Astronomy 104 Mid-Term #2 Study Guide
Spring Semester 2009

Craig Lecture Midterm #2 in class Monday, April 6.
Cabanela Lecture Midterm #2 in class Tuesday, April 7.

The midterm covers Chapters 4 through 5, and 14 through 15, but not all topics from each chapter are on the test. The detailed list below was what you should know how to do. A practice exam is attached. We should warn you we expect the practice exam will take about 75 minutes. The actual midterm will be a bit shorter, since you will only be allowed about 50 minutes for it.

Objective (what you should be able to do on the test)	**Reading from the textbook**
Know the meaning of the terms used to describe motion, including speed, velocity, and acceleration.	4.1
What are Newton's Three Laws of Motion and how do they apply to different situations?	4.2
What are the different forms of energy and be able to list examples of each form.	4.3
Describe how the strength of the gravitational force depends on mass and distance.	4.4
Discuss the importance of Newton's work in understanding the solar system.	4.4
Correctly predict the motion of two falling objects dropped near the Earth's surface.	4.1 and 4.5
How did Newton's Laws extend Kepler's three laws? Put another way, what additional understanding of Kepler's Laws does understanding Newton's Laws give us.	4.4
Define gravitational equilibrium and identify the force pushing outward from the center of the sun.	14.1
Identify nuclear fusion as the source of the sun's energy.	14.2
List, roughly, the amount of energy the sun produces each second (power of the sun)	14.1, Labs 6 and 8
List the things that go into the fusion reactions in the sun and the net products of the fusion reactions.	14.2
Explain, in terms of mass and energy, why fusion produces energy.	14.2
Describe how the types of electromagnetic radiation differ from each other.	5.2
Describe the electromagnetic spectrum.	5.2
Objective (what you should be able to do on the	**Reading from the textbook**

test)	
List types of light in order of their wavelength or their energy.	5.2
Explain what can be learned from the thermal spectrum of an object.	5.4
Describe the relationship between temperature of an object and the color and amount of light it produces.	5.4
Compare the radius of two stars given their luminosity and color (or temperature)	5.4 and 15.1
Compare the luminosity of two stars given their radius and color (or temperature)	5.4 and 15.1
Compare the temperature of two stars given their radius and luminosity.	5.4 and 15.1
List the properties of stars that can be measured from the light they emit, and the circumstances in which those things can be measured.	15.1
Define luminosity.	15.1
Describe methods of measuring the temperature of, distance to, luminosity (or absolute magnitude) of, and mass of a star.	15.1
Describe the method of parallax.	15.1 and Lab 7
Explain how parallax angle depends on distance.	15.1 and Lab 7
Describe how the inverse square law can be used to calculate luminosity if distance is known.	15.1 and Lab 6
Describe how the inverse square law can be used to calculate distance if luminosity is known.	15.1 and Lab 6
Describe the H-R diagram	15.1
Interpret the relative sizes, temperatures and luminosities of stars appearing on the HR diagram.	15.1
Recognize that the mass of a star determines its main sequence properties.	15.1

Astronomy 104 PRACTICE Mid-Term #2

Spring Semester 2009

[NOTE: This practice mid-term has more questions than the actual mid-term will. However, on both the Multiple Choice section is worth 30 points total, and the Essay section is worth 20 points total.]

DO NOT OPEN THIS EXAM UNTIL TOLD TO DO SO BY INSTRUCTOR.

Exam Rules:

a. Exam will start at the beginning of your lecture period and must be turned in 50 minutes after the exam begins.
b. Bring you student ID to the exam. It will be checked as you turn in the exam.
c. **Exam is Closed Book and Closed Notes**.
d. **Cell phones must be off and out of sight (not even "vibrate").**
e. **No electronic devices allowed with exception of a calculator except at discretion of instructor.**
f. I expect everyone to be honorable and not copy answers from someone else's exam. I consider it a personal insult for you to cheat and thus cheating will be dealt with by giving the cheater an "F" for the entire course.

Exam Hints:

a. If you have trouble with a problem, skip it and go to the next one, come back to it later.
b. Don't be afraid to raise your hand and ask a question of the instructor if you have a problem with interpreting a question.

Multiple Choice Questions:

1. Which of the following is an example in which of an object has a velocity but no acceleration?
   a. A car driving around in a circular racetrack at exactly 200 km/hr.
   b. A person jumping up and down, with a period of exactly 60 hops per minute.
   c. A student pushes off on a sled and slides down a snowy hill, traveling in a straight line and speeding up as they go down the hill.
   d. A car is driving at exactly 50 km/hr when the driver places the car in neutral and lets it come to a stop.
   e. None of the above

2. The planets never travel in a straight line as they orbit the Sun. According to Newton's second law of motion, this must mean that:
   a. a force is acting on the planets.
   b. the planets will eventually fall into the Sun.
   c. the planets are always accelerating.
   d. the planets have angular momentum.
   e. the planets have gravity.

3. The fact that the Voyager 2 space probe continues to move out of the solar system, even though its rockets have no fuel and the pull of the Sun's gravity on Voyager 2 is completely negligible, is an example of
   a. the universal law of gravitation.
   b. Newton's first law of motion.
   c. Newton's second law of motion.
   d. Newton's third law of motion.
   e. none of the above

4. According to Newton's Third Law, and the Law of Universal Gravitation, the gravitational pull of the Earth on the Sun is
   a. smaller than the gravitational pull of the Sun on the Earth
   b. equal to the gravitational pull of the Sun on the Earth
   c. larger than the gravitational pull of the Sun on the Earth

5. According to Newton's Universal Law of Gravitation which of the following statements are true?
   a. The gravitational force between two objects depends on the masses of both objects and how far apart they are.
   b. There is no gravity in space.
   c. You are gravitationally attracted to your classmates.
   d. Both (a) and (b)
   e. Both (a) and (c)

6. You observe two different stars. One appears green, the other appears orange. Which star is hotter?
   a. The green star.
   b. The orange star.
   c. Both are the same temperature.

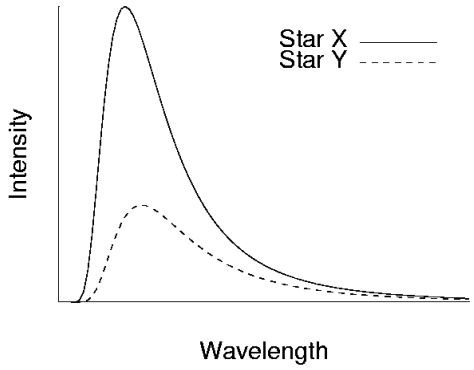
7. You observe two different stars. One appears green, the other appears orange. Which star is more luminous, assuming both are the same size.
   a. The green star.
   b. The orange star.
   c. Both are the same luminosity.

8. The difference between x-rays and visible light is that visible light _____ than x-rays.
   a. moves faster
   b. has shorter wavelength
   c. moves slower
   d. has less energy

9. Which has longer wavelength, red light, or blue light?
   a. Red light.
   b. Blue light
   c. Sometimes red light has longer wavelength, sometimes blue light does.

10. As the wavelength of light gets smaller the energy of the light gets
    a. Larger
    b. Smaller
    c. Stays the same

11. The figure below shows the spectra for two stars. Based on the picture, what can you conclude about the temperatures of Star X and Star Y?
    a. Star X is hotter
    b. Star Y is hotter
    c. Star X and Star Y are the same temperature
    d. Nothing can be concluded about the temperatures of X and Y from this picture

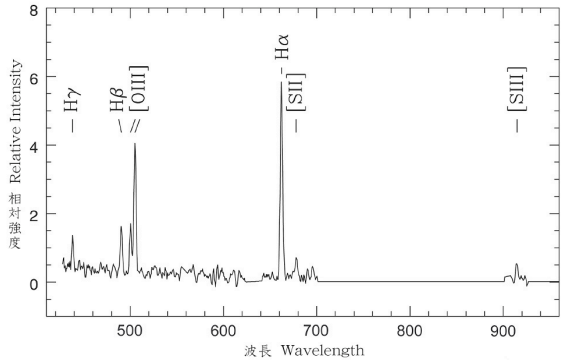


12. Suppose you have a light bulb at some temperature. If you double the temperature of the light bulb, how does the ***amount of light*** change coming from the bulb change?
    a. It increases by a factor larger than two
    b. It increases by exactly a factor of two
    c. It increases by less than a factor of two

13. Suppose you have a light bulb at some temperature. If you double the temperature of the light bulb, how does the ***wavelength*** at which most of the light that is emitted change?
    a. It decreases.
    b. It increases.
    c. It stays the same.

14. Which of the following is ***not*** a type of electromagnetic radiation?
    a. Radio waves
    b. Infrared light
    c. Gamma rays
    d. Beta rays

15. An emission spectrum looks
    a. like a smooth rainbow of colors.
    b. mostly dark with a few bright lines.
    c. mostly like a smooth rainbow with a few dark gaps.



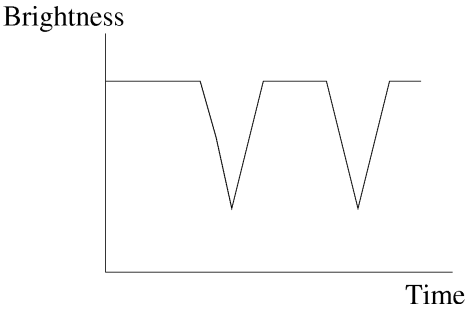
16. The spectrum shown above is a(n)
    a. Continuous spectrum
    b. Absorption spectrum
    c. Reflection spectrum
    d. Emission spectrum

17. Consider a cloud of warm (4000K) interstellar gas that is not very dense. The type of spectrum produced by this gas will be an/a _____ spectrum.
    a. emission
    b. absorption
    c. continuous

18. Power in the sun is derived from
    a. Fusion of light elements into heavier elements
    b. Fission of heavy elements into light elements
    c. Gravitational energy released by the contraction of the sun
    d. The burning of coal and other materials

19. In nuclear reactions in the sun, four nuclei of _____ combine to make a single nucleus of _____.
    a. Helium; hydrogen
    b. Hydrogen; helium
    c. Carbon; helium
    d. Protonium; hydrogen

20. The graph below shows the light curve of an eclipsing binary system. Based on the graph the luminosity of one star in the binary system is _____ the luminosity of the other star.
    a. the same as
    b. larger than
    c. smaller than



21. Which of the following can one ***not*** measure from the spectrum of a star?
    a. The composition of the star
    b. The temperature of the star
    c. The radius of the star

22. Which of the properties below is typically the most difficult to measure for a star?
    a. Composition
    b. Distance
    c. Temperature
    d. Apparent magnitude

23. All stars on the main sequence are
    a. Are fusing hydrogen into helium in a shell surrounding the core
    b. Are fusing hydrogen into helium in the core
    c. Are fusing helium into carbon in the core

24. Stars in the upper left portion of the main sequence are
    a. Massive, stable stars
    b. Stars like our sun
    c. Red giants
    d. White dwarfs

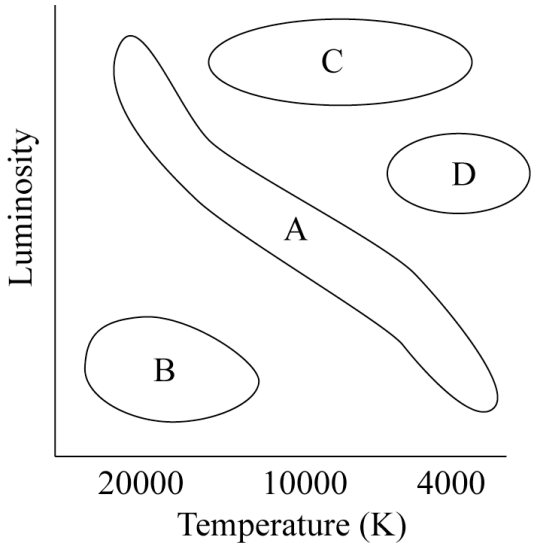
25. Imagine comparing two stars of about the same luminosity, one in the upper left portion of an HR diagram, and one in the upper right portion. Compared to the star in the upper left portion, the temperature of the star in the upper right portion is
    a. Hotter
    b. Cooler

26. Imagine comparing two stars of about the same luminosity, one in the upper left portion of an HR diagram, and one in the upper right portion. Compared to the star in the upper left portion, the radius of the star in the upper right portion is
    a. smaller
    b. larger

27. Most main sequence stars are less massive than our sun. This means that most main sequence stars are also _____ than our sun.
    a. less luminous
    b. hotter
    c. younger
    d. larger diameter

28. Parallax is used to measure the _____ a star.
    a. color of
    b. distance to
    c. size of
    d. composition of

29. You observe two stars, A and B. Star A is cooler than star B, but is more luminous than star B. This means that
    a. Star A is smaller than star B
    b. Star B is smaller than star A
    c. Star A and Star B are the same size
    d. Star A is closer than star B
    e. We can't answer this question with the information given.



30. Which region on the HR diagram above is the main sequence?
    a. A
    b. B
    c. C
    d. D

31. Stars in which region on the HR diagram at above are the smallest?
    a. A
    b. B
    c. C
    d. D

32. The mass of a star can be measured if
    a. It is very bright
    b. It is part of a binary system
    c. It is very cool
    d. It is very nearby

33. Fusion takes place in what part of a star?
    a. the corona
    b. the photosphere
    c. the core

34. The luminosity of a main sequence star is determined by its
    a. Mass
    b. Diameter
    c. Rotation rate
    d. Age

35. Imagine you are in a spaceship. You observe the sun while near the Earth, then fly to a point much farther from the Sun. You repeat your observations. When you compare the two observations you will find that the _____ of the Sun changes.
    a. Apparent brightness
    b. Luminosity
    c. Temperature
    d. Composition

36. The luminosity of a star is
    a. how bright the star appears to be when you look at it.
    b. a combination of how bright the star appears to be when you look at it and how far away the star is.
    c. completely determined only by the temperature of the star.
    d. the amount of energy the star releases every second.

37. Imagine two stars called A and B. Both stars have the same temperature and same composition, but are not necessarily the same diameter. From this, you can conclude that
    a. Both stars definitely have the same luminosity, no matter what their diameters are.
    b. Star A or star B could be more luminous; the star with the ***larger*** diameter will be more luminous.
    c. Star A or star B could be more luminous; the star with the ***smaller*** diameter will be more luminous.
    d. Star A or star B could be more luminous, but the diameter of the stars has nothing to do with it.

38. The light you see from a distant star appears to dimmer than the light coming from the same star would if you were close to it because
    a. The light loses energy as it moves through space
    b. The light spreads out as it moves through space
    c. The light slows down as it moves through space
    d. The light changes wavelength as it moves through space

39. Imagine we could place a telescope on Jupiter, which is about five times farther from the sun than the earth is (in other words the orbit of Jupiter has a radius five time bigger than the orbit of the Earth). The telescope on Jupiter would be able to measure parallax for star _____ than a telescope on earth could.
    a. five time closer
    b. five times farther
    c. ten times closer
    d. ten times farther

[This next question is a bit hard and involves a bit more math than would be typical in our exams, but if you can get it, you definitely understand the inverse square law of light.]

40. There are three stars, I, II, and III. Star I has luminosity 20 times the sun and is 2 light years away. Star II has luminosity 90 times that of the Sun and is 3 light years away. Star III has luminosity 100 times that of the Sun and is 5 light years away. In which choice below are the stars correctly listed from brightest to dimmest?
    a. I, II, III
    b. III, II, I
    c. II, III, I
    d. II, I, III
    e. III, I, II

Discussion Questions for PRACTICE Mid-Term #2:

(Turn this section in with "computer graded" sheet)

On the actual mid-term exam, there will be three short answer questions of which you must answer two for full credit. If you answer all three, your best two answers will be used in determining your score. Answer the questions below as fully and clearly as you can. You will be graded both on clarity (using full sentences that make sense) and on completeness and correctness.

1. According to Newton's third law, if a semi-trailer truck hits a little car, the force the truck exerts on the car is equal to the force the car exerts on the truck. Why is it that in such a collision that the car ends up much more damaged?

2. Explain how a continuous spectrum changes as the temperature of the object emitting the light changes.

3. Describe each of the three types of spectra and how they are produced.

4. On February 21, 2007, astronomers working with the Spitzer Infrared Space Telescope announced that they had obtained the spectra of two planets orbiting stars other than the Sun. This was possible because these two planets are in orbits that are oriented such that they pas in front of the star they orbit once during each orbit. Some of the light from the star then passes through the atmosphere on its way to us. By comparing the spectra of the star when the planet is in front of the star versus when the planet is not, astronomers can identify the parts of the spectra due to the planet.
    a. What kind of spectra would the planet's atmosphere have if we assume that the star is a dense light source and that light is passing through a "thin gas" atmosphere of the planet? *Explain your reasoning.*
    b. What could astronomers learn about the planet if they could obtain this kind of spectra for it? *Again, briefly explain your answer.*

5. We explained in class the theory that the Sun's energy output is being generated by the nuclear fusion of hydrogen into helium at the Sun's core. For a scientist, for something to be a theory it has to make testable predictions that have thus far proven accurate. What evidence do we have that there is nuclear fusion going on in the Sun's core? Specifically, what does the theory that nuclear fusion powers the Sun predict that has indeed been observed to be true?

6. Describe how the spectrum of a warm dense object changes if its temperature is increased.

7. Explain how to use the inverse square law to measure distances. What do you need to know to use the inverse square law in this way?