NATS 102 – Prather
Exam #2 – March, 3 2004

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!

NATS 102 Prather **Name _____**
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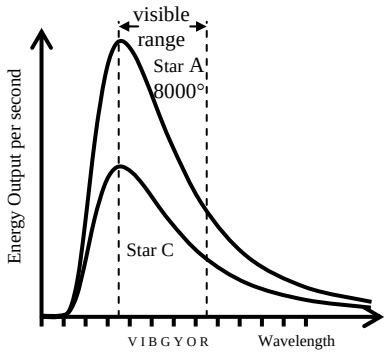
Use the graph at right to answer the next two questions.



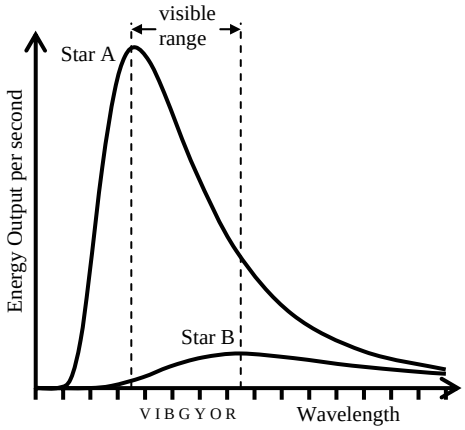
1. Which of the following relationships is possible to infer about stars A and C based on the information provided in the graph at right?
   a. Star A is smaller than Star C.
   b. Star A is larger than Star C.
   c. The stars are the same size.
   d. It is not possible to infer any of these relationships.

2. Which of the two stars (A or C) is at a higher temperature?
   a. Star A
   b. Star C
   c. The two stars have the same temperature.
   d. It is not possible to infer this relationship.

3. Which, if any, of the different wavelengths of light listed below completely passes through Earth's atmosphere and reaches the surface? *Choose (bubble in) all that apply*.
   a. gamma
   b. radio
   c. infrared
   d. X-rays
   e. none of the above

4. Which type of telescope uses two glass lenses to collect and focus light?
   a. reflector
   b. refractor
   c. mirrored
   d. satellite

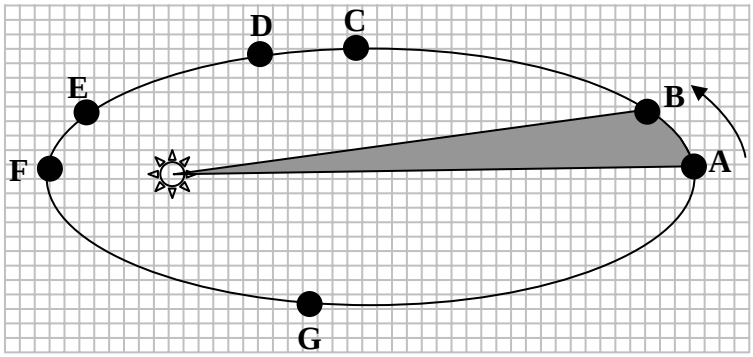
Use the graph at right to answer the next two questions.



5. Which of the two stars (A or B) emits light that has a peak emission with the longer wavelength?
   a. Star A
   b. Star B
   c. The stars' peak emissions are at the same wavelength.
   d. None of the above.

6. Which of the two stars (A or B) would appear red?
    a. Star A
    b. Star B
    c. Neither star would appear red.
    d. There is insuffiecient information to determine the star's color.

7. In the drawing at right, the motion of a planet traveling around a star is shown. We have shaded in a triangular area that was swept out during the motion of the planet while moving from position A to B. Which two other planet positions (provided below) would sweep out another triangular area for the motion of the planet that would obey Kepler's Second Law?
    a. C to D
    b. E to F
    c. F to G



8. Which of the following moves the slowest?
    a. radio waves
    b. visible light
    c. x-rays
    d. infrared light
    e. They all move at the same speed.

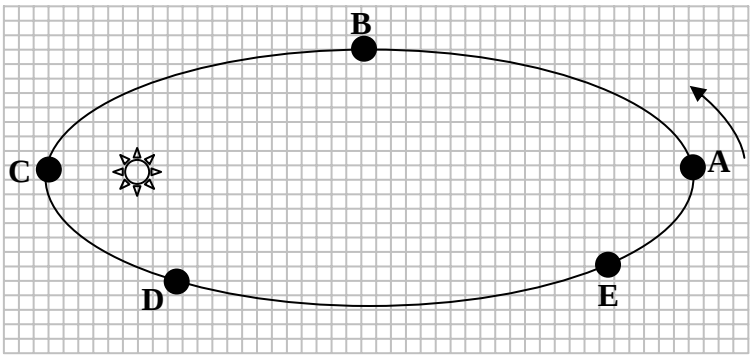
9. The most important function of a telescope is its ability to
    a. resolve fine detail.
    b. magnify an object.
    c. project light.
    d. gather light.

10. Energy is released from atoms in the form of light when electrons
    a. move from high energy levels to low energy levels.
    b. move in their orbit around the nucleus.
    c. move from low energy levels to high energy levels.
    d. leave the atom.

11. Which of the following has the least energy?
    a. radio waves
    b. visible light
    c. x-rays
    d. infrared light
    e. They all have the same energy.

12. Imagine that you are the head of a funding agency that can afford to build only one telescope. Which of the four proposed telescopes below would be best to support?
    a. A gamma ray telescope in Antarctica
    b. A radio telescope in orbit above the Earth
    c. A visible telescope located high on a mountain in Peru
    d. An ultraviolet telescope located in the Mojave desert

13. The planet shown in the drawing at right obeys Kepler's Second Law. Each lettered position represents the location for the planet during a particular day. At which lettered position would the planet move the farthest for that day?



14. Rigel is much more luminous than Sirius B. Rigel and Sirius B have the same temperature. Which star has the greater surface area?
    a. Rigel
    b. Sirius B
    c. the same
    d. There is insufficient information to answer this question.

15. Light can be thought of as being composed of tiny packets of energy called
    a. protons.
    b. electrons.
    c. photons.
    d. neutrons.

16. Kepler proposed that the orbits of the planets have what shape?
    a. circular
    b. focal-planer
    c. elliptical
    d. equal-triangular

17. Kepler's Laws of planetary motion are based on detailed observations catalogued by which astronomer?
    a. Isaac Newton
    b. Tycho Brahe
    c. Galileo Galilei
    d. Nicholas Copernicus

18. If a small weather satellite and the large International Space Station are orbiting Earth at the same altitude above Earth's surface, which of the following is true?
    a. The large space station has a longer orbital period.
    b. The small weather satellite has a longer orbital period.
    c. Each has the same orbital period.

19. Which of the following astronomers first proposed the heliocentric model of the solar system?
    a. Isaac Newton
    b. Claudius Ptolemy
    c. Tycho Brahe
    d. Nicholas Copernicus

20. Imagine a new planet in our solar system located 3 AU from the Sun. Which of the following best approximates the orbital period of this planet?
    a. 1 year
    b. 3 years
    c. 5 years
    d. 9 years
    e. 27 years

For the next two questions, consider the information in the table and the student comment both provided below.

Planet	Distance from the Sun (in Astronomical Units - AU)	Planet mass (in terms of Earth's mass)
Mercury	0.38	0.06
Venus	0.72	0.82
Earth	1.0	1.0
Mars	1.52	0.11
Jupiter	5.20	318

A student in your class makes the following comment about the relationship between the location of planets in our solar system and their orbital period and mass:

"As we look at planets farther away from the Sun than Mercury we see that their distance gets bigger and that the mass of the planets is also getting larger. So I think that the farther away a planet is the longer it takes to go around the sun and the more massive the planet will be too."

21. Which planet listed in the table illustrates the fact that the student is incorrect in their reasoning.
    a. Mercury
    b. Venus
    c. Earth
    d. Mars
    e. Jupiter

22. Which of the following Laws would you use to explain to this student that their reasoning is incorrect?
    a. Newton's 3rd
    b. Kepler's 2nd
    c. Newton's Law of Gravity
    d. Kepler's 3rd
    e. Newton's 2nd

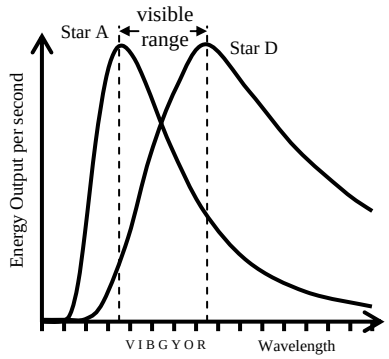
23. A model for which the stars, planets, and other objects orbit the stationary Earth is called a(n) _____ model.
    a. geocentric
    b. heliocentric
    c. epicycle
    d. retrograde

24. If the stars Betelgeuse and Rigel were to have the same luminosity but the temperature of Betelgeuse is cooler than Rigel, which star has the greater surface area?
    a. Betelgeuse
    b. Rigel
    c. They are the same size.
    d. There is insufficient information to answer this question.

25. Imagine that you throw a ball directly upward. Which of the following statements best describes how Newton's Second Law accounts for the motion of the ball when it reaches its maximum height?
    a. The ball has a velocity that is zero and an acceleration that is zero.
    b. The ball has a velocity that is upward and an acceleration that is downward.
    c. The ball has a net force that is downward and an acceleration that is downward.
    d. The ball has a net force that is downward and a velocity that is downward.
    e. The ball has a net force that is downward and an acceleration of zero.

26. The explanation for the retrograde motion of planets in the current heliocentric model is that
    a. the planets sometimes change their direction of travel.
    b. planets closer to the Sun move faster and overtake those farther from the Sun.
    c. the planets move on smaller circles called epicycles while they orbit the Sun.
    d. planets farther from the Sun move faster and overtake those closer to the Sun.

Use the graph at right to answer the next two questions.



27. Which of the two stars (A or D) is at a higher temperature?
    a. Star A
    b. Star D
    c. The two stars have the same temperature.
    d. It is not possible to infer this relationship.

28. Which of the following relationships is possible to infer about stars A and D based on the information provided in the graph at right?
    a. Star A is smaller than Star D.
    b. Star A is larger than Star D.
    c. The stars are the same size.
    d. It is not possible to infer any of these relationships.

29. Imagine you are observing two stars. One star is hot and small and the other star is cooler and larger. Which star is more luminous?
    a. the hotter star
    b. the larger star
    c. They have the same luminosity.
    d. There is insufficient information to answer this question.

30. Some telescopes are placed in space above Earth's atmosphere primarily for which of the following reasons?
    a. Some of the light being sent out from the telescopes can be blocked by Earth's atmosphere.
    b. Some of the light from stars can be absorbed by Earth's atmosphere.
    c. Astronomers want to observe continuous spectra from stars rather than absorption spectra.
    d. Astronomers want to observe continuous spectra from the stars rather than emission spectra.

31. Consider the dark line absorption spectra shown below for Star X and Star Z. What can you determine about the color of the two stars? *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).*

Star X

Star Z

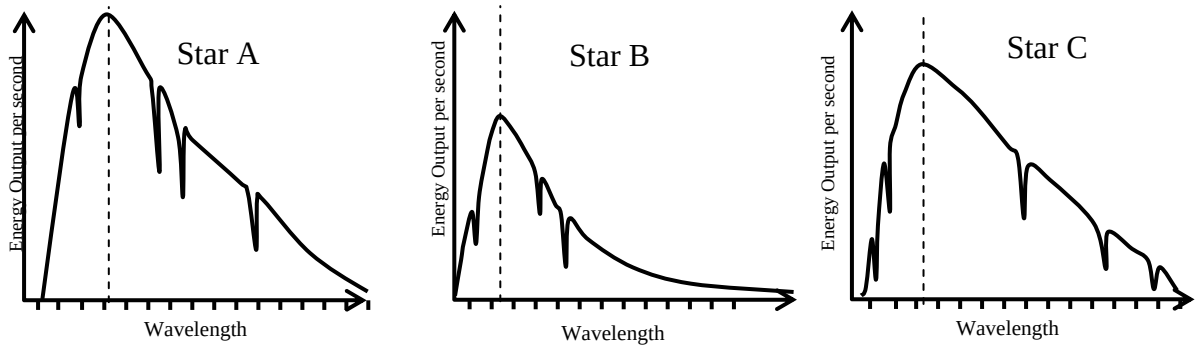
    a. Star X would appear blue and Star Z would appear red.
    b. Star X would appear red and Star Z would appear blue.
    c. Both stars would appear the same color.
    d. The color of the stars cannot be determined from this information.

32. Which of the following is the type of spectrum we observe from the Sun?
    a. continuous spectrum
    b. bright line emission spectrum
    c. dark line absorption spectrum

33. Which of the following best describes what would happen to the orbital period of a planet if the mass of the planet were doubled but it stayed at the same orbital distance?
    a. It would orbit half as fast.
    b. It would orbit less that half as fast.
    c. It would orbit twice as fast.
    d. It would orbit more than twice as fast.
    e. It would orbit with the same speed.

34. Kepler's second law says "a line joining a planet and the Sun sweeps out equal areas in equal amounts of time." Which of the following statements means nearly the same thing?
    a. Planets move fastest when they are moving toward the Sun.
    b. Planets move equal distances throughout their orbit of the Sun.
    c. Planets move slowest when they are moving away from the Sun.
    d. Planets move farther in a given time when they are closer to the Sun.
    e. Planets move the same speed at all points during their orbit of the Sun.

35. The three spectral curves shown in the graphs below illustrate the energy output versus wavelength for three unknown stars A, B, and C. Which of the stars has the highest temperature?



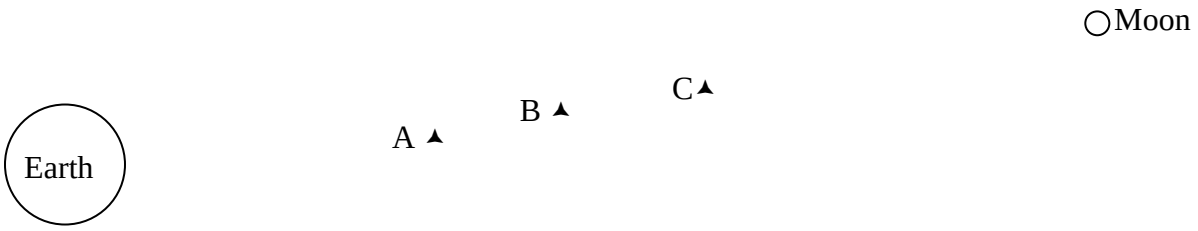
    a. Star A
    b. Star B
    c. Star C
    d. All three stars have the same temperature.

36. What happens to the light that is missing in an absorption spectrum?
    a. It is absorbed by the atoms inside the hot, dense object.
    b. It is reflected by atoms on the surface of the hot, dense object.
    c. It is absorbed by atoms in a low density gas cloud.
    d. It is emitted by atoms in a low density gas cloud.

37. According to Kepler's Second Law of Planetary Motion, a planet with an orbit like Earth's would
    a. move faster when further from the Sun.
    b. move slower when closer to the Sun.
    c. experience a dramatic change in orbital speed from month to month.
    d. experience very little change in orbital speed over the course of the year.
    e. none of the above.

38. Which is the correct reasoning for why an x-ray telescope located in Antarctica that is to be used to look for evidence of black holes in the centers of galaxies would not get funded?
    a. There are no such things as black holes.
    b. x-rays are too energetic to detect with a telescope.
    c. You can't build a telescope in Antarctica.
    d. x-rays don't completely penetrate Earth's atmosphere.

Use the picture below to answer the next three questions. In this picture the Earth-Moon system is shown (not to scale) along with three possible positions (A-C) for a spacecraft traveling from Earth to the Moon. Note that position B is exactly halfway between Earth and the Moon.

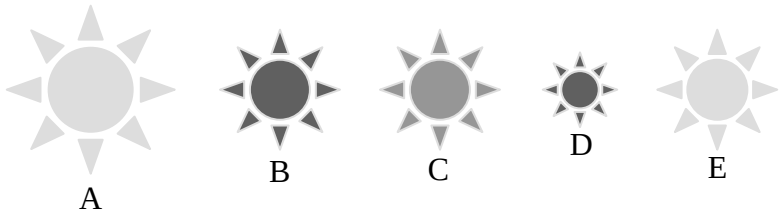


39. At which position would the gravitational force exerted by the Moon on the spacecraft be the strongest?

40. At which position would the spacecraft feel the strongest total gravitational force?

41. At which position would the spacecraft feel the weakest total gravitational force?

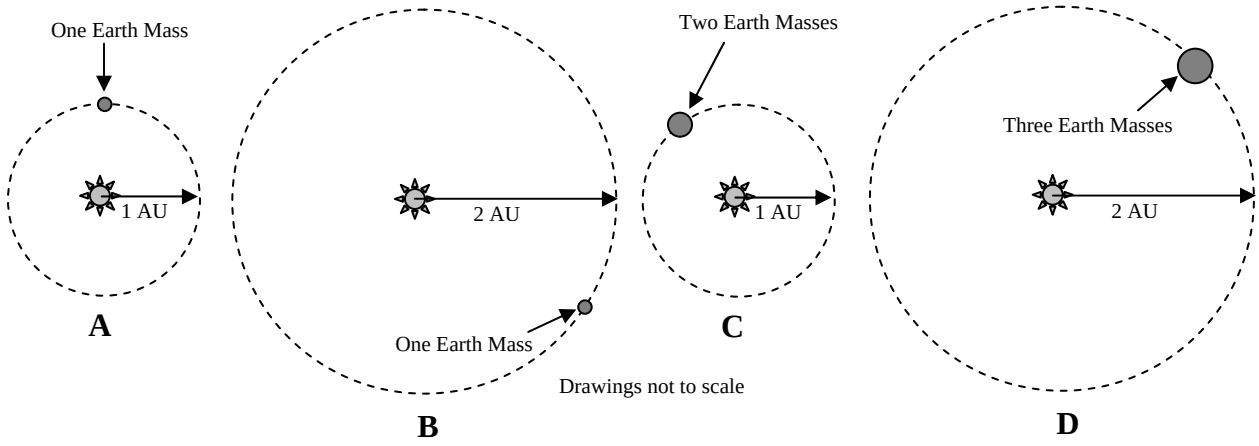
Imagine you are comparing the five stars (A-E, shown below) of different sizes and temperatures. The temperature of each star is indicated by a shade of gray (as shown at right), such that the lighter the shade of gray, the higher the temperature of the star.



42. Which of the following is the most correct ranking for the luminosity of these stars from greatest to least?

    a. A > B = C = E > D
    b. E = A > C > D = B
    c. B > C > E > D > A
    d. A > E > C > B > D
    e. C > A > E > B > D

The figure below shows four identical stars, and four planets of various masses in circular orbits of various size. In each case the mass of the planet is given in Earth masses and the orbital distance is given in Astronomical Units (AU). Note that the sizes of the stars and the orbital distances have not been drawn to scale.



43. Which of the following is the best possible ranking for the period of the orbit of these planets from shortest to longest?

    a. C < B <D <A
    b. A = C < B =D
    c. A = B = C = D
    d. A < B < C <D
    e. A = B < C < D

44. A planet is moving with retrograde motion. Over the course of several weeks, how will the planet appear to move relative to the background stars?
    a. east to west
    b. west to east
    c. It will not move at all, as planets do not move with respect to the stars.
    d. It will move randomly, as planets move differently than the stars.

45. Shown below are the spectra of stars A and B. How does the temperature of the two stars compare? *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).*

Star A

Star B

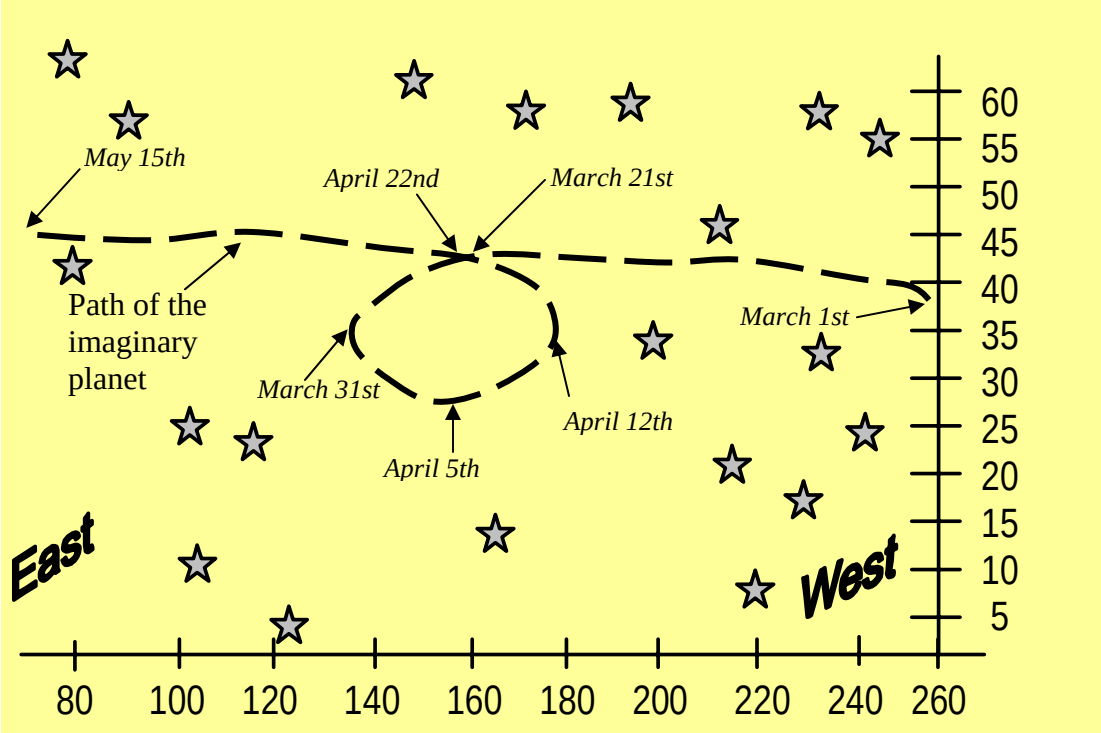
a. Star A is at the higher temperature.
b. Star B is at the higher temperature.
c. Both stars are the same temperature.
d. The relative temperatures of the stars cannot be determined from this information.

46. If an electron in an atom moves from an energy level of 5 to an energy level of 10,
a. a photon of energy 5 is emitted.
b. a photon of energy 15 is emitted.
c. a photon of energy 5 is absorbed.
d. a photon of energy 15 is absorbed.

47. Imagine that you observe the Sun while in your space ship in orbit around the Moon. Which of the following spectra would you observe by analyzing the sunlight?
a. dark line absorption spectrum
b. bright line emission spectrum
c. continuous spectrum

48. Imagine that the light from a hot, dense object passed through a cool, diffuse cloud and then through a prism. If the temperature of the hot, dense object were increased slightly, which of the following changes would happen to the resulting spectrum?
a. The lines would move to the blue end of the spectrum.
b. More lines would appear at the blue end of the spectrum.
c. The lines would move toward the red end of the spectrum.
d. More lines would appear at the red end of the spectrum.
e. The lines in the spectrum would not change.

Use the graph provided below, on which an imaginary planet's motion has been plotted over several months, to answer the next two questions.



49. On which date, if any, would the planet appear to rise in the west?
    a. March 1st
    b. March 31st
    c. April 5th
    d. April 12th
    e. Never

50. For how many days would this planet have appeared to move with retrograde motion?
    a. 10 days
    b. 12 days
    c. 15 days
    d. 17 days
    e. 32 days