# Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Test Form **B**

## INST 2403

## Our Place in the Universe

## Third Exam

## November 13, 2017

# Instructions

1. Use a number 2 pencil.
2. **Important:** Write your name on the computer form and fill in the appropriate circles. Bubble in your ID number in the **Identification Number** field. Bubble in **B** in the **Key** field.
3. Select only the best answer to each question; multiple answers will be marked wrong. No points are taken off for wrong answers, so it is to your advantage to guess if you are unsure of the answer.
4. Mark your answers on the computer form. You may write in the exam booklet if you wish, but only the computer form will be graded.
5. You must **sign** and **return this exam booklet** in order to receive credit for the exam!
6. You will have a maximum of **70 Minutes** to complete the exam.
7. This exam contains **33 questions**.
8. Use the backside of this exam booklet to record the answers to the **last three questions,** which are **not** multiple-choice but short answer questions.
9. You should be able to answer all questions without using a calculator, but if you wish, you can use a scientific calculator. The following formulae might be useful:

c = λ f, E= hf, T λpeak = 0.003 K m, P = A σ T4

Constants (approx.): c = 3 x 108 m/s, h= 7 x 10-34 Js, σ = 6 x 10-8 W m-2 K -4

1. What inevitably will force the Sun to evolve away from being a main sequence star?
   1. It will completely run out of hydrogen.
   2. It will explode violently.
   3. It will build up a core of helium which will prevent hydrogen fusion.
   4. The core will lose all of its neutrinos and fusion will cease.
   5. It will run out of helium.
2. Which is NOT a correct statement about the stellar parallax?

a) The distance to a star in parsecs is the inverse parallactic angle in arcseconds.

b) The apparent motion of the star within half a year represents twice the parallactic angle.

c) The method is based on the comparison between apparent and absolute magnitude of the star.

d) The method cannot be used if the star is too far away.

e) All are correct statements.

1. Which of the following is the most common type of star?
   1. White dwarfs
   2. Red giants
   3. Main Sequence
   4. Supergiants
   5. Neutron stars
2. To what physical property of a star does the spectral type correspond?
   1. Luminosity
   2. Temperature
   3. Radius
   4. Mass
   5. Density
3. What is the single most important characteristic in determining the course of a star's evolution?
   1. Absolute brightness
   2. Distance
   3. Surface temperature
   4. Mass
   5. Radius
4. The Hertzsprung-Russell diagram is a plot of
   1. luminosity versus mass
   2. temperature versus radius
   3. luminosity versus temperature
   4. radius versus mass
   5. temperature versus mass
5. Interstellar gas is composed mainly of
   1. hydrogen and helium.
   2. carbon.
   3. ammonia, methane, and water vapor.
   4. hydrogen and carbon.
   5. alcohol
6. Two stars have the same radius, but one has four times the temperature of the other star. How much brighter is the hotter star?
   1. 4 times
   2. 16 times
   3. 64 times
   4. 1/64 as bright
   5. None of the above
7. What makes the subject of stellar evolution so difficult and complex?
   1. Stellar evolution is too expensive to study in detail.
   2. We don’t yet understand nuclear fusion well enough to model stellar cores.
   3. Stars live too long to be observed from birth to death.
   4. Shock waves disrupt the orderly evolution of stars.
   5. Most stars do not emit enough energy to study them thoroughly.
8. Sirius is a double star. Both components, called Sirius A and B, are white stars, but only Sirius A is a main sequence star. Which of the following is the correct order of luminosities, starting with the largest? 
   1. Sirius A, Sirius B, Sun
   2. Sun, Sirius A, Sirius B
   3. Sirius B, Sirius A, Sun
   4. None of the above
9. Consider two stars with 2 solar masses (star A) and 3 solar masses (star B). Which is a true statement?
   1. Star B will live longer because it has more hydrogen to fuse.
   2. Star A will live 1.5 times shorter than star B.
   3. Star A will live 1.5 times longer than star B.
   4. Star A will live more than 1.5 times longer than star B.
   5. None of the above.
10. Many properties of stars are redundant, i.e. giving the same information. Which one is not redundant?
    1. Temperature
    2. Radius
    3. Spectral Class (OBAFGKM)
    4. Color
    5. All are giving us the same information.
11. Why is Venus's surface hotter than Mercury's?
    1. Venus rotates more slowly, so it "bakes" more in the Sun's heat
    2. Clouds in Mercury's atmosphere reflect sunlight back into space and keep its surface cool
    3. Carbon dioxide in Venus's atmosphere absorbs heat from its surface and radiates it back to the surface, thereby warming it.
    4. Venus is closer to the Sun
    5. Venus’s surface is actually cooler than Mercury’s.
12. The energy source of the sun is
13. Hydrogen Fusion
14. Helium Fusion
15. Carbon Fusion
16. Fission
17. None of the above
18. Jupiter is the largest planet and consists mostly of hydrogen and helium. Why did it not become a star?
    1. It spins too fast.
    2. It does not have enough mass.
    3. It has too many moons.
    4. The Sun is too close.
    5. Its radius is not big enough
19. Why does fusion of hydrogen release energy?
    1. Fusion breaks the electromagnetic bonds between hydrogen atoms, releasing energetic photons.
    2. The mass of a helium nucleus is smaller than the mass of four protons.
    3. The mass of a helium nucleus is larger than the mass of four protons.
    4. The velocity of four protons is larger than the velocity of a helium nucleus.
20. Hydrostatic equilibrium is a balance between …?
    1. core temperature and surface temperature
    2. temperature and density
    3. heat pressure and gravity
    4. gravity and luminosity
    5. gravity and density
21. The temperature of the sun’s surface is about
    1. 6000 K
    2. 50000 K
    3. 15 million K
    4. 1.5 billion K
    5. 15 billion K
22. White dwarfs sit where in the Hertzsprung-Russell diagram?

a. upper left corner

b. lower left corner

c. upper right corner

d. lower right corner

e. none of the above

1. Is it likely that Mars once had liquid water on its surface?
   1. No, because Mars' atmosphere is too thin, so water would evaporate instantly.
   2. Yes, because we observe things like runoff-channels, splosh craters, etc.
   3. Yes, because the Mars rovers actually found small amounts of liquid water on Mars.
   4. No, because Mars is too cold, so water would turn into ice.
   5. None of the others.
2. Which of the following is NOT a correct statement about the greenhouse effect and global warming?
   1. The greenhouse effect is NOT due to energy trapped in the atmosphere, but due to energy being absorbed by the atmosphere and being reradiated in all directions, including back to the ground where it is absorbed.
   2. Global warming is the slow but steady warming of the earth very likely caused by an increase in greenhouse gases like CO2 due to human activities, e.g. burning of fossil fuels.
   3. Even if humans stopped burning fossil fuel tomorrow, the average temperature would still be rising for decades.
   4. The strength of the greenhouse effect is strongly correlated with the amount of greenhouse gasses in the atmosphere. This correlation between the average temperature of Earth and the CO2 concentration in the atmosphere can be shown to exist since hundreds of thousands of years.
   5. All are correct statements
3. Meteor showers such as the Perseids in August are caused by …
   1. the breakup of meteoroids in the asteroid belt that hit our atmosphere at predictable times
   2. the Earth passing through debris left by a comet
   3. passing asteroids triggering auroral displays
   4. nuclear reactions in the upper atmosphere
   5. the tidal effects of the Moon.

1. Main-sequence stars with a mass greater the sun …
   1. …live longer
   2. …have smaller radii
   3. …have a larger luminosity
   4. …have a lower surface temperature
   5. …have a lower core temperature
2. Stars in the upper left corner of a Hertzsprung-Russell diagram
3. have small radii, large luminosity
4. large mass and small luminosity
5. high temperature and small life expectancy
6. low temperature and high life expectancy
7. none of the above
8. Two stars have the same chemical composition, spectral type, and luminosity class, but one is 2.5 light years from the Earth and the other is 25,000 light years from the Earth. The farther star appears to be …

a) 100 times fainter.

b) 10,000 times fainter.

c) 100,000,000 times fainter.

d) the same brightness since the stars are identical.

1. What is the main constituent of Venus’ atmosphere? ( *Hint: Venus has a run-away greenhouse effect*)
   1. Carbon dioxide
   2. Oxygen
   3. Nitrogen
   4. Sulfuric acid
   5. Hydrogen
2. In the light of solar system theory, why do the orbits of the planets all lie in nearly the same plane?
   1. The sun’s gravity forced them into these orbits.
   2. The angular momentum of the solar system was kept to a minimum this way.
   3. The early solar nebula flattened into a disk.
   4. This happened purely by chance.
   5. They do not lie in nearly the same plane.
3. How did Mercury’s location in the solar system affect its composition?
   1. Mercury is rich in metals because only metallic grains could survive the high temperatures near the sun
   2. Mercury is poor in metals because metallic grains cannot withstand these high temperatures
   3. Because Mercury is so close to the sun, its composition is similar to the sun’s: mostly helium and hydrogen
   4. The nearby sun caused ice in Mercury’s interior to melt into liquid water
4. One difference between the Jovian planets and the terrestrial planets is that the atmospheres of the Jovian planets consist largely of the light elements hydrogen and helium, while the terrestrial atmospheres contain hardly any. Why is this?
   1. The large Jovian planets have enough mass that their gravitational force is big enough to retain the light gases, which escaped the smaller terrestrial planets long ago
   2. It is impossible to tell, because we cannot see through the clouds covering these planets
   3. The strong electric fields of the Jovian planets help them retain the light gases that escaped the terrestrial planets long ago
   4. Biological activity is responsible for the composition of the Jovian atmospheres
   5. The greenhouse effect helps these planets to retain the lighter elements.
5. Which of the following is **not** a way in which the terrestrial and Jovian planets differ?
   1. The terrestrial worlds are small and dense, while the Jovian worlds are large and gaseous
   2. The terrestrial worlds have few or no moons, while the Jovian worlds have many moons
   3. The Jovian planets have orbits that are highly inclined to the ecliptic and do not revolve in the same direction as the terrestrial planets
   4. The orbits of the terrestrial worlds are relatively close together, while the orbits of the Jovian worlds are far apart
   5. The Jovian planets do not have a solid surface.

**Short Answer Questions [3 points each]**

***(Please use the space below or a white sheet of paper to record your answers)***

1. Why are main sequence stars brighter the hotter they are, while, on the other hand, red giants are so bright even though they have a relatively cool surface?
2. From what we know about the formation of the solar system, explain why it makes sense that there are two different types of planets in the solar system.
3. Explain the greenhouse effect.