

ASTRO 150

EXAM 1 - SAMPLE

This examination is closed book. Please keep your answer sheet covered during the exam.

- * Sit in the seat with the number that matches the number on the computer answer sheet
- * Write your NAME, SS#, and SECTION NUMBER on the ESSAY PAGE of the exam.
- * In the NAME portion of the computer sheet, fill in your last name, leave one blank space, then continue with your first name.
- * Enter your student ID number in the IDENTIFICATION NUMBER boxes of the computer sheet.
- * Write your Section Number in spaces K and L of the SPECIAL CODE

Wednesday 9:00AM Section 01 (Winkin)
 10:00AM Section 02 (Winkin)
 11:00AM Section 03 (Blinkin)
 12:10PM Section 04 (Blinkin)
 1:10PM Section 05 (Nodd)
 2:10PM Section 06 (Nodd)

- * Fill in all circles corresponding to the letters/numbers of your name, ID number, and section.
- * Turn in the COLORED PAGE OF THIS EXAM and the COMPUTER SHEET.

USEFUL FORMULAE

$$F = ma \qquad v = \lambda \times f \qquad L \propto R^2 T^4 \qquad E = mc^2$$

$$E_{\text{photon}} \propto f \qquad B = \frac{L}{4\pi R^2} \qquad \lambda_{\text{max}} = \frac{3 \times 10^6 \text{ nm}}{T}$$

$$\theta_{\text{min}} = \frac{12 \text{ arc sec}}{\text{diameter [cm]}} \qquad \theta_{\text{min}} = 2 \times 10^5 \frac{\lambda}{\text{diameter}} \text{ arc sec}$$

NOTE: The real exam will also include a 1-page essay question, to be presented in the lecture preceding the exam. You will have to write your answer on an attached sheet during the exam.

Part I: Multiple Choice: Select the *best* answer to each of the questions below. Place your answer on the computer answer sheet provided.

1. A light year is a unit of
 - a) mass.
 - b) time.
 - c) distance.
 - d) energy.
 - e) force.
 2. Which of the following are correctly placed in order of decreasing distance:
 - a) Alpha Centauri, Sun, Pluto, Andromeda Galaxy
 - b) Andromeda Galaxy, Alpha Centauri, Pluto, Sun,
 - c) Andromeda Galaxy, Sun, Pluto, Jupiter
 - d) Alpha Centauri, Sun, Moon, Pluto, Jupiter, Cleveland
 - e) Sun, Moon, Jupiter, Pluto, Oakland.
 3. Why did Ptolemy use epicycles in his model of the solar system?
 - a) to account for the motions of stars
 - b) to compensate for the ellipticity of the orbits of the planets
 - c) to explain the retrograde motions of the planets
 - d) to explain the phases of the moon
 - e) to explain the changing length of the days through the year
 4. Which of the following is one of Kepler's Laws of planetary motion?
 - a) planets move on elliptical orbits with the Sun at one focus
 - b) an object in motion tends to stay in motion unless a force acts
 - c) never allow the lead-off runner to reach first base
 - d) inner planets orbit in a different direction than outer planets
 - e) the force of gravity between two objects decreases with the distance squared
- *** Use the following choices for questions 5 and 6:
- a) made the first accurate measurements of the size of the Earth
 - b) was the first astronomer to propose epicycles
 - c) explained how white light from the sun turns into a rainbow after passing through a prism
 - d) was the first to discover that the orbits of planets are ellipses
 - e) is famous for the first observations of the planets and stars with a telescope
5. Which of the choices above best describes Galileo?
 6. Which of the choices above best describes Isaac Newton?
 7. How does an object move when no forces act on it?
 - a) with constant acceleration
 - b) in a straight line at constant speed
 - c) in an ellipse
 - d) if no forces act on it, it doesn't move
 - e) in a circle

8. If the distance between two objects is doubled, the force of gravity between them will
- double
 - decrease by a factor of two
 - increase by a factor of four
 - decrease by a factor of four
 - remain the same
9. Suppose an object moves in a circular path at constant speed. What can be said about any force that might be acting on it?
- there is no force acting on it
 - the force acting on it must be directed along the edge of the circle
 - the force act only at the top or bottom of the circle
 - the force acting on it must be acting in the direction opposite to its motion
 - the force acts towards the center of the circle
10. The product of the wavelength multiplied by the frequency of a wave is
- the speed of the wave
 - the energy of the wave
 - the curl of the wave
 - the force of the wave
 - none of the above.
11. A particle of light is a(n)
- graviton
 - quark
 - lepton
 - photon
 - plausibon
12. Light with a wavelength of 420 nanometers is
- infrared
 - red
 - yellow
 - blue
 - ultraviolet
13. Light with a wavelength of 10,000 nanometers is
- infrared
 - red
 - yellow
 - blue
 - ultraviolet
14. Mercury lies 3 times closer to the Sun than the Earth; on Earth the Sun appears
- the same brightness as on Mercury
 - one third as bright as on Mercury
 - one ninth as bright as on Mercury
 - 3 times brighter than on Mercury
 - 9 times brighter than on Mercury

15. Infrared light waves have _____ compared with visible electromagnetic radiation.
- high energy and long wavelength.
 - low energy and long wavelength.
 - low energy and short wavelength.
 - high energy and short wavelength.
 - all of the above
16. If a blackbody emits light by purely thermal radiation there is a unique correspondence between
- the temperature of the object and the wavelength at which it is brightest
 - the temperature of the object and its surface area
 - the mass of the object and the power radiated away into space
 - the mass of the object and its surface area
 - the color of the object and its surface area
17. Consider a star that is its brightest at a wavelength of 400 nanometers. If in the future that star cools down until its temperature is reduced by a factor of 2, at what wavelength will it be brightest?
- 200 nanometers
 - 800 nanometers
 - 1600 nanometers
 - 50 nanometers
 - not enough information given
18. Two stars, one red and the other blue, lie at the same distance from the Sun. The red star appears to be two times brighter than the blue star. Which of the following statements is true about these stars?
- the red star is hotter
 - the red star is bigger
 - the red star is smaller
 - both a) and c)
 - none of the above
19. Pretend that all stars are the same (same size, same temperature). Suppose a 1 meter diameter telescope can barely detect one of the stars that is a certain distance away. How much farther into space could a 2 meter telescope barely detect stars?
- 8 times
 - 4 times
 - 2.8 times
 - 2 times
 - 1.4 times
20. Suppose we observe a cool, tenuous gas with a hot 'black body' behind it. The combined spectrum will be
- absorption lines only
 - emission lines only
 - continuous radiation only
 - continuous radiation with dark lines superimposed
 - continuous spectrum with bright lines superimposed
21. When an atom loses one or more electrons it is said to be
- ionized
 - excited
 - forgetful
 - in the ground state
 - recombined

22. Why is spectroscopy called the "Rosetta Stone of astronomy"?
- because spectral lines allow identification of the color of stars
 - spectroscopy has been used for thousands of years to "read" the stars
 - because understanding spectroscopy is hard
 - for no good reason at all
 - spectral lines are the fingerprints of the elements that make up the stars.
23. Which of the following processes will result in the emission of a photon?
- the electron in an atom jumping to a higher energy level
 - the electron in an atom jumping to a lower energy level
 - an atom becoming ionized
 - the electron in an atom remaining in the ground state
 - the atom having a burrito with extra hot sauce for lunch
24. Which of the following telescopes has the best resolving power
- a 10 cm telescope in optical wavelengths.
 - a 10 cm telescope in ultraviolet wavelengths.
 - a 100 cm radio telescope observing at a wavelength of 100 meters.
 - your eye at optical wavelengths
 - not enough information given to answer this question...
25. The temperature at the surface of the Sun is about
- 6,00K
 - 3,000K
 - 6,000K
 - 600,000K
 - 15,000,000K
26. As specifically defined in lecture, the term "brightness" means
- energy per second per unit area in the visual region of the spectrum.
 - energy per second per unit area over all wavelengths.
 - score on the ITBS.
 - total energy per second radiated over all wavelengths.
 - none of the above.
27. What would be the approximate luminous lifetime of the Sun if it derived its energy entirely from gravitational contraction (what was called Kelvin-Helmholtz contraction in lecture)?
- 5,756 years
 - 10,000 years
 - one million years
 - 100 million years
 - 10 billion years
28. Neutrinos are a good probe of the center of the Sun because
- they travel at the speed of light and so arrive quickly
 - they interact weakly with matter, and so arrive at Earth unaffected by the rest of space
 - they have large mass
 - they are not a good probe because they are impossible to detect
 - both c) and d)

29. In the proton-proton chain, how many protons are required to make a helium nucleus?
- 1
 - 2
 - 4
 - 5
 - 8
30. Hydrostatic equilibrium describes the balance between
- pressure and gravity
 - mass and luminosity
 - supply and demand
 - temperature and density
 - radius and brightness
31. What are the two most abundant elements in the Sun?
- air and fire
 - carbon and hydrogen
 - carbon and helium
 - hydrogen and helium
 - hydrogen and oxygen
32. For which of the following reasons have solar neutrino experiments surprised scientists?
- too few neutrinos have been detected compared to those expected from models of the Sun
 - far too many solar neutrinos have been detected
 - the wrong kind of solar neutrinos have been found
 - no solar neutrinos have been found
 - Ray Davis is missing
33. The "surface" of the Sun that we see in visible wavelengths is called the
- corona
 - chromosphere
 - atmosphere
 - photosphere
 - gymnopedisphere
34. Why do sunspots appear dark?
- they emit no light
 - they are holes in the luminous outer layers of the Sun that allow us to see the dark inside
 - you would too if you were in the burning hot outer layers of the Sun!
 - they are cooler than their surroundings
 - the intense magnetic fields block the light
35. The energy transport process in which heated material rises and cooler material sinks is
- conduction
 - convection
 - radiation
 - neutrino emission
 - ionization

36. Einstein's famous equation, $E = mc^2$, says that
- a) electromagnetism is the same as mass.
 - b) energy is equivalent to mass.
 - c) kinetic energy is determined by mass.
 - d) the speed of light never changes.
 - e) energy is equivalent to light.
37. The temperature of the center of the Sun is roughly
- a) 15,000 K.
 - b) 150,000 K.
 - c) 1,500,000 K.
 - d) 15,000,000 K.
 - e) 150,000,000 K.
38. The proton-proton chain produces enough energy to keep the Sun shining for
- a) thousands of years.
 - b) hundreds of thousands of years.
 - c) millions of years.
 - d) hundreds of millions of years.
 - e) billions of years.
39. Which of the following is true of the proton-proton chain?
- a) Protons are fused to produce deuterium, or ^2H .
 - b) Protons are split to form neutrons and positrons.
 - c) Protons combine to form helium when 4 of them collide simultaneously.
 - d) Protons decay into energy and neutrinos.
 - e) There are franchises throughout the Midwest.
40. Which of the following statements concerning solar neutrinos is correct?
- a) less have been observed than predicted
 - b) observed and predicted numbers are equal
 - c) more have been observed than predicted
 - d) none have been observed
 - e) 5 were seen in Indianapolis just last Wednesday