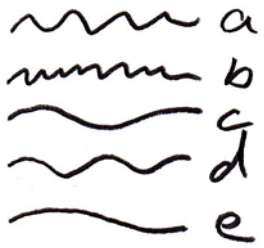
Physics
Answers to Final Exam Practice, Part I

#1-4 In its earliest form, our solar system was huge, cold, and slowly-turning. It had no particular shape. Over time, our solar system shrank, heated up, began to spin faster, and became disk-shaped. For the questions below, give the immediate causes for each event.

1. What caused it to shrink? **Gravity pulled it together.**
2. What caused it to heat up? **As the nebula pulled together, pressure (compression) caused it to heat up.**
3. What caused it to spin faster? **The nebula spun faster because it contracted (pulled together)**
4. What caused its shape to become a disk? **The <u>momentum</u> of the flying particles in the nebula pulled them outward.**
5. Today's planets formed from dust and gases that clumped together. What caused this clumping into actual planets? **Gravity**
6. The inner planets of our solar system are rocky, while the outer planets are "gas giants." Why are the inner and outer planets different? **The sun "burned away" the gases that were near the sun. The inner planets are close to the sun, so there was not much gas available for them to become gas giants.**
7. What is Nuclear Fusion? **Nuclear fusion is the combination of existing atoms to create entirely new atoms of a new element.**
8. How does nuclear fusion produce energy? **When atoms fuse, the new atoms that are created have less mass than the atoms that fused. This means mass is "lost." That "lost" mass is converted to energy.**
9. Nuclear fusion can only occur in the center of the solar system. Why is that? **In order to fuse, atomic nuclei have to hit each other with great force. This can only happen if the atoms are moving very fast. Hot atoms move the fastest, and the hottest part of the solar system was the center (where there was the most pressure).**
10. What would happen to the orbit of a planet if it suddenly started orbiting faster? **The planet would have more momentum, and this momentum would "pull" the planet farther from the sun.**
11. As a new star is born, what type of atoms first begin to fuse? **Hydrogen**
12. Which type of new atoms are created when these first atoms fuse? **Helium**
13. As stars get older, they often expand to become red giants. Why do stars expand in this way, and why do they turn red? **In older star, a lot of hydrogen has already fused. This fusion creates helium, which is more dense than hydrogen. The helium sinks to the star's core and pushes the hydrogen outward. This outward push causes the star to expand (become giant). As the fusing hydrogen moves away from the star's core, it enters an area of lower pressure. This causes hydrogen fusion to slow down, which produces less energy. This fusing hydrogen cools off, so it turns red (the coolest color).**
14. How do we know what elements are inside stars? **We use spectroscopes to examine the wavelengths of light coming from those stars.**
15. Put these star colors in order from hottest (on the left) to coolest (on the right**Blue, White, Yellow, Orange, Red**
16. A massive star (25 times the size of our sun) is like an onion. It has layers of various elements. Why do those layers form?**The outer layers fuse, creating heavier elements. Those heavier elements sink to the star's center, where they themselves fuse to create even heavier elements. Then those new elements sink to the star's center. This is repeated until there are many layers whose densities increase as the star's center is approached.**
17. Why can't a star like our sun ever become a black hole? **In order to form a black hole, a star must have tremendous gravity. Our sun does not have enough mass. A dead star must have at least three times the mass of the sun in order to become a black hole.**
18. Why isn't our sun blue? **Our sun doesn't have enough mass. Blue stars are the hottest stars, and a hot star needs a lot of pressure. In order for there to be a lot of pressure, a star needs a lot of mass. Our sun doesn't have that much mass.**
19. Draw a high energy wave and a low energy wave. Label them? **Letter b, on the right, shows a high energy wave. Letter e shows a low energy wave.**



20. Which of the waves on the right has the longest wavelength (see diagram)
Wave e, because it has the most space between crests.
21. At some point, our sun will shrink and become a white dwarf. Why will shrinking cause the sun to turn white. **Shrinking will compress the sun. Compression will heat it up. Heating will cause it to turn from red to white.**
22.Our solar system formed from a Nebula. Where do Cosmologists think that nebula came from (just before it was a nebula – <u>not</u> way back at the moment of the Big Bang)?
Cosmologists think our nebula came from material that was blasted into space during a supernovae (the explosive death of a massive star).
23. Protons and electrons fuse in a: **neutron star**
24. The shape of a black hole is: **a sphere**
25. The place where all of the mass of a black hole is located: **the singularity**

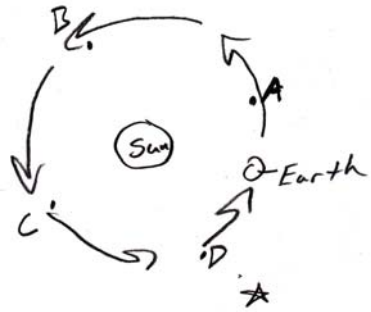
26. When a massive, dying star blows itself apart, if the remaining mass is less than three times the mass of the sun, the leftover material will form a: **neutron star**

28. Cosmologists think the material in our bodies was once part of a massive star. Explain how it went from a star to our bodies. **They think the star exploded in a supernova. The supernova blasted material out into the universe. Some of this material pulled back together to form our solar system. Some of those bits of the solar system ended up in our bodies.**

29. Describe two pieces of evidence for Big Bang theory? **1) all distant galaxies are moving away from us 2) There is microwave radiation (energy) spread throughout the universe. Cosmologists think this is "heat" left over from the Big Bang.**

30. Cosmologists have observed that distant galaxies are moving away from us, but they say that these galaxies are not moving through space. How can this be? **Cosmologists tell us that the *space* between the galaxies is expanding. The galaxies are not moving through space.**

31. Nobody knows how big the universe is. We don't even know whether or not it goes on forever. Plus, there's no way that we can ever find out how big it is. Explain why we can never know the universe's size. **The universe isn't old enough. Since the universe is only about 14billion years old, light from objects farther than about 14 billion light years has not had enough time to reach us.**

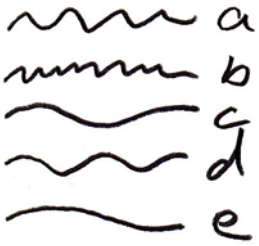


32. At which position on the right will people on the Earth see the other star undergo the greatest blue shift? **The answer is C, because the earth is moving toward the star at position C. If this is on the test, the diagram will be different.**

33. At which position on the right will people on the Earth see the other star undergo the greatest red shift? **The answer is A, because the earth is moving away from the star at position A. If this is on the test, the diagram will be different.**

34. You're a bat, and you're flying around in search of insects. You send out a screeching sound. Your screech echoes off of a mosquito that is coming toward you. Compared to the sound you made, the screech that you hear is: **higher in pitch. When things move toward you, their sounds are higher pitched. When they move away, their sounds are lower pitched.**

35. You already know that velocity=d/t, so t=d/v. Ned the cosmologist measures the distance of galaxy D at 9 billion light years away from earth. He measures the velocity at which Galaxy D is moving away from us, and he gets 0.5c. According to Ned's measurements, what is the age of the universe? **t=d/v, so age of universe = 9 billion light years / 0.5c = 18 billion years.**



36.Assuming that all of the waves on the right came from the same light source out in space, in which case was the light source moving most rapidly away from the earth? **e, because the wavelengths of e have been lengthened ("stretched out"). This is what happens to waves emitted by an object that is moving away from us.**

37. "Cosmologists tell us that nothing at all happened in the billions of years before the Big Bang." Why is that last statement false? **Cosmologists say that time did not exist before the Big Bang; there was no "before."**

38. "If I am 37 years old, then my age in light years is much greater than 37." What is wrong with that statement?**A light year is a measure of distance (the distance that light travels in one year) not time. You can measure distances in light years, but you can't measure ages in light years.**

39. What was the "cosmic singularity?" **The infinitely small point where all of the universe's mass was located at the moment of the Big Bang.**