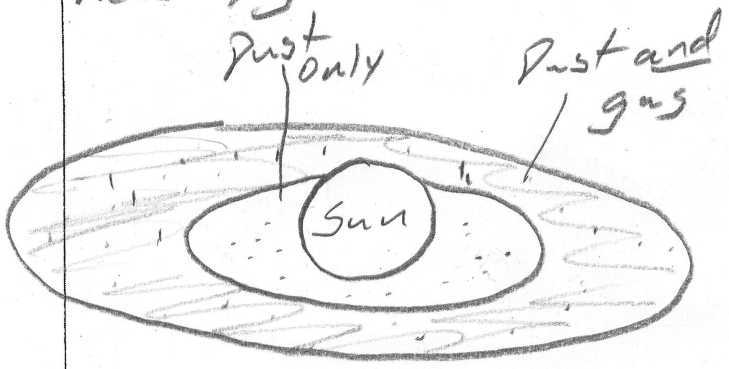
The cloud began to heat up because: It compressed itself



2nd

The sun was "born" as nuclear fusion began in the center of the cloud. Nuclear fusion could only begin in the center of the cloud because: Nuclear fusion requires hot/fast atoms

Only the frozen gasses far from the sun survived. Near the sun, mostly dust remained. This is because: Sun "burned off" nearby gases.



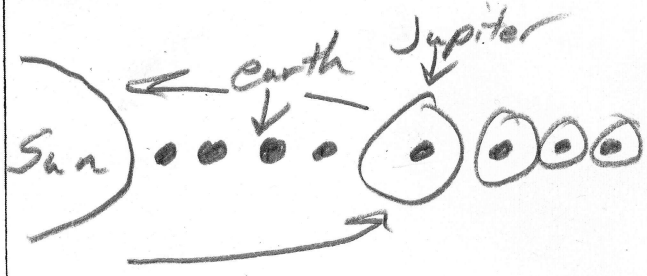
3rd

The tiny particles of dust and gas gradually clumped together to form planets because: gravity

The inner planets are rocky, but the outer planets have small rocky cores surrounded by thick gas layers. This is because. Sun burned off nearby gases

The force that keeps the planets from flying away from the sun is: gravity

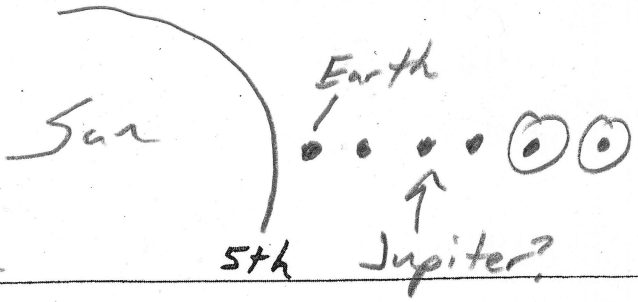
The force that keeps the planets from being pulled into the sun is: The planets' momentum.



4th

In approximately 5 billion years [redacted], when the sun is approximately 10 billion years old, scientists think the sun will expand to cover Mercury and possibly Venus. If that happens, what might happen to the outer, gas planets?

Their gas layers may be "burned off," revealing their rocky cores.



5th