

## ISP 205: Visions of the Universe Fall 2008, Section 2

The following is the list of questions and answers for the cumulative part of the final. All of the cumulative part of the final (the first 24 out of 48 questions) will be taken from this list. They may not be verbatim, e.g. the numbers may change or the effect reversed, but they will essentially be the same questions in content.

- Q. Which of the following would happen if the Earth started spinning (rotating) in the opposite direction it is spinning now?
- A. The Sun would rise in the West and set in the East.
- Q. The Earth spins (rotates/revolves) around an axis that is tilted compared to the axis about which it orbits the Sun. Which of the following would be true if the Earth's spin was NOT tilted? (that is, which of the following would be true if the axis the Earth spins around was the same as the axis about which it orbits its sun?)
- A. The temperature would not change much during the year in both the northern and southern hemispheres.
- Q. What is the main reason it is warm in Michigan in the summer?
- A. The tilt of the Earth's axis means we receive the most direct sunlight then.
- Q. If the moon is full at midnight, what will it be at 2 AM the same night?
- A. full.
- Q. Which of the following would make your weight half what it is now?
- A. Being on a planet the same size as Earth but half the mass.
- Q. When you see the Moon,
- A. Light is emitted by the Sun, reflects off the Moon, and a little bit of that enters your eye.
- Q. The center of our Milky Way Galaxy is about 25 million light years away. If a star explodes there, how long will it be before we see this happen?
- A. 25 million years.
- Q. A photon that has a wavelength of 600 nanometers
- A. is less energetic than a photon with a wavelength of 400 nanometers.
- Q. Which answer shows the correct pattern from closest object to the Earth to farthest from the Earth?
- A. the Moon - Jupiter - stars other than the Sun.
- Q. What led to the acceptance of the idea that the Earth revolves around the Sun over the previous view that the Earth was the center of the Universe?
- A. That theory described the observations better and explained the motions of all objects with one consistent model.
- Q. We see a set of spectral lines at 600 nanometers and 500 nanometers in the laboratory. We observe a star and see this set of spectral lines at 594 and 495 nanometers respectively. Which of the following can we conclude?
- A. That the star is moving toward us.

- Q. Now we observe another star and see these wavelengths at 588 nanometers and 490 nanometers. What can we conclude about this star?
- A. It is moving twice as fast toward us as the first star. j
- Q. If someone drops a 10-pound weight and a 5-pound weight from the same height on the Moon, what will happen?
- A. The two weights will hit the ground at the same time.
- Q. Why don't we glow in the dark?
- A. People only emit light that is invisible to our eyes.
- Q. For objects that emit thermal radiation (like stars) which of the following is true?
- A. Hotter objects emit more photons and more of these have higher energies.
- Q. Why is a red rose red?
- A. It absorbs photons of most colors, but reflects and scatters light at red wavelengths.
- Q. Which of the following is the main advantage of a larger telescope (bigger mirror)?
- A. To be able to collect more light to see fainter objects.
- Q. Which of the following is NOT an important reason for having telescopes in space?
- A. To place the telescope closer to the stars.
- Q. If there are two identical stars, but one is three times farther away than the other one.
- A. The closer one will appear to be nine times brighter than the more distant one.
- Q. Why are there no X-ray telescopes on the surface of the Earth?
- A. X-ray photons are not able to pass through the atmosphere.
- Q. How would the gravitational force between the Sun and the Earth change if the Sun doubled its mass?
- A. The gravitational force between the Sun and Earth would be twice as large.
- Q. The gravitational force between two objects is
- A. larger between objects of larger masses, and decreases as the square of the distance between the objects.
- Q. Why does an atom only absorb some wavelengths of light and not all of them?
- A. It only absorbs wavelengths of light with energies that correspond to specific differences between energies of allowed electron orbits.
- Q. The Sun and the giant planets are composed mainly of the same two elements. These are
- A. hydrogen and helium.
- Q. Which of the following is true?
- A. The planets all orbit the Sun in the same direction, and with the exception of Pluto, they all do so in the same plane like a flat disk.
- Q. What fraction of the total mass of the Solar System does the Sun contain? The planets?
- A. The Sun contains more than 99% of the mass in the Solar System, and the planets contain less than 1% .

- Q. Based on physical properties, which grouping of planets makes the most sense?  
A. Mercury, Venus, Earth, and Mars together, and Jupiter, Saturn, Uranus, and Neptune.
- Q. According to radioactive dating of meteorites, approximately how old is the solar system?  
A. 4.5 billion years.
- Q. Which planet has an atmosphere that is very similar to the Earth's?  
A. None of them do.
- Q. The Moon has many more impact craters on its surface than the Earth does. What does this tell us?  
A. That the Moon's surface is old, and that the Earth's is young, because the Moon stopped having major geological activity a long time ago, while the Earth still does.
- Q. Where is the water on Venus?  
A. It does not have any because Venus was too hot for liquid water, and the water vapor left its atmosphere?
- Q. Which one below has the correct order starting with planet with the highest surface pressure, going to the planet with the lowest surface pressure?  
A. Venus (highest) - Earth - Mars (lowest)
- Q. Why doesn't the Earth have a runaway greenhouse effect?  
A. Because it has liquid water oceans in which carbon dioxide (CO<sub>2</sub>) gas can be dissolved.
- Q. Where is the water on Mars?  
A. Some of it is frozen on and beneath the surface, a little is in the atmosphere, and some has been lost from the system.
- Q. Why is Pluto classified as a "dwarf planet" and not one of the eight major planets?  
A. Because Pluto is similar to many other objects in the Kuiper Belt which are not known as planets.
- Q. Lost in Space: You're in the hottest place in the solar system. The temperature is 15 million degrees and nuclear fusion is definitely occurring in your vicinity. Where are you?  
A. The core of the Sun.
- Q. If a solar system was forming around a star that was cooler than the Sun, the most likely place to find a habitable region with an Earth-like atmosphere would be  
A. a planet closer to the star than the Earth is from the Sun.
- Q. What property of a gas makes it a greenhouse gas?  
A. It absorbs and scatters infrared light, but allows visible light to pass freely.
- Q. Why do the moons of Jupiter that are closer to the Jupiter have more activity than its moons that are farther away?  
A. The farther away a moon is from Jupiter, the smaller the tidal force.

- Q. Which of the following is \*NOT\* a method (either current or planned for the future) for detecting planets around stars other than the Sun?
- A. Measuring the changes in the colors of a stars caused by the strong weather patterns on giant planets.
- Q. Which is the best description of how the planets formed
- A. The disk of material around the forming Sun condensed into small bodies called planetisimals, which then coalesced through collisions into larger and larger bodies.
- Q. What is actually measured in the Doppler technique that indicates the presence of a massive planet?
- A. The systematic shifting to shorter and longer wavelengths of light emitted by the star.
- Q. Why do the jovian (giant) planets have a lot of the lightest elements, hydrogen and helium, but the terrestrial planets are mostly rocks made up of heavier elements?
- A. Because in the early solar system, it was too hot for water and other light compounds to condense onto rocky surfaces, but it was cool enough where the jovian planets form for water ice to condense on protoplanets.
- Q. What have we learned about solar system formation by studying other stars that are forming now?
- A. That disks are common around forming stars.
- Q. How does the fusion of hydrogen into helium produce the energy that powers the Sun?
- A. The helium has a little bit less mass than the four hydrogens that get fused together to make it, and this difference comes out as energy according to  $E = mc^2$ .
- Q. Why does some material in the proto-solar nebular end up in a disk around the central star instead of all falling into the center?
- A. The conservation of angular momentum from the initial cloud out of which the protostar forms.
- Q. Why does the fusion of Hydrogen into Helium happen in the Sun, but we can not easily make it happen on Earth?
- A. Because it requires very high temperatures and densities to fuse the hydrogen nuclei together, since their positive charges repel each other.
- Q. With all of the energy produced in the Sun and the high temperature and pressure this creates, why doesn't the Sun just explode?
- A. Gravity acts to pull the mass together and this balances the pressure pushing out.
- Q. What about a star cluster would lead to a determination that it has an old age?
- A. The absence of bright, blue stars.
- Q. Why would a universe with only low-mass stars be unfavorable for life in that universe?
- A. Because high-mass stars are critical producers of many elements necessary for life as we know it.
- Q. What type of star is most common?
- A. Main sequence stars.

- Q. Where did the iron and other heavy elements in the universe come from?  
A. They were produced by nuclear reactions that occur inside massive stars.
- Q. Will our Sun explode some day as a supernova?  
A. No, the Sun will end its life as a white dwarf.
- Q. When a star settles down to a stable existence as a main-sequence star, what characteristic determines where on the main sequence in an H-R diagram the star will fall?  
A. its mass.
- Q. Which of the following has the largest parallax (apparent shift seen during the course of a year in the position of a star in the sky relative to other distant objects)?  
A. A nearby star.
- Q. Which types of stars evolve so they have iron cores and may explode as supernovae?  
A. Very massive stars.
- Q. Why are the less massive stars (like the Sun) NOT able to produce elements heavier than carbon and oxygen?  
A. Because the star's center cannot get hot and dense enough for the nuclear reactions that build heavier nuclei.
- Q. Suppose you discover a star in the our Milky Way galaxy made purely of hydrogen and helium. What would the likely age of this star be, and where would it probably be located?  
A. The star would most likely be old and located in the stellar halo of our Galaxy.
- Q. Which of the following best describes the formation of a spiral galaxy?  
A. It cools by radiation, it contracts by gravity, and it spins up because of angular momentum conservation.
- Q. Why does the fusion process in a massive star end with iron?  
A. Iron is the most stable element, so energy can't be produced by turning Iron into other elements.
- Q. Why does the fusion process stop at Carbon and Oxygen for stars with modest masses like the Sun?  
A. Because these stars are not massive enough to make their centers hot and dense enough for the nuclear reactions that build heavier nuclei.
- Q. Where is the Sun located within our own Galaxy?  
A. About twenty-eight thousand light years from the center, in the disk of the Galaxy.
- Q. What type of galaxy is our Milky Way galaxy?  
A. A spiral galaxy.
- Q. How did Harlow Shapley figure out that the Sun was not at the center of our Milky Way Galaxy?  
A. Most of the globular clusters are on one side of the sky, which should not happen if the Sun was in the center of the Galaxy.

- Q. Which component of our Galaxy contains the largest amount of mass?  
A. Dark matter.
- Q. Which of the following is rare or non-existent?  
A. An elliptical galaxy with bright blue stars.
- Q. Which of the following best describes how a galaxy without dark matter would differ from those with dark matter?  
A. The motions of stars and gas in the galaxy without dark matter would be smaller in the outer regions beyond where most of the galaxy light is.
- Q. What effect does the black hole at the center of our Milky Way Galaxy have on the Sun?  
A. None.
- Q. What is the evidence that there is a massive black hole at the center of our Galaxy?  
A. We observe that stars very close to the Galactic center orbit (move) very quickly, indicating that there is a massive, dense object at the center.
- Q. If your extra-terrestrial friends said that they lived near some newly formed stars in our Galaxy, where would you go to visit them?  
A. The disk of our Galaxy, probably in or near a spiral arm.
- Q. Your nice but not very bright roommate offers to drive you to the exam, but takes a wrong turn, and accidentally drives *inside* the Schwarzschild radius (event horizon) of a black hole. You use your cell phone to try to send a radio SOS message back to AAA (who prudently have located their office outside the Schwarzschild radius). What will be the fate of that message?  
A. The message will never emerge from the Schwarzschild radius.