Test Bank for Astronomy The Universe at a Glance 1st Edition by Chaisson

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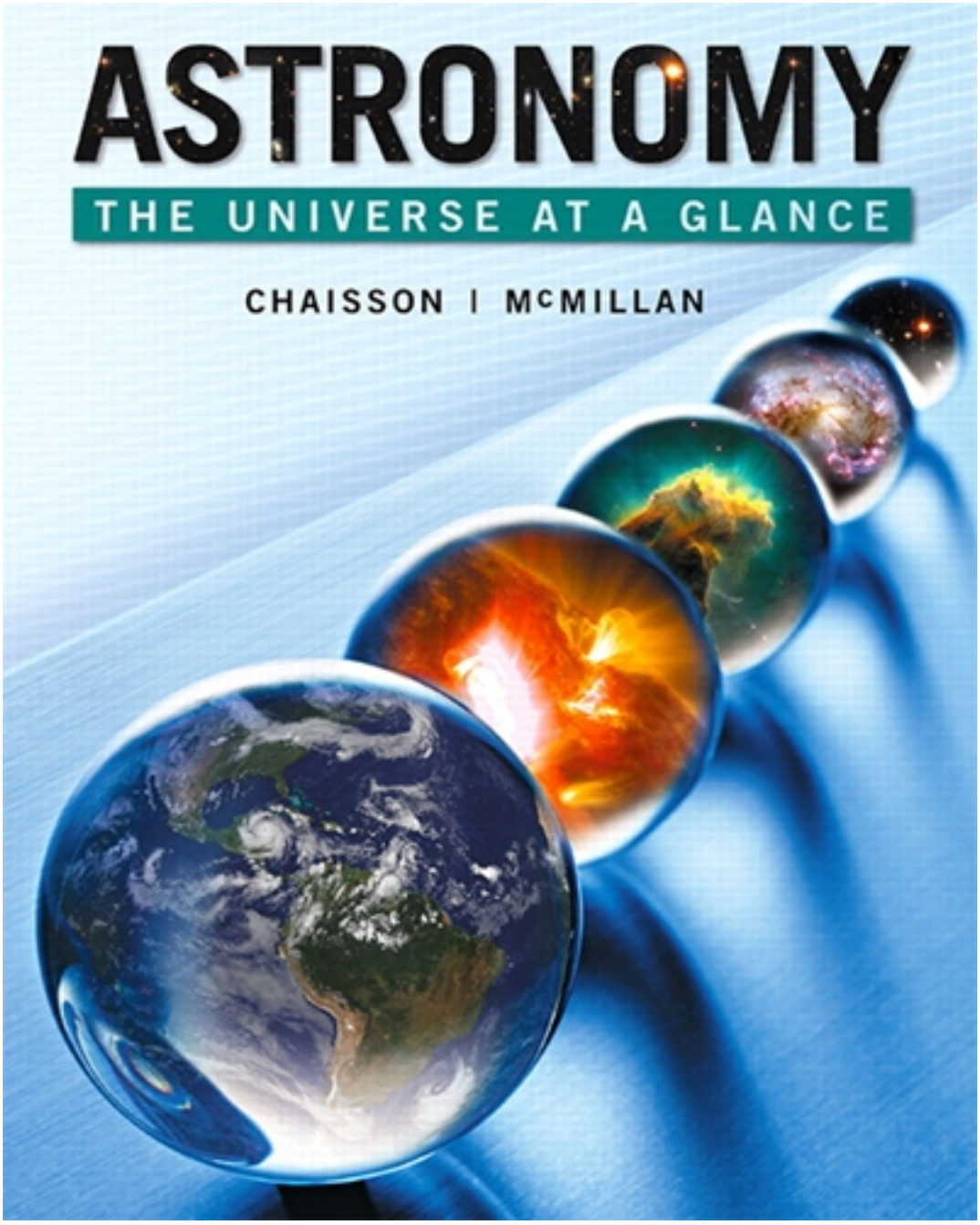


Test Bank

Astronomy: The Universe at a Glance **(Chaisson/McMillan)**
Chapter 2 Light and Telescopes

1) You would perceive a change in a visible light wave's amplitude as a change in its color.
Answer: FALSE
Diff: 1
Section Ref: 2.1

2) Gamma Rays are a type of electromagnetic radiation.
Answer: TRUE
Diff: 1
Section Ref: 2.1

3) X-rays travel at a greater speed than radio waves.
Answer: FALSE
Diff: 1
Section Ref: 2.1

4) Wave energy can only be transmitted through a material medium.
Answer: FALSE
Diff: 2
Section Ref: 2.1

5) As white light passes through a prism, the red (longer) wavelengths bend less than the blue (shorter) wavelengths, so forming the rainbow of colors.
Answer: TRUE
Diff: 2
Section Ref: 2.2

6) Observations in the X-ray portion of the spectrum are routinely done from the surface of the Earth.
Answer: FALSE
Diff: 2
Section Ref: 2.2

7) A blue star has a higher surface temperature than a red star.
Answer: TRUE
Diff: 1
Section Ref: 2.3

8) In blackbody radiation, the energy is radiated uniformly in every region of the spectrum, so the radiating body appears black in color.
Answer: FALSE
Diff: 2
Section Ref: 2.3

9) As a star's temperature increases, the frequency of peak emission also increases.
Answer: TRUE
Diff: 2
Section Ref: 2.3

10) An observer will measure the wavelength of waves emanating from a source that is moving away as longer than it really is.
Answer: TRUE
Diff: 2
Section Ref: 2.3

11) The absorption lines for a cool thin gas are identical in color and energy to the emission lines of the same gas if hot enough to glow.
Answer: TRUE
Diff: 1
Section Ref: 2.4

12) The spectral lines of each element are distinctive to that element, whether we are looking at emission or absorption lines.
Answer: TRUE
Diff: 1
Section Ref: 2.4

13) The shorter a wave's wavelength, the greater its energy.
Answer: TRUE
Diff: 1
Section Ref: 2.5

14) The red hydrogen alpha line carries more energy per photon than the blue-green hydrogen beta line does.
Answer: FALSE
Diff: 2
Section Ref: 2.5

15) In an atom, electrons can have only specific, allowed orbital energies.
Answer: TRUE
Diff: 1
Section Ref: 2.5

16) An X-ray photon has more energy than a visible photon.
Answer: TRUE
Diff: 2
Section Ref: 2.5

17) Molecular spectra, like elemental ones, involve only the vibration of the particles.
Answer: FALSE
Diff: 2
Section Ref: 2.5

18) The primary purpose of an astronomical telescope is to magnify the images of distant objects, making them appear closer.
Answer: FALSE
Diff: 1
Section Ref: 2.6

19) The light gathering ability of a telescope is most dependent on the diameter of its primary objective.
Answer: TRUE
Diff: 1
Section Ref: 2.6

20) All radio telescopes are reflectors in design.
Answer: TRUE
Diff: 2
Section Ref: 2.7

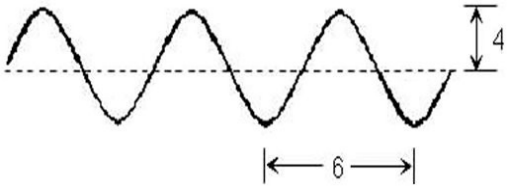
21) In addition to visible light, Hubble can do some work in the infrared and ultraviolet portions of the spectrum.
Answer: TRUE
Diff: 2
Section Ref: 2.8

22) Due to our ozone layer, ultraviolet astronomy must be done from space.
Answer: TRUE
Diff: 2
Section Ref: 2.8

23) A wave's velocity is the product of the
A) frequency times the period of the wave.
B) period times the energy of the wave.
C) amplitude times the frequency of the wave.
D) frequency times the wavelength of the wave.
E) amplitude times the wavelength of the wave.
Answer: D
Diff: 1
Section Ref: 2.1

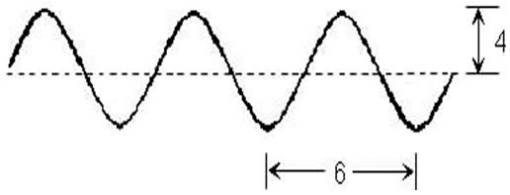
24) The number of waves passing the observer per second is
A) the wavelength in angstroms.
B) the amplitude in nm.
C) the frequency in Hertz.
D) the period in seconds.
E) the energy in milliwatts.
Answer: C
Diff: 1
Section Ref: 2.1

25) Consider this diagram. Which statement is TRUE?



A) The wavelength is 4.
B) The wavelength is 6.
C) The wavelength is 8.
D) The wavelength is 12.
E) The wavelength cannot be determined from this diagram.
Answer: B
Diff: 2
Section Ref: 2.1

26) Consider this diagram. Which statement is TRUE?



A) The amplitude is 4.
B) The amplitude is 6.
C) The amplitude is 8.
D) The amplitude is 12.
E) The amplitude cannot be determined from this diagram.
Answer: A
Diff: 2
Section Ref: 2.1

27) If a wave's frequency doubles, its wavelength
A) is halved.
B) is also doubled.
C) is unchanged, as c is constant.
D) is now 4 times longer.
E) becomes 16 times longer.
Answer: A
Diff: 2
Section Ref: 2.1

28) Which of these is constant for ALL types of electromagnetic radiation in a vacuum?
A) Amplitude
B) Wavelength
C) Frequency
D) Velocity
E) Photon energy
Answer: D
Diff: 1
Section Ref: 2.1

29) Of all the forms of electromagnetic radiation, the one with the lowest frequency is
A) gamma rays.
B) ultraviolet rays.
C) visible light.
D) microwaves.
E) radio waves.
Answer: E
Diff: 1
Section Ref: 2.2

30) The two forms of electromagnetic radiation that penetrate the atmosphere best are
A) X-rays and gamma rays.
B) ultraviolet and visible light.
C) visible and infrared light.
D) visible and radio waves.
E) infrared and microwaves.
Answer: D
Diff: 1
Section Ref: 2.2

31) The visible color of electromagnetic radiation that has the shortest wavelength is
A) red.
B) orange.
C) green.
D) blue.
E) violet.
Answer: E
Diff: 2
Section Ref: 2.2

32) Which type of radiation can be observed well from Earth's surface?
A) Gamma ray
B) X-ray
C) Ultraviolet
D) Visible
E) Infrared
Answer: D
Diff: 3
Section Ref: 2.2

33) The temperature scale that places zero at the point where all atomic and molecular motion ceases is
A) Fahrenheit.
B) Celsius.
C) Kelvin.
D) centigrade.
E) Ransom.
Answer: C
Diff: 2
Section Ref: 2.3

34) The hottest objects with temperatures in the millions of Kelvins, give off most of their radiation in which part of the electromagnetic spectrum?
A) Visible
B) Radio
C) Ultraviolet
D) X-ray
E) Gamma ray
Answer: D
Diff: 2
Section Ref: 2.3

35) What is TRUE of a blackbody?
A) It appears black to us, regardless of its temperature.
B) Its energy is not a continuum.
C) Its energy peaks at the wavelength determined by its temperature.
D) If its temperature doubled, the peak in its curve would be doubled in wavelength.
E) It has a complete absence of thermal energy.
Answer: C
Diff: 1
Section Ref: 2.3

36) The wavelength at which a blackbody radiates most depends on its
A) radius.
B) mass.
C) magnetic fields.
D) temperature.
E) direction of motion.
Answer: D
Diff: 2
Section Ref: 2.3

37) Stars like our Sun emit most of their light in which part of the electromagnetic spectrum?

A) The visible
B) The X-ray
C) The ultraviolet
D) The radio
E) The infrared
Answer: A
Diff: 2
Section Ref: 2.3

38) To see the Sun's hot corona (a temperature of 1,000,000 K), which part of the electromagnetic spectrum should one observe?
A) The visible
B) The X-ray
C) The ultraviolet
D) The radio
E) The infrared
Answer: B
Diff: 2
Section Ref: 2.3

39) The Doppler Effect is a phenomenon that allows one to measure an object's
A) temperature.
B) radius.
C) line-of-sight speed.
D) chemical composition.
Answer: C
Diff: 1
Section Ref: 2.3

40) The light from an object moving tangentially (to your left or right) will exhibit
A) a blueshift.
B) a redshift.
C) a shift in peak wavelength towards the red.
D) a shift in peak wavelength towards the blue.
E) no shift.
Answer: E
Diff: 2
Section Ref: 2.3

41) If a light source is approaching you at a speed very close to the speed of light, it will appear
A) redder than it is.
B) bluer than it is.
C) brighter than it is.
D) fainter than it is.
E) lower temperature than it is.
Answer: B
Diff: 2
Section Ref: 2.3

42) What is spectroscopy?
A) An analysis of the way in which atoms absorb and emit light
B) A study of the geometry of rainbows
C) An observational technique to measure the brightness of light at different colors
D) The use of CCDs to capture light more efficiently than with photographic film
E) A method to freeze atmospheric turbulence for better resolution
Answer: A
Diff: 1
Section Ref: 2.4

43) The Orion Nebula, M-42, is a hot, thin cloud of glowing gas, so its spectrum is
A) a continuum, strongest in the color red.
B) a few bright lines against a dark background.
C) a few dark lines in the continuum.
D) a continuum, but with both bright and dark lines mixed in.
E) not in the visible portion of the spectrum.
Answer: B
Diff: 2
Section Ref: 2.4

44) A neon light (thin hot neon gas in a sealed tube) gives us
A) a continuous spectrum, since the neon is hot enough to glow.
B) a few bright emission lines, telling us the gas is neon.
C) a continuum, with dark lines identifying the neon atoms that are present.
D) a lot of random bright red lines due to the motion of the hot atoms.
E) nothing visible to us, but a lot of infrared lines as heat.
Answer: B
Diff: 2
Section Ref: 2.4

45) A hydrogen atom consists of an electron and a(n)
A) proton.
B) ion.
C) neutrino.
D) neutron.
E) lepton.
Answer: A
Diff: 1
Section Ref: 2.5

46) An emission spectrum can be used to identify a(n)
A) proton.
B) electron.
C) neutron.
D) atom.
E) neutrino.
Answer: D
Diff: 1
Section Ref: 2.5

47) The classical model of the hydrogen atom that explains its spectral line structure is due to
A) Kirchhoff.
B) Bohr.
C) Fraunhofer.
D) Newton.
E) Mendeleev.
Answer: B
Diff: 1
Section Ref: 2.5

48) In Bohr's model of the atom, electrons
A) only make transitions between orbitals of specific energies.
B) are not confined to specific orbits.
C) are spread uniformly through a large, positive mass.
D) can be halfway between orbits.
E) move from orbit to orbit in many small steps.
Answer: A
Diff: 2
Section Ref: 2.5

49) Why are molecular lines more complex than elemental spectral lines?
A) Molecules have two or more atoms.
B) Molecules can vibrate and rotate as well.
C) Molecules are heavier than atoms.
D) Molecules are the basis of life.
E) Most of the universe is made of molecules, not individual atoms.
Answer: B
Diff: 2
Section Ref: 2.5

50) What is the primary purpose of an astronomical telescope?
A) To magnify and make distant objects appear closer.
B) To separate light into its component colors.
C) To measure the intensity of light very accurately.
D) To access wavelengths that we cannot see visually.
E) To collect a lot of light and bring it to a focus.
Answer: E
Diff: 1
Section Ref: 2.6

51) What is the resolution of a telescope?
A) Its ability to see very faint objects
B) Its ability to distinguish two adjacent objects close together in the sky
C) Its ability to make distant objects appear much closer to us
D) Its ability to separate light into its component colors for analysis
E) Its ability to focus more than just visible light for imaging
Answer: B
Diff: 1
Section Ref: 2.6

52) What is the light-gathering power of an 8-inch telescope compared to a 4-inch telescope?
A) 2× better
B) 4× better
C) 8× better
D) 16× better
E) 32× better
Answer: B
Diff: 2
Section Ref: 2.6

53) What are two advantages of large scopes over smaller ones?
A) Large scopes have a larger field of view and sharper focus.
B) Large scopes are not subject to atmospheric turbulence and opacity like smaller ones.
C) Large scopes are easier to mount and control than small ones.
D) Large telescope have more light gathering power and better resolution.
E) Large telescopes give higher magnification and are easier to build.
Answer: D
Diff: 2
Section Ref: 2.6

54) What problem does adaptive optics correct?
A) Defects in the optics of the telescope, such as the original Hubble mirror
B) The opacity of the Earth's atmosphere to some wavelengths of light
C) The light pollution of urban areas
D) Turbulence in the Earth's atmosphere which creates twinkling
E) Chromatic aberration due to use of only a single lens objective
Answer: D
Diff: 2
Section Ref: 2.6

55) What is TRUE of radio telescopes?
A) They have poorer angular resolution than a refractor.
B) They have better angular resolution than a reflector.
C) They are the smallest, most compact telescopes.
D) They can only be used above the atmosphere.
E) They are most sensitive to the opacity of the ozone layer.
Answer: A
Diff: 1
Section Ref: 2.7

56) Which of the following is a problem inherent in all large radio telescopes?
A) They are badly affected by poor seeing and atmospheric turbulence.
B) The lightest breeze shakes them, making the observations blurry.
C) Their waves are blocked by water vapor, so they must be located in deserts.
D) Radio waves have long wavelengths, so radio telescopes have poor resolution.
E) The dust clouds in the Milky Way block almost all wavelengths except light.
Answer: D
Diff: 2
Section Ref: 2.7

57) Radio dishes are large in order to
A) attract funding from NASA and the NSF.
B) give greater magnification.
C) increase their angular resolution and collect the very weak radio photons.
D) increase the range of waves they can collect.
E) detect shorter waves than optical telescopes for superior resolution.
Answer: C
Diff: 2
Section Ref: 2.7

58) Compared to optical telescopes, radio telescopes are built large because
A) they're less expensive to make than optical telescopes.
B) radio photons don't carry much energy.
C) atmospheric turbulence is more of a problem.
D) radio sources are harder to find.
E) radio waves are absorbed by the atmosphere.
Answer: B
Diff: 3
Section Ref: 2.7

59) In astronomy, an interferometer can be used to
A) yield better seeing conditions with optical telescopes.
B) decrease the effects of light pollution in getting darker sky backgrounds.
C) improve the angular resolution of radio telescopes.
D) increase the sensitivity of infrared telescopes to longer wavelengths.
E) speed up the processing of CCD images.
Answer: C
Diff: 2
Section Ref: 2.7

60) This design combines the radiation from two different telescopes to greatly enhance resolution via computer synthesis.
A) Cassegrain reflector
B) Newtonian reflector
C) Prime focus reflector
D) Refractor
E) Interferometer
Answer: E
Diff: 2
Section Ref: 2.7

61) Which of the following greatly improves the angular resolution of radio maps?
A) Schmidt corrector plates
B) More sensitive spectrometers
C) Switching from film to CCD imaging
D) Use of interferometers
E) Chilling the infrared detectors
Answer: D
Diff: 2
Section Ref: 2.7

62) Advantages of radio astronomy include
A) radio waves are not scattered or deflected by Earth's atmosphere.
B) radio observations can be made even when the Sun is in the sky.
C) radio observations can be made even when the sky is obscured by clouds.
D) radio observations let astronomers study things that emit little visible light.
E) all of the above.
Answer: E
Diff: 1
Section Ref: 2.7

63) A typical space telescope is operated by how many astronauts?
A) 7
B) 5
C) 3
D) 1
E) 0
Answer: E
Diff: 1
Section Ref: 2.8

64) The gas between stars that has a temperature below a few hundred kelvins is best studies with which kind of telescope?
A) Radio
B) Infrared
C) Optical
D) Ultraviolet
E) X-ray
Answer: B
Diff: 1
Section Ref: 2.8

65) In which part of the electromagnetic spectrum have astronomers been unable to get any information?
A) Gamma rays
B) X-rays
C) Ultraviolet
D) Microwaves
E) We now can access information in all spectral lengths.
Answer: E
Diff: 1
Section Ref: 2.8

66) The design of modern X-ray telescopes depends on
A) lenses made of germanium.
B) the prime focus design, with mirrors made of iron.
C) grazing incidence optics.
D) achromatic lenses to keep the X-rays in focus.
E) the Cassegrain design, with mirrors made of lead.
Answer: C
Diff: 2
Section Ref: 2.8

67) The product of the wavelength times the frequency of a wave is its _____.
Answer: velocity
Diff: 1
Section Ref: 2.1

68) In a wave, the distance from peak to peak is called the wave's _____.
Answer: wavelength
Diff: 2
Section Ref: 2.1

69) The part of the electromagnetic spectrum with the shortest wavelengths is called _____.
Answer: gamma rays or gamma
Diff: 2
Section Ref: 2.2

70) _____ is the color of the lowest frequency visible light.
Answer: Red
Diff: 1
Section Ref: 2.2

71) The Earth's atmosphere is transparent to _____, as well as some radio and near-infrared wavelengths.
Answer: visible light
Diff: 2
Section Ref: 2.2

72) The Sun's blackbody curve peaks in the _____ portion of the spectrum.
Answer: visible
Diff: 1
Section Ref: 2.3

73) Stars that appear blue or white in color are _____ than our yellow Sun.
Answer: hotter
Diff: 1
Section Ref: 2.3

74) Knowing the peak emission wavelength of a blackbody allows you to determine its _____.
Answer: temperature
Diff: 2
Section Ref: 2.3

75) _____ is the scientific study of the distribution of electromagnetic waves by energy and how these patterns are created in atoms and molecules.
Answer: Spectroscopy
Diff: 1
Section Ref: 2.4

76) The emission line for a given atom shows spectral features at the _____ location as in its absorption spectrum.
Answer: same
Diff: 1
Section Ref: 2.4

77) The colors of a neon light arise because it is a(n) _____ spectrum.
Answer: emission (or bright line)
Diff: 2
Section Ref: 2.4

78) The longer the wavelength of the photon, the _____ the energy it carries.
Answer: lower
Diff: 1
Section Ref: 2.5

79) Because the changes in energy levels happen in discrete steps, we refer to these as _____ leaps.
Answer: quantum
Diff: 1
Section Ref: 2.5

80) The spectra of molecules are more complex because molecules can vibrate and _____ instead of just exhibiting electronic transitions like atoms.
Answer: rotate
Diff: 2
Section Ref: 2.5

81) The light-gathering power of a telescope varies with the _____ of the diameter of the lens or mirror.
Answer: square
Diff: 1
Section Ref: 2.6

82) The ability of a telescope to separate two closely spaced stars is called _____.
Answer: resolution
Diff: 2
Section Ref: 2.6

83) Radio astronomy uses _____ to achieve better resolution than optical telescopes.
Answer: interferometry
Diff: 1
Section Ref: 2.7

84) Radio telescopes image a universe much _____ in temperature than with visible light.
Answer: colder
Diff: 2
Section Ref: 2.7

85) It takes _____ astronauts to operate the Hubble Space Telescope.
Answer: zero
Diff: 1
Section Ref: 2.8

86) No one can hear you scream (or fire a weapon) in space, regardless of the Hollywood special effects. Explain why.
Answer: Sound waves must travel though a material medium, and cannot pass through a vacuum. The blast might be seen, but the boom will not be heard.
Diff: 1
Section Ref: 2.1

87) How do sound and light waves differ?
Answer: Sound waves travel much slower, and need a physical medium, such as air, to be transmitted. Light travels best in the vacuum of space.
Diff: 2
Section Ref: 2.1

88) Describe the relationship between frequency and wavelength.
Answer: The higher the frequency, the shorter the wavelength.
Diff: 2
Section Ref: 2.1

89) What two regions of the electromagnetic spectrum are best utilized by ground-based astronomers, and why?
Answer: The atmosphere is opaque to most radiation except visible and radio waves.
Diff: 2
Section Ref: 2.2

90) What do infrared and ultraviolet waves have in common? How do they differ?
Answer: Both are forms of electromagnetic radiation, both travel at c in a vacuum, and both are largely absorbed by our atmosphere. They differ greatly in frequency, wavelength, and photon energy, however, with UV much more penetrating than IR, as anyone who has experienced a sunburn is aware.
Diff: 2
Section Ref: 2.2

91) What information about a star can be inferred from its Doppler shift?
Answer: The Doppler shift gives the star's velocity along our line-of-sight, either towards or away from us.
Diff: 2
Section Ref: 2.3

92) State the relationship between photon energy, frequency, and wavelength.
Answer: The higher the frequency, the greater the energy the photon carries, but the shorter its wavelength.
Diff: 2
Section Ref: 2.5

93) Explain how Bohr's model creates emission and absorption lines in the spectrum.
Answer: Bohr's model has the electron orbitals quantized into discrete energies. Each upward transition to a higher energy state produces an absorption line (energy is absorbed). Each downward transition produces an emission line (energy is given off). The energy absorbed or emitted is exactly equal to the difference in energy levels.
Diff: 3
Section Ref: 2.5

94) Why doesn't the Hubble Space Telescope need adaptive optics?
Answer: Adaptive optics correct poor seeing in our atmosphere, but above the atmosphere, Hubble always has perfect seeing and sharp images all the time.
Diff: 3
Section Ref: 2.6

95) Why do stars appear to twinkle?
Answer: In space, the light of the stars appears steady and images are sharp. But in passing through our atmosphere, the narrow shafts of star light are shifted constantly by turbulence, hence the images dance around in the eyepiece for us on the ground.
Diff: 1
Section Ref: 2.6

96) Why is the angular resolution of radio telescopes much worse than that of smaller optical telescopes?
Answer: Radio waves are much longer in wavelength than light waves, so they carry little energy, and a lot of them are needed for sharp images.
Diff: 2
Section Ref: 2.7

97) Why do gamma ray telescopes have poor angular resolution?
Answer: Because scientists have not yet developed a way to focus these.
Diff: 2
Section Ref: 2.8

98) Why is UV astronomy difficult to do from the ground?
Answer: The atmosphere blocks most of the UV waves before they reach the ground. In order to see a wide range of UV wavelengths, you have to get very high in the atmosphere, such as with a balloon observatory, or above the atmosphere.
Diff: 2
Section Ref: 2.8

99) What is meant by the wavelength of light? By its frequency? Explain how they are related to each other.
Answer: The wavelength is the distance between successive wave crests, while the frequency is the number of waves that pass the observer per second. All forms of EM radiation travel in a vacuum at 300,000 km/sec., and this velocity is the product of the wavelength X the frequency of the radiation.
Diff: 2
Section Ref: 2.1

100) What is white light? Why do we perceive different colors with a prism?
Answer: White light is composed of all the colors blended together uniformly. The colors are all present, as is shown when a prism spreads them back apart; each color corresponds to a different wavelength of EM radiation.
Diff: 3
Section Ref: 2.2

101) How can a star's blackbody spectrum be used to determine the temperature of a star?
Answer: Careful analysis of the blackbody curve of the star's entire radiation spectrum will reveal a peak that is unique to a given photospheric temperature. Basically, the bluer the star's radiation, the hotter its surface will be.
Diff: 1
Section Ref: 2.3

102) Why would a hotter star appear blue-white while a cooler star appear red or not be visible at all?
Answer: The hotter the star the shorter the wavelength it peaks at. A star that emits light across the entire visible spectrum would appear white. One that peaked beyond the visible would appear blue-white. A cooler star may peak in the red part of the spectrum, or even in the infrared.
Diff: 2
Section Ref: 2.3

103) Give an example of the Doppler Effect being used in a baseball game.
Answer: The Doppler "gun" can focus on the motion of the baseball, and give us the speed that the pitcher is delivering it to the plate.
Diff: 1
Section Ref: 2.3

104) Give and explain an example of the use of the Doppler Effect on the highway.
Answer: The radar gun of a highway patrolman sends out a pulsed beam to be reflected back, thus giving the speed of your car and perhaps netting you a ticket.
Diff: 2
Section Ref: 2.3

105) Why is spectroscopy important to astronomers?
Answer: Virtually all the information we receive about the universe comes in the form of electromagnetic waves, such as light waves. Analyzing the light with spectroscopy can give us the temperature, composition, and motion of the source, so this is the basis of modern astrophysics.
Diff: 1
Section Ref: 2.4

106) Define absorption and emission lines.
Answer: Absorption: When light from a continuous source, such as the dense photosphere of a star, is passed though a thin, cool gas, certain energies from the continuum are absorbed, depending on which elements are present, creating a pattern of dark lines which identify the elements and molecules present in the cool gas cloud. Emission: A hot, thin gas cools off by emitting photons, but only at discrete wavelengths determined by the electron transitions downward of the component atoms. These appear as a pattern of bright emission lines.
Diff: 3
Section Ref: 2.4

107) How are we able to determine the chemical composition and temperature of any visible object?
Answer: When an electron moves from one energy level to another (makes a transition) in an atom of a given element, it produces a photon of light at a wavelength that is unique to that transition for that element. If this spectral line with this wavelength is observed then, we know that it must have been produced by that element. Which transitions occur are determined largely by the temperature of the gas; for instance, hydrogen shows up best at 10,000 K, while helium lines require even higher temperatures.
Diff: 3
Section Ref: 2.5

108) Compare how doubling the diameter of a mirror will affect both resolution and light gathering power.
Answer: The resolution would now be twice as sharp, but the increase in surface area, with the squaring for the area, would now detect stars four times fainter than before.
Diff: 2
Section Ref: 2.6

109) Why must radio dishes be built so large?
Answer: Radio waves carry little energy, so a lot of them must be collected to give resolution and image quality comparable to light telescopes.
Diff: 2
Section Ref: 2.7

110) What are some advantages of radio telescopes over optical scopes?
Answer: Radio telescopes can be used day or night, they are much less affected by cloudy skies, and they open a new window to observe the Universe. They allow us to observe astronomical objects at a different wavelength than an optical telescope, thus giving an opportunity to compare and contrast the images.
Diff: 2
Section Ref: 2.7

111) How do radio interferometers greatly enhance resolution in radio wavelengths?
Answer: Hooking two or more radio dishes together with a computer lets us get resolution not equal to the diameters of the dishes, but to the separations between the scopes.
Diff: 2
Section Ref: 2.7