ASTR 1050: Survey of Astronomy *Fall 2012*

Practice Final Exam, December 11, 2012 (40 points total)
Instructor: Michael Brotherton
Comprehensive

Instructions
This exam is **closed book and closed notes,** although you may use a calculator (much of the math on the exam may be easy enough to work without a calculator, however, but if you want to borrow one please ask!). Formulas and constants you might want during the exam are given on the last page. The exam consists of 40 multiple choice questions. Please mark with a number 2 pencil your answers on a blue 5-answer scan sheet (only one answer per question). Completely erase any stray marks. In the special code section please fill in "FINAL". Please don't cheat and make your best effort. Good luck!

Multiple Choice (40 questions)

1. What is the approximate temperature of the black body spectrum fit to the observed the cosmic background radiation?
a. Absolute zero.
b. 3K.
c. 30K.
d. 300K.
e. 3000K.

2. Which is the accepted interpretation of Hubble's Law?
a. The universe is expanding.
b. The universe is contracting.
c. The universe is exploding, with the Milky Way at the center.
d. The universe is always the same, but light loses energy as it travels.
e. None of the above.

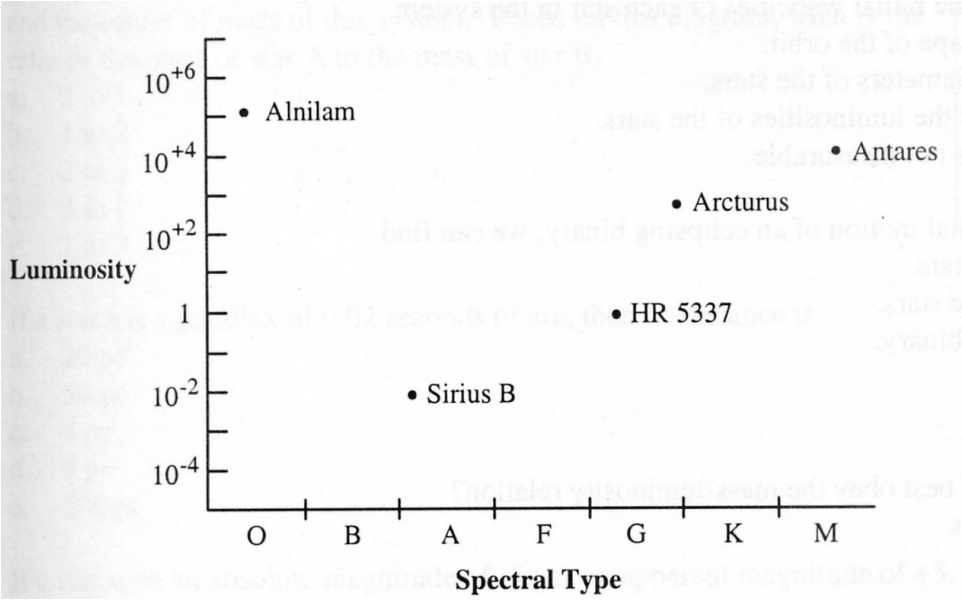
3. Within the first ten minutes of the existence of our universe, what happened?
a. Recombination, leading to the release of the cosmic background radiation.
b. Creation of the first stars, leading to reionization.
c. The universe became transparent to photons.
d. All the elements formed, including the heavy elements like iron.
e. Some of the lighter elements formed, primarily hydrogen and helium.

4. According to the big bang theory, what is the approximate age of the universe?
a. It's infinitely old.
b. About 14,000 years old.
c. About 14,000,000 years old.
d. About 14,000,000,000 years old.
e. About 14,000,000,000,000 years old.

5. Which is true about radio waves?
a. They travel at the speed of sound.
b. They travel at the speed of light.
c. They don't travel at all, they just resonate in place.
d. They have higher energies than gamma rays.
e. They have higher frequencies than X-rays.

6. If two objects have the same surface area, but one has three times the temperature, how much more blackbody radiation does it emit?
a. the same
b. 3x
c. 9x
d. 27x
e. 81x

Use the H-R diagram, with luminosities in solar units, to answer the next few questions:



7. Which star in the diagram above is a white dwarf?
a. Alnilam
b. Antares
c. Arcturus
d. HR 5337
e. Sirius B

8. Which star in the diagram above has the largest radius?
a. Alnilam
b. Antares
c. Arcturus
d. HR 5337
e. Sirius B

9. Which star in the diagram above is the most like our own sun?
a. Alnilam
b. Antares
c. Arcturus
d. HR 5337
e. Sirius B

10. What process provides the sun's energy?
a. The release of gravitational energy as it collapses.
b. The fire of burning carbon compounds.
c. The fission of heavy elements as in nuclear reactors on Earth.
d. The fusion of hydrogen into helium.
e. The fusion of helium into carbon.

11. What is the approximate total lifetime of a G star like the sun?
a. ten million years.
b. a hundred million years.
c. a billion years.
d. ten billion years.
e. a hundred billion years.

12. What is a planetary nebula?
a. The dusty disk from which planets form around collapsing stars.
b. A fancy term for a cloud in the atmosphere of a planet.
c. A kind of planet with clouds.
d. A cloud of reflecting dust around a comet when it is being heated by the sun.
e. The hot exposed degenerate stellar core lighting up its expelled outer atmosphere.

13. The mass of the black hole at the center of the Milky Way is
a. about the same as the sun's.
b. a few thousand solar masses.
c. a few hundred thousand solar masses.
d. a few million solar masses.
e. a few hundred million solar masses.

14. If a galaxy (A) is three times farther away than another galaxy (B), what might we expect about their velocities relative to Earth?
a. The recessional velocity of A is one third that of B.
b. The recessional velocity of A is three times that of B
c. The recessional velocity of A is one ninth that of B.
d. The recessional velocity of A is nine times that of B
e. There's no expected relationship.

15. Based on the galaxies found in the Local Group of galaxies, the most common type of galaxy in the universe is expected to be
a. the spiral galaxies.
b. the barred spiral galaxies.
c. the dwarf elliptical galaxies.
d. the irregular galaxies.
e. the giant elliptical galaxies.

16. Which is the sequence of star classifications in order of decreasing surface temperature?
a. OBAFGKM
b. MKGFABO
c. MKFGABO
d. OBFAGKM
e. ABCDEFG

17. If two stars are identical (same mass, luminosity, age, size, etc.), but one is three times closer to Earth than the other, how much brighter is it seen to be?
a. The same brightness
b. 3 times brighter
c. 9 times brighter
d. 27 times brighter
e. 81 times brighter

18. What is the correct order of planets from the sun, nearest to farthest?
a. Mercury, Venus, Mars, Earth, Jupiter, Saturn, Neptune, Uranus
b. Mars, Mercury, Venus, Earth, Jupiter, Saturn, Uranus, Neptune
c. Mercury, Venus, Earth, Mars, Jupiter, Saturn, Neptune, Uranus
d. Mars, Venus, Earth, Mercury, Jupiter, Saturn, Uranus, Neptune
e. Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune

19. Tidal forces are the result of
a. erosion by ocean waves
b. greenhouse gas warming by water vapor.
c. volcanic explosions.
d. solar heating.
e. the fact that gravity depends on distance.

20. The sky is blue because
a. the Sun mainly emits blue light.
b. molecules scatter red light more effectively than blue light.
c. the atmosphere absorbs mostly blue light.
d. the atmosphere transmits mostly blue light.
e. molecules scatter blue light more effectively than red light.

21. How does the greenhouse effect work?
a. The higher pressure of the thick atmosphere at lower altitudes traps heat in more effectively.
b. Greenhouse gases absorb X rays and ultraviolet light from the Sun, which then heat the atmosphere and the surface.
c. Ozone transmits visible light, allowing it to heat the surface, but then absorbs most of the infrared heat, trapping the heat near the surface.
d. Greenhouse gases absorb infrared light from the Sun, which then heats the atmosphere and the surface.
e. Greenhouse gases transmit visible light, allowing it to heat the surface, but then absorb infrared light from Earth, trapping the heat near the surface.

22. Which planet has rings?
a. Jupiter.
b. Saturn.
c. Neptune.
d. Uranus.
e. all of the above.

23. About how many exoplanets have been found?
a. Just a few – less than 10.
b. Almost 100.
c. Close to 1000.
d. Over 10,000.
e. Millions.

For the next 4 questions, please use the following answer key:

a) Uranus
b) Venus
c) Saturn
d) Mars
e) Jupiter

24. Which of the above worlds has the most extreme greenhouse effect?

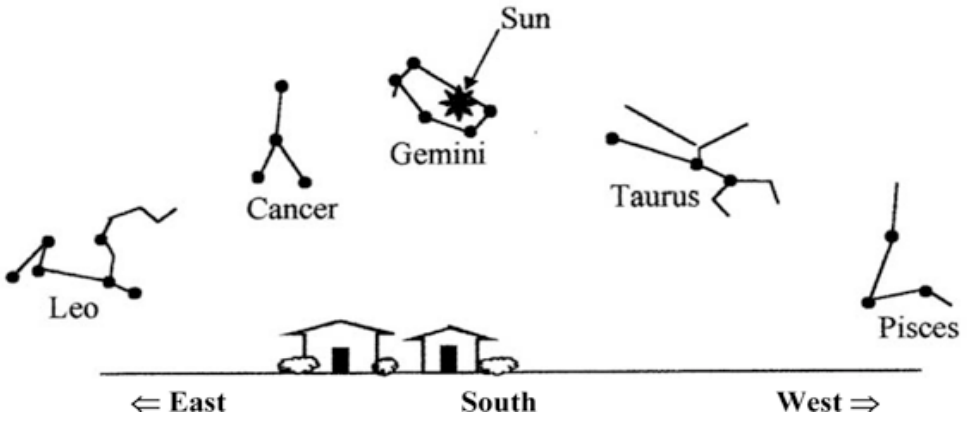
25. Which of the above worlds has a reddish color?

26. Which of the above worlds has blue methane clouds in its atmosphere?

27. Which of the above worlds is closest to the sun?

28. Which of the following is the farthest away?
a. the nearest star (other than our Sun)
b. Pluto
c. the Andromeda galaxy
d. the Orion Nebula
e. Jupiter

29. Refer to the figure below, and imagine we can see constellations during the day time. At noon the sun appears in the direction of the constellation Gemini. At sunset on the same day, six hours later, the sun would appear to be in the direction of which Constellation?
a. Leo.
b. Cancer.
c. Gemini.
d. Taurus.
e. Pisces.



30. The speed of light is $3x10^8$ m/s. What is it in km/s?
a. $3x10^5$ km.
b. $3x10^6$ km.
c. $3x10^9$ km.
d. $3x10^{10}$ km.
e. $3x10^{11}$ km.

31. If you were at the South Pole during winter, you would see:
a. The sun rise in the east and set in the west.
b. The stars rise in the east and set in the west.
c. The stars spinning around you once per 24 hours, from left to right.
d. The stars spinning around you once per 24 hours, from right to left.
e. Stationary stars in the sky.

32. Which of the following best describes constellations?
a. a group of stars all at the same distance
b. a collection of stars that are near one another in space
c. powerful influences on human personality
d. a group of stars all seen in the about the same direction as viewed from Earth
e. a mix of stars and planets

33. You are standing on the North Pole in the year 2012. In what direction is Polaris, the North star?
a. 40 degrees up from the horizon, due East.
b. It is impossible to say.
c. directly overhead
d. The answer depends on whether it's winter or summer.
e. The answer depends on what time of day (or night) it is.

34. Why do we have seasons on Earth?
a. The phase of the moon controls how much sunlight is reflected to heat the Earth.
b. The tilt of Earth's axis constantly changes between 0 and 23 ½ degrees, giving us summer when Earth is tilted more and winter when it is straight up.
c. Earth's distance from the Sun varies, so that it is summer when we are closer to the Sun and winter when we are farther from the Sun.
d. Seasons are caused by the influence of the planet Jupiter on our orbit.
e. As Earth goes around the Sun and Earth's axis remains pointed toward Polaris, the Northern and Southern hemispheres alternately receive more and less direct sunlight.

35. If we lived on the equator in the tropics, when would the sun be directly overhead at noon?
a. every day, always
b. the summer solstice
c. the winter solstice
d. the equinoxes
e. never

36. If the Moon is setting at rising at dusk (6pm), the phase of the Moon must be
a. new.
b. full.
c. first quarter.
d. third quarter.
e. waxing crescent.

37. At approximately what time would the first quarter Moon set?
a. midnight
b. 6 A.M.
c. 9 A.M.
d. 6 P.M.
e. noon

38. If we dropped a feather and hammer on the Moon from the same height at the same time, what would happen?
a. The hammer would hit the ground first.
b. The feather would hit the ground first.
c. They would both just float away.
d. They would hit the ground at the same time.
e. It's impossible to know.

39. The simplest version of Kepler's third law derived for our solar system, $p^2=a^3$, means that:
a. planets farther from the Sun move at slower average speeds than nearer planets.
b. a planet's period does not depend on the eccentricity of its orbit.
c. all orbits with the same semimajor axis have the same period.
d. the period of a planet does not depend on its mass.
e. All of the above are correct.

40. Let's ride off into the sunset like cowboys. Sunsets are red because
a. sunlight must pass through more atmosphere then, and the atmosphere scatters more light at red wavelengths than bluer wavelengths.
b. the cooler atmosphere in the evening absorbs more blue light.
c. sunlight must pass through more atmosphere then, and the atmosphere scatters even more light at bluer wavelengths, transmitting mostly red light.
d. the Sun emits more red light when it's setting.
e. none of the above

Potentially Useful Relationships/Formulae

$$\frac{\text{Angular diameter}}{206265 \text{ arcsec}} = \frac{\text{linear diameter}}{\text{distance}}$$

Kepler's third law: P^2 is proportional to a^3

Newton's Constant of Gravitation: $G = 6.67 \times 10^{-11}$ m^3/s^2kg

Circular Velocity: $V_c = (GM/R)^{0.5}$

Newton's Law of Gravitation: $F = -GMm/r^2$

Photon Energy: $E= hc/\lambda$, where Planck's Constant is $h = 6.63 \times 10^{-34}$ J s

Classical Doppler shift: $V_r/c = \Delta\lambda/\lambda_0$, where λ is wavelength

Wien's Law: $\lambda_{max} = 3000000/T$ (λ in nm, T in degrees Kelvin)

Wien's Law: $\lambda_{max} = 3000/T$ (λ in microns, T in degrees Kelvin)

Steffan-Boltzmann Law: $E = \sigma T^4$ ($J/s/m^2$), where $\sigma = 5.7 \times 10^{-8}$ $J/m^2s\ deg^4$

c = speed of light = 3×10^8 m/s

Einstein's Mass-Energy relationship: $E = mc^2$

Distance in pc: d = 1/p where p is the parallax in arcseconds

Stellar Luminosity $L = 4\pi R^2\sigma T^4$

Binary star version of Kepler's 3rd Law: $M_A + M_B = a^3/P^2$

Mass-Luminosity Relation for Stars (using solar units): $L = M^{3.5}$

Stellar Lifetimes in solar units (solar lifetime is about 10 billion years): $Time = 1/M^{2.5}$

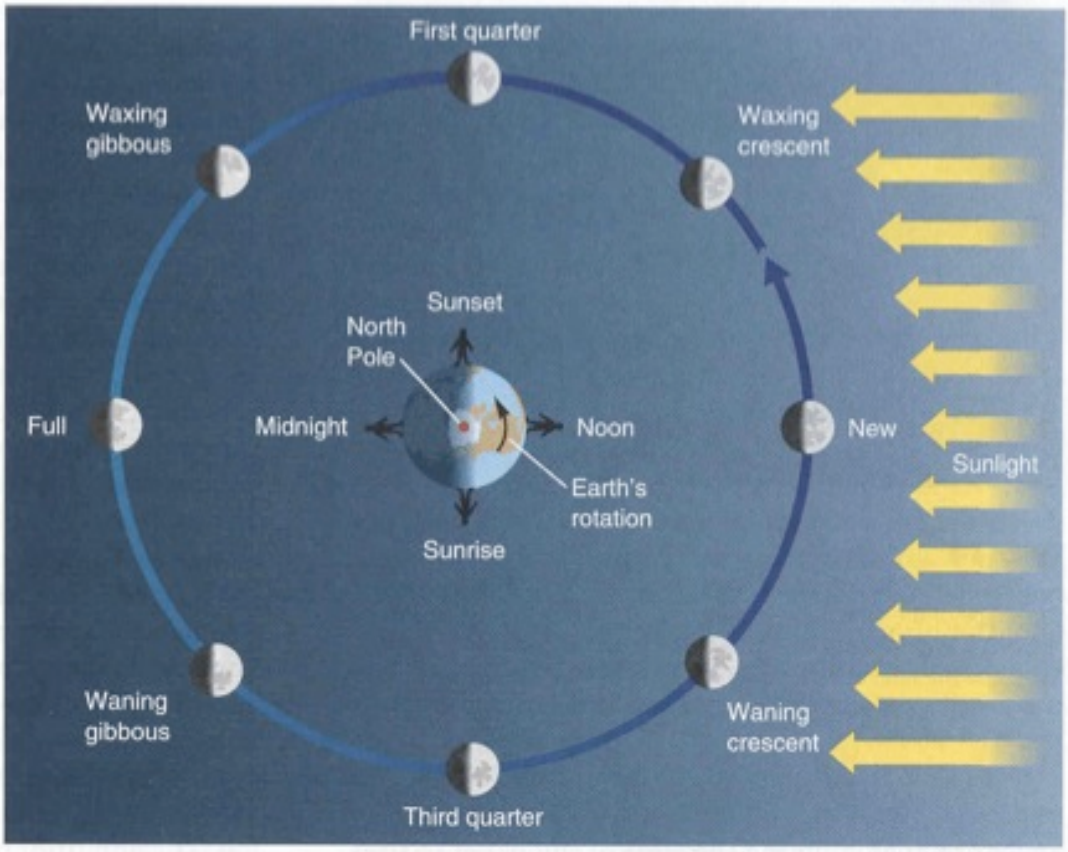
Schwarzschild Radius, $R_s = 2GM/c^2$

Mass of the sun: 2×10^{30} kg

Hubble's Law: $V_r = H_0 D$ (where H0 = 70 km/s/Mpc)


As seen from Earth
New
Waxing crescent
First quarter
Waxing gibbous
Full
Waning gibbous
Third quarter
Waning crescent

a


First quarter
Waxing gibbous
Waxing crescent
Sunset
North Pole
Full
Midnight
Noon
New
Sunlight
Earth's rotation
Sunrise
Waning gibbous
Waning crescent
Third quarter