

**NATS 102 – Prather
Exam #3 – April 5, 2003
Test Form A**

*Answer all of the following questions on the bubble sheet provided using a #2 pencil. Make sure that your **Name, Student ID Number** and **test form letter** are on the answer sheet and that all answers are recorded in the correct position. **ALWAYS SELECT THE BEST ANSWER.** Each question is worth 1 point. This is a closed-book, closed-note exam and you have approximately 50 minutes to complete it. If you have questions, please raise your hand.*

**Be sure to write and bubble in your ID number and test form letter.
IF YOUR STUDENT ID BEGINS WITH AN “S,” WRITE IT IN AND
BUBBLE A “0.”**

**DO NOT START THE EXAM UNTIL YOU ARE
TOLD TO DO SO!**

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1. You observe two spectra (shown below) that are redshifted relative to that of a stationary source of light. Which of the following statements best describes how the sources of light that produced the two spectra were moving? Assume that the left end of each spectrum corresponds to shorter wavelengths (blue light) and that the right end of each spectrum corresponds with longer wavelengths (red light).



Spectrum A



Spectrum B

- Source A is moving faster than source B.
 - Source B is moving faster than source A.
 - Both sources are moving with the same speed.
 - It is impossible to tell from looking at these spectra.
2. The standard model of solar system formation offers what explanation for the different compositions of the terrestrial and Jovian planets?
- During condensation, the heavier elements tended to sink nearer the Sun and, being rare, only provided enough material to build the relatively small terrestrial planets.
 - During the collapse of the gaseous nebula, most of the material tended to collect far from the Sun because of the large centrifugal forces, which provided the necessary material to build the large Jovian planets.
 - The large gravitational forces of Jupiter tended to prevent planet formation in the inner solar system and eventually attracted most of the material into the region of the Jovian planets.
 - The terrestrial planets were formed near the Sun where, because of the high temperatures, only heavier elements were able to condense.

3. The star Rigel is about 100,000 times as luminous as the Sun and belongs to spectral type B8. The star Sirius B is about $\frac{1}{3000}$ times as luminous as the Sun and also belongs to spectral type B8. Which star has the greatest surface temperature?
- Rigel
 - Sirius B
 - They have the same temperature.
 - There is insufficient information to determine this.
4. The star Aprilia is 10 pc away. It's apparent magnitude is +3.1. What is most likely its absolute magnitude?
- +6.2
 - +3.1
 - +0.31
 - 3.1
 - 6.2

Jelly Star has an apparent magnitude of +1.1 and an absolute magnitude of +1.1. Pooh Bear Star has an apparent magnitude of +3.72 and an absolute magnitude of +6.1. Answer the following four questions using this information.

5. Which of the stars described above gives off more light?
- Jelly Star
 - Pooh Bear Star
 - They give off the same amount of light.
 - There is insufficient information to determine this.
6. Which of these stars is closer to Earth?
- Jelly Star
 - Pooh Bear Star
 - They are the same distance from Earth.
 - There is insufficient information to determine this.
7. Which of these stars appears brighter to us here on Earth?
- Jelly Star
 - Pooh Bear Star
 - They would appear equally bright from Earth.
 - There is insufficient information to determine this.
8. If both of these stars are main sequence stars, which star is hotter?
- Jelly Star
 - Pooh Bear Star
 - They would be the same temperature.
 - There is insufficient information to determine this.
-

9. Consider the information given below about the lifetime of three main sequence stars A, B, and C.
- Star A will be a main sequence star for 45,000 million years.
 - Star B will be a main sequence star for 70 million years.
 - Star C will be a main sequence star for 2 million years.

Which of the following is a true statement about these stars?

- a. Star A has the greatest mass.
 - b. Star C has the greatest mass.
 - c. Stars A, B and C all have approximately the same mass.
 - d. None of the above
10. Which of the following statements is always true of two stars that have the same absolute magnitude?
Choose all that apply.
- a. They have the same temperature.
 - b. They have the same luminosity.
 - c. They have the same spectral class.
 - d. They have the same surface area.
 - e. None the above.
11. Vega has an apparent magnitude of +0.03 and an absolute magnitude of +0.58. If it were moved twice as far from Earth as it is now, which one of the following would occur?
- a. apparent magnitude number would increase
 - b. apparent magnitude number would decrease
 - c. apparent magnitude number would stay the same
 - d. absolute magnitude number would increase
 - e. absolute magnitude number would decrease

Star A has an absolute magnitude of +2.0 and belongs to spectral class B8. Star B has an absolute magnitude of +11.2 and belongs to spectral class O9. Use this information to answer the following two questions.

12. Which star is brighter?
- a. Star A
 - b. Star B
 - c. They have the same brightness.
 - d. There is not enough information to determine this.
13. Which star has the greater surface temperature?
- a. Star A
 - b. Star B
 - c. They have the same temperature.
 - d. There is not enough information to determine this.
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14. Which of the following planets formed at temperatures below the freezing point of water? **Choose all that apply.**
- Venus
 - Earth
 - Mars
 - Jupiter
 - Saturn
15. A blue giant star of spectral type K9 and a red main sequence star of the same spectral type have the same
- luminosity.
 - temperature.
 - absolute magnitude.
 - size.
16. According to sunspot observations, the Sun appears to complete one rotation about every
- day.
 - week.
 - month.
 - year.
 - decade.
17. In which part of the Sun does nuclear fusion take place?
- photosphere
 - nucleosphere.
 - Gammasphere.
 - core
 - radiative layer
18. A moon covered with numerous and very old craters created by meteorite impacts likely
- has no ocean to cover the craters.
 - orbits a large Jupiter sized planet.
 - has a cold, solid interior.
 - has no protective magnetic field.
19. The Sun is about five times farther from Jupiter than Earth. Approximately how many Suns would fit between the Sun and Jupiter?
- 5
 - 10
 - 50
 - 150
 - 550
20. A bright star is moving toward Earth. If you were to look at the spectrum of this star, what would it look like?
- an absorption spectrum that is redshifted relative to an unmoving star
 - an emission spectrum that is redshifted relative to an unmoving star
 - a continuous spectrum that is blueshifted relative to an unmoving star
 - an absorption spectrum that is blueshifted relative to an unmoving star
 - a continuous spectrum that is redshifted relative to an unmoving star

21. The total main sequence lifetime of stars like the Sun is about
- 1 million years.
 - 10 million years.
 - 10 billion years.
 - 100 billion years.
22. The force that dominates the collapse of the gas and dust in a solar nebula is
- static electricity.
 - gravity.
 - magnetism.
 - friction.
 - nuclear force.

Star A appears brighter than Star B, but Star A actually gives off less light than Star B. The apparent magnitude and absolute magnitudes for Star A are $m = 0$ and $M = 1$, respectively. Use this information to answer the following four questions.

23. Which of the following are the best possible values for the apparent and absolute magnitudes of Star B?
- $m = 1$ and $M = 1$
 - $m = -1$ and $M = 1$
 - $m = 1$ and $M = -1$
 - $m = -1$ and $M = -1$
24. Which is the most correct statement about the distance of Star A from Earth?
- Star A is closer than 10 pc from Earth.
 - Star A is exactly 10 pc from Earth.
 - Star A is farther than 10 pc from Earth.
25. If both stars are main sequence stars, which is true about the temperatures of Star A and Star B?
- Star B is hotter than Star A.
 - Star B is cooler than Star A.
 - Star B is the same temperature as Star A.
26. If both stars are main sequence stars, which is true about the lifetimes of Star A and Star B?
- Star B will live longer than Star A.
 - Star A will live longer than Star B.
 - Star B will have the same lifetime as Star A.

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27. Main sequence stars with high masses also have
- high luminosities.
 - low luminosities.
 - the same luminosity as stars with small masses.
 - There is no relationship between mass and luminosity for main sequence stars.

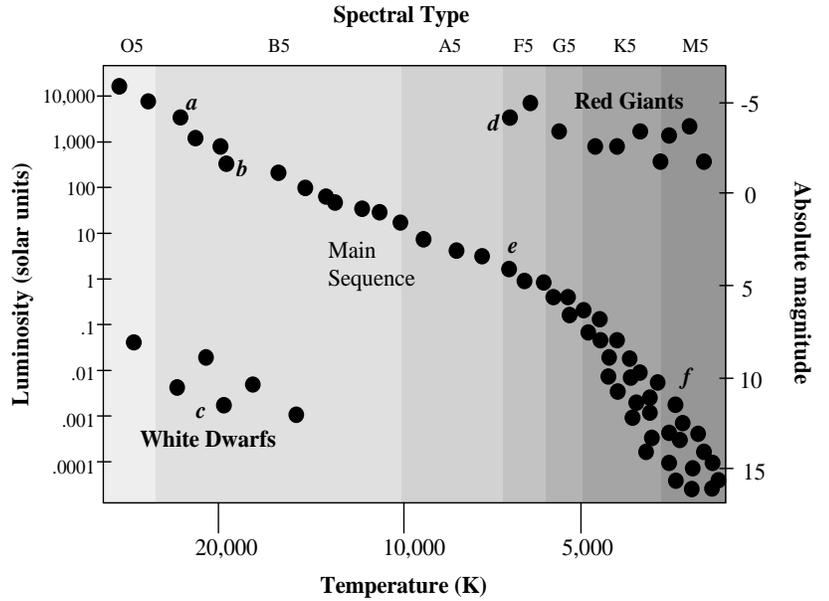
28. Compared to stars on the upper left-hand part of the main sequence, stars on the lower right-hand part of the main sequence (**choose all that apply**)
- have longer lifetimes.
 - are hotter.
 - are smaller.
 - are less luminous.
 - are bluer.
29. How does the Sun produce the energy that heats our planet?
- The gases inside the Sun are on fire; they are burning like a giant bonfire.
 - Hydrogen atoms are combined into helium atoms inside the Sun's core. Small amounts of mass are converted into huge amounts of energy in this process.
 - When the gas inside the Sun is compressed, it heats up. This heat radiates outward through the star.
 - Magnetic energy gets trapped in sunspots and active regions. When this energy is released, it explodes off the Sun as flares that give off tremendous amounts of energy.
 - The core of the Sun has radioactive materials that give off energy as they decay into other elements.
- 30. If our atmosphere was able to absorb visible light as effectively as it absorbs UV light, which of the following would be true?**
- The Earth's surface temperature would be warmer than it is today.**
 - The Earth's surface temperature would be cooler than it is today.**
 - The Earth's surface temperature would be the same temperature as it is today.**
 - There is not enough information to answer this question.**
31. Which one of the planets listed, initially formed at the outermost location where the temperature was high enough for water to boil?
- Venus
 - Earth
 - Mars
 - Jupiter
 - Saturn
32. Which of the following sequences of spectral classes represent the *coolest* to *hottest* stars?
- OBAFGKM
 - ABFGKMO
 - OMKGFBA
 - MKGFABO
 - MFKGABO
- 33. Which of the following forms of light from the Sun provides the greatest energy INPUT to the Earth's surface?**
- radio**
 - infrared**
 - visible**
 - ultraviolet**
 - x-ray**

34. The processes of plate tectonics result from the movement of regions of
- Earth's interior because they are at different temperatures.
 - water because they are at different temperatures.
 - Earth's atmosphere because they are at different pressures.
 - Earth's interior because they have different chemical compositions.
35. Main sequence stars begin life as
- a white dwarf,.
 - a cloud of gas and dust.
 - a very large hot planet.
 - a red giant.
36. Rigel has an apparent magnitude of +0.18 and an absolute magnitude of -6.69. The distance to Rigel is
- less than 10 parsecs.
 - 10 parsecs.
 - more than 10 parsecs.
- 37. Which of the following is not part of the greenhouse effect?**
- Visible light from the Sun is absorbed by Earth's surface.**
 - Due to the Ozone hole UV light can significantly increase the surface temperature of Earth.**
 - Earth's surface and atmospheric gases give off infrared light.**
 - The amount of light given off by Earth is equal to the amount of light absorbed from the Sun.**
38. Star A has a mass of 5 solar masses and Star B has a mass of 10 solar masses. How will the fusion rate of Star A compare to the fusion rate of Star B?
- Star A's fusion rate will be more than two times slower than that of Star B.
 - Star A's fusion rate will be two times slower than that of Star B.
 - Star A's fusion rate will be the same as that of Star B.
 - Star A's fusion rate will be two times faster than that of Star B.
 - Star A's fusion rate will be more than two times faster than that of Star B.
39. Compared to stars on the lower right-hand part of the main sequence, stars on the upper left-hand part of the main sequence (**choose all that apply**)
- are redder.
 - are cooler.
 - have longer lifetimes.
 - are more luminous.
 - are smaller.

The HR Diagram at right is provided to assist with answering the following two questions.

40. Which is hotter, a main sequence star with an absolute magnitude of $M=4$ or a white dwarf with a luminosity 100 times smaller than the Sun?
- the main sequence star
 - the white dwarf
 - They have the same temperature.
 - There is insufficient information to determine this.

41. Which statement is the most correct about the comparison between a K5 main sequence star and a B5 main sequence star?
- The K5 star is cooler, dimmer, smaller, and will not live as long as the B5 main sequence star.
 - The K5 star is hotter, dimmer, larger, and will live longer than the B5 main sequence star.
 - The K5 star is smaller, hotter, brighter, and will not live as long as the B5 main sequence star.
 - The K5 star is hotter, brighter, smaller, and will live longer than the B5 main sequence star.
 - The K5 star is dimmer, cooler, smaller, and will live longer than the B5 main sequence star.



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42. How many Moon orbital diameters would fit across a star five times larger than the Sun?
- 5
 - 10
 - 20
 - 50
 - 550

43. Volcanoes are usually found in places where
- the low pressure of the atmosphere pulls the lava/magma to the surface.
 - earthquakes occur from oceanic plates colliding with continental plates.
 - deep-rooted mountains have cracked Earth's crust.
 - Earth's rotation has caused weak spots in its crust.

44. In a main sequence star, gravitational collapse is balanced by
- convection of stellar material from the core.
 - pressure caused by photons produced during nuclear fusion.
 - solid material at the stellar core.
 - pressure from coronal mass ejections from the core.
 - interior cooling of the star.
45. On an H-R diagram, stars at the same temperature are found
- aligned horizontally (i.e., side-by-side).
 - aligned vertically (i.e., one above the other).
 - next to each other on the main sequence.
 - near the bottom of the diagram
 - near the top of the diagram
46. Astronomers have discovered massive gas giant planets like Jupiter orbiting their companion stars at closer than 0.7 AU (about the distance of Venus's orbit). Why *don't* astronomers believe that these gas giant planets originally formed at these locations?
- The planets' gravity would have been too large to form that close to the star.
 - The temperature in the early solar nebula was too high at these distances.
 - Their orbital periods are too long for them to be located that close to their companion stars.
 - A young star's solar wind would have blown the planets farther away.
47. If you were constructing a scale model of the solar system that used a Sun that was the size of a basketball (~ 12" diameter), which of the following lengths would most closely approximate the scaled distance between Earth and the Sun?
- 3 feet (length of an outstretched arm)
 - 10 feet (height of a basketball goal)
 - 100 feet (height of an 8 story building)
 - 300 feet (length of a football field)
- 48. Which of the following is part of the greenhouse effect?**
- Earth's atmosphere becomes thicker with greenhouse gasses.**
 - Infrared light becomes permanently trapped in our atmosphere.**
 - The ozone hole causes significant increases in surface temperature.**
 - Earth's surface and atmospheric gases absorb energy and then give off infrared light.**
 - Heat is transferred in the atmosphere through air circulation.**
49. The number of sunspots we can observe changes from a maximum number to very few spots in a cycle with a period of approximately
- a day.
 - a week.
 - a month.
 - a year.
 - a decade.

50. An important line in the absorption spectrum of stars occurs at a wavelength of 656nm for stars at rest. Imagine that you observe five stars (A-E) from Earth and discover that this absorption line is at the wavelength shown in the table below for each of the five stars.

1. STAR	2. Wavelength of Absorption line
A	650 nm
B	663 nm
C	656 nm
D	657 nm
E	646 nm

Based on the information in the table above, which of the following is the most accurate ranking of the speed of the stars from moving fastest toward the Earth to moving fastest away from Earth.

- a. B, D, C, A, E
- b. E, D, C, B, A
- c. C, E, A, D, B
- d. A, B, C, D, E
- e. E, A, C, D, B