

ASTRONOMY 0089: EXAM 1
Class Meets M,W,F, 1:00 PM
Feb 12, 1996

INSTRUCTIONS: First fill in your name and social security number (both by printing and by darkening the correct circles). Sign your answer sheet using your normal signature. Now answer all 49 questions. Students should choose the best answer of those given. There is only one correct answer for each question. Please remember to answer questions 48 and 49 as these identify which version of the exam you've taken. Read all questions carefully before answering.

1. In March the Sun crosses the Celestial Equator. This event is known as
 - a. the Autumnal Equinox.
 - b. The Summer Solstice.
 - c. the Spring Solstice.
 - d. the Vernal Equinox.
 - e. the ecliptic.

2. Which of the following is an important cause of the Earth's seasons?
 - a. The distance of the Earth from the Sun.
 - b. The Solar cycle.
 - c. The tilt of the Earth's axis with respect to the plane of its orbit about the Sun.
 - d. The elliptical nature of the Earth's orbit about the Sun.
 - e. The varying speed of the Earth in its orbit about the Sun.

3. A light source is moving TOWARDS us with a speed V . As a consequence of its motion a spectral line is shifted by 4 nm toward shorter wavelengths relative to its laboratory position. What would be the change in wavelength (relative to the laboratory wavelength) if the light source were moving AWAY from us with a speed of $2V$?
 - a. 2 nm towards longer wavelengths.
 - b. 4 nm towards shorter wavelengths.
 - c. 8 nm towards shorter wavelengths.
 - d. 16 nm towards longer wavelengths.
 - e. 8 nm towards longer wavelengths.

4. To specify the velocity of an object you need to specify both its speed and its direction of travel.
 - a. True
 - b. False

5. Which of the following statements regarding scientific theories is correct?
- They are based on faith.
 - A theory is acceptable only as long as it explains existing observations.
 - Some physical theories (e.g., Newton's Law of Gravity) have been rigorously demonstrated to be correct.
 - They do not need to make testable predictions.
 - Control experiments are always unnecessary when testing a theory.
6. Suppose a radio telescope operating at a wavelength of 1 meter has a theoretical angular resolution of 1 arcminute. If it were to operate at a wavelength of 2 meters, its theoretical angular resolution would be
- 3 arcminutes
 - 2 arcminutes
 - 0.5 arcminutes
 - 0.25 arcminutes
 - 8 arcminutes
7. A Sidereal month refers to which of the following?
- The time between successive new moons.
 - The time between similar phases of Venus.
 - The orbital period of the Moon about the Earth as defined by the distant stars.
 - A calendar month in which two full moons occur.
 - The time between identical configurations of the Moon, Sun, and Earth.
8. Which of the following statements about the escape velocity on the Earth's surface is INCORRECT?
- It depends on the mass of the Earth.
 - It depends on the mass of the object which is to be ejected into space.
 - It depends on the radius of the Earth.
 - It is the minimum velocity an object, fired from the Earth's surface, has to have in order for it to overcome the Earth's gravitational attraction.
 - It is larger than the orbital velocity of the same object at the Earth's surface.
9. The typical resolution of a ground based optical telescope is 1 arcsecond. Which of the following statements regarding the arcsecond is correct?
- It is approximately the angular diameter of a dime seen at a distance of 3 km.
 - It is approximately the angular diameter of Mars as seen from the Earth.
 - It is approximately the angular diameter of a dime seen at a distance of 100 km.
 - 1 arcsecond is 60 arcminutes.
 - It is the typical resolution of a human eye.

10. How would you write the number, 0.001654, in scientific notation.
- 1.654×10^3
 - 1.654×10^4
 - 1.654×10^2
 - 1.654×10^{-3}
 - 1.654×10^{-4}
11. Spectroscopy is
- the splitting of UV, optical, and IR electromagnetic radiation into its component colors.
 - the name given to a spectrum showing both emission and absorption lines.
 - the name given to the physical process which enables a solid to produce a continuous spectrum.
 - the change in wavelength caused by a light source moving towards or away from an observer.
 - the name given to those atmospheric windows which are transparent to electromagnetic radiation.
12. Why is observing in the infrared like observing in the optical with the lights on?
- Because the photons have so little energy they are harder to detect.
 - Because astronomical objects emit very little infrared radiation compared with optical radiation.
 - Because the telescope and dome are all emitting infrared radiation characteristic of their temperature.
 - Because the photons have so much energy they degrade into many photons when they strike the mirror causing a lot of scattered light.
 - Because the atmosphere scatters the photons so badly there is a lot of unwanted light falling onto the telescope.
13. Which of the following best describes chromatic aberration?
- The inability of a spherical mirror to focus all light at a single point.
 - An aberration arising in reflecting telescopes. It arises because a mirror has a slightly different focus for light of different wavelengths.
 - The shift in wavelength of absorption features in a spectrum arising from the motion of a source towards or away from the observer.
 - The formation of a spectrum when light is reflected off a surface which has many fine parallel grooves ruled across its surface.
 - An aberration arising in refracting telescopes. It arises because a lens has a slightly different focus for light of different wavelengths.
14. Interferometry is the process in which two or more telescopes are used simultaneously to improve the angular resolution over what could be achieved by using a single telescope.
- True
 - False

15. Suppose the angular diameter of an object at a distance of 1 light year is 6 arcseconds. At a distance of 2 light years its angular diameter would be
- 6 arcseconds
 - 24 arcseconds
 - 12 arcseconds
 - 3 arcseconds
 - 1.5 arcseconds
16. An emission line occurs in a spectrum when
- there is a cold gas between us and the light source.
 - an atom undergoes a collision.
 - the spectrum is that of a perfect black body.
 - the energy at that wavelength is higher than at neighboring wavelengths.
 - the energy at that wavelength is lower than at neighboring wavelengths.
17. The daytime sky is blue because
- the Sun emits more blue light than other colors.
 - molecules and atoms in the Earth's atmosphere preferentially absorb red light.
 - molecules and atoms in the Earth's atmosphere preferentially scatter blue light.
 - the molecules in the atmosphere absorb radiation of all wavelengths. They then emit this absorbed energy predominantly in the blue part of the visible spectrum.
 - of the effects of atmospheric turbulence.
18. The colors of visible light, in order of INCREASING wavelength, are
- violet, indigo, blue, green, yellow, orange, red
 - indigo, violet, yellow, blue, green, orange, red
 - red, orange, yellow, green, blue, indigo, violet
 - red, orange, green, blue, yellow, violet, indigo
 - red, orange, indigo, yellow, green, blue, violet

19. When an electron in an isolated atom undergoes a transition (i.e., moves) from an excited state to the ground state a photon is emitted.
- True
 - False
20. A solar eclipse can be observed from the Earth at any Moon phase.
- True
 - False
21. The angular diameter of the Moon is approximately 30 arcminutes. What is the approximate angular diameter of the Sun?
- 15 arcminutes
 - 45 arcminutes
 - 60 arcminutes
 - 30 arcminutes
 - 10 arcminutes
22. Which of the following photons has the highest energy?
- Infrared
 - X-ray
 - Optical
 - Radio
 - Ultraviolet
23. Which of the following statements regarding refraction is FALSE?
- It can cause visible light to be dispersed into its component colors.
 - It refers to the change in direction of light as it passes from one medium (e.g., air) to another medium (e.g., glass).
 - Refraction causes the Sun to rise somewhat earlier than it would if the Earth had no atmosphere.
 - Refraction arises because the speed of light is different for different media.
 - The amount of refraction (or bending) is independent of the wavelength of the radiation.
24. The Doppler effect is one of the most important tools used to study the Universe. The Doppler effect refers to
- the separation of light into its component colors.
 - the change in wavelength caused by an object moving towards or away from us.
 - the change in wavelength caused by an object moving perpendicular to our sight line.
 - the emission of a photon as an electron moves from an excited state to the ground state.
 - the absorption of a photon as an electron moves from the ground state to an excited state.

25. The reason that the primary mirror of an astronomical telescope is often polished to a parabolic shape is
- to avoid chromatic aberration which would be produced by a spherical mirror.
 - because it is easier to produce than a spherically shaped mirror.
 - to avoid spherical aberration by bringing parallel rays to a single focus.
 - it is lighter and hence easier to mount compared to an equivalent spherical mirror.
 - all of the above.
26. You are driving on a straight stretch of road covered with ice. You apply the brakes but because of the ice your car continues to move forward. This is a manifestation (consequence) of which law?
- Newton's third law which states that when one body exerts a force on a second body, the second body exerts an equal and opposite force on the first body.
 - From $F=ma$ it follows that there was insufficient power applied to the brakes.
 - Newton's Law of gravity.
 - Newton's Law of inertia which states that a body continues at constant speed unless acted on by an outside force.
 - Conservation of angular momentum.
27. You are told that there is a Full Moon. Approximately where would you find the Moon at midnight?
- Well above the horizon (i.e., high in the sky).
 - Setting in the West.
 - Rising in the East.
 - Since the time of year is not provided, insufficient information is given.
 - Because it is a Full moon, it would not be visible at midnight.
28. A black body emits no radiation.
- True
 - False
29. The density of water is $1\text{gm}/\text{cm}^3$. On an undiscovered planet, the inhabitants use the "sam" and the "nel" as the units of mass and length respectively. If $1\text{ sam} = 2\text{ gm}$, and $1\text{ nel} = 2\text{ cm}$ what is the density of water in the new units?
- $4.0\text{ sam}/\text{nel}^3$
 - $0.5\text{ sam}/\text{nel}^3$
 - $0.25\text{ sam}/\text{nel}^3$
 - $2.0\text{ sam}/\text{nel}^3$
 - $8.0\text{ sam}/\text{nel}^3$

30. Where can solar system planets be found in the night sky?
- Near the North Pole.
 - Within a narrow band about the celestial equator.
 - Within a narrow band about the ecliptic.
 - Only in directions 180 degrees away from the Sun.
 - All over.
31. If you are standing at the North Pole which of the following statements is true?
- As the seasons change you are able to see all locations on the celestial sphere.
 - At the beginning of Winter the Sun is above the horizon for at least 4 hours each day.
 - The stars never rise or set, but instead rotate about the zenith once every 24 hours.
 - The stars rise and then set 12 hours later.
 - The celestial equator passes through the zenith.
32. The ecliptic is the projection of the Earth's equator onto the celestial sphere.
- True
 - False
33. Which astronomical object moves about 12 degrees East with respect to the background stars each day (Hint: divide 360 by 12).
- Mars
 - Jupiter
 - Sun
 - Venus
 - Moon
34. Which of the following statements about the solar day is INCORRECT?
- It is defined by the Sun.
 - It is the time between successive noons.
 - It varies with the time of year.
 - It is defined to have exactly 24 hours.
 - It is NOT used by Astronomers to locate stars in the sky.
35. If a star emitted a spectrum IDENTICAL to that of a black body we could determine the star's chemical composition.
- True
 - False

36. Consider two stars, A and B, which are in orbit about each other. The mass of star A is $10 M_{\odot}$ (i.e. 10 times the mass of the sun) while the mass of star B is $5 M_{\odot}$. Which of the following statements about the magnitude of the gravitational force is correct?
- The gravitational force exerted on star A by star B is 2 times LARGER than the gravitational force exerted by star B on star A.
 - The gravitational force exerted on star A by star B is 4 times LARGER than the gravitational force exerted by star B on star A.
 - The gravitational force exerted on star A by star B is 2 times SMALLER than the gravitational force exerted by star B on star A.
 - The gravitational force exerted on star A by star B is 4 times SMALLER than the gravitational force exerted by star B on star A.
 - The gravitational force exerted on star A by star B is exactly the same as the gravitational force exerted by star B on star A.
37. When it is mid-spring in South America, what season is it in Europe?
- Winter
 - There is insufficient information.
 - Spring.
 - Autumn (Fall)
 - Summer
38. Suppose you have a MASS of 100 kg on Earth. If you move to a planet with a surface gravity 3 times that of the Earth your MASS would be
- 100 kg.
 - 11.1 kg.
 - 900 kg.
 - 33.3 kg.
 - 300 kg.
39. Scattering refers to what process?
- The change in wavelength of a photon caused by the motion of the light source.
 - The process in which the direction of travel of a photon is altered. The photon's energy remains essentially unchanged.
 - The absorption of a photon by an atom or molecule. In the process the photon is destroyed.
 - The splitting of visible light into its component colors.
 - The splitting of any electromagnetic radiation into its component colors.
40. A sidereal day is defined by the rotation of the Earth with respect to the stars, and is about 4 minutes shorter than a Mean Solar Day.
- True
 - False

41. The effective angular resolution achieved by a ground based optical telescope is primarily determined by which of the following?
- The diameter of the primary mirror.
 - The diameter of the secondary mirror.
 - The wavelength of the radiation it is collecting.
 - The manufacturing accuracy of the mirror's surface.
 - The effect of atmospheric turbulence (or seeing).
42. Which statement regarding Kepler's laws, or their implications, is INCORRECT?
- Planets move in elliptical orbits.
 - The closer a given planet is to the Sun the slower it moves.
 - The orbital speed of the planet varies so that a line joining the Sun and the planet sweeps out equal areas in equal times.
 - The further a planet is away from the Sun, the larger its orbital period.
 - The orbital period of a planet about the Sun is independent of the planet's mass.
43. A Schmidt telescope is used primarily for survey work. Which of the following statements concerning a Schmidt telescope is true?
- It has a small field, so small that even the moon could not be photographed in a single exposure.
 - It uses lenses only.
 - It uses a parabolic mirror and a flat secondary mirror.
 - It uses a parabolic mirror and a convex secondary mirror.
 - It uses a spherical primary mirror in conjunction with a thin correcting lens.
44. An ion is
- a device used to smooth clothes.
 - a fundamental constituent of matter.
 - a positively charged electron.
 - a type of electromagnetic radiation.
 - an atom with at least one electron removed.

45. The synodic period of the moon is the time it takes to complete one full cycle of phases.
- True
 - False
46. The Sun's surface temperature is approximately 6000 K, and its energy distribution (spectrum) peaks at approximately 500 nm. Using Wien's law, what is the surface temperature of a star whose energy distribution peaks at 125 nm?
- 12,000 K
 - 24,000 K
 - 6,000 K
 - 3,000 K
 - 1,500 K
47. Which statement regarding X-ray telescopes is correct?
- They use nested grazing incidence mirrors.
 - They are operated on high mountains to overcome the effects of absorption caused by the Earth's atmosphere.
 - They are of similar design to optical telescopes.
 - They are of similar design to radio telescopes.
 - Because X-ray photons are of extremely high energy it is not possible to focus them using any type of mirror or lens.
48. Mark the appropriate box.
- If the color of your exam is white, mark answer (a)
 - If the color of your exam is green, mark answer (b)
 - If the color of your exam is pink, mark answer (c)
 - If the color of your exam is orange, mark answer (d)
49. Mark answer (b)

Answers:

1(d) 2(c) 3(e) 4(a) 5(b) 6(b) 7(c) 8(b) 9(a) 10(d)
 11(a) 12(c) 13(e) 14(a) 15(d) 16(d) 17(c) 18(a) 19(a) 20(b)
 21(d) 22(b) 23(e) 24(b) 25(c) 26(d) 27(a) 28(b) 29(a) 30(c)
 31(c) 32(b) 33(e) 34(d) 35(b) 36(e) 37(d) 38(a) 39(b) 40(a)
 41(e) 42(b) 43(e) 44(e) 45(a) 46(b) 47(a)