ASTRONOMY SPRING SEMESTER EXAM REVIEW MATERIAL
**Spring Semester Review: Astronomy**

3. From the center outward, the correct order of the zones of the Earth is
   A. Solid core, mantle, liquid core, crust, atmosphere.
   B. Liquid core, solid core, crust, mantle, atmosphere.
   **C.** Solid core, liquid core, mantle, crust, atmosphere.
   D. Liquid core, solid core, mantle, crust, atmosphere.

7. The composition of the Earth's atmosphere today is about 78% ____ , 21% ____ , and much less than 1% ____.
   A. Oxygen, nitrogen; carbon dioxide and other gases
   B. Nitrogen, carbon dioxide; oxygen and other gases
   C. Oxygen, carbon dioxide; nitrogen and other gases
   **D.** Nitrogen, oxygen; carbon dioxide and other gases

11. The most abundant element in the Earth's core is _________.
    A. Nitrogen
    B. Oxygen
    C. Hydrogen
    **D.** Iron

15. The hotter inner core of the Earth is _____ and the relatively cooler outer core is _____.
    A. Solid; also solid
    B. Liquid; also liquid
    C. Liquid; solid
    **D.** Solid; liquid

19. The process in which two tectonic plates meet and one slips beneath another is called _____.
    A. Convection
    B. Pangea
    **C.** Subduction
    D. Rifting
20. Van Allen belts exist in the Earth's _________.
   A. Troposphere
   B. Core
   C. Mantle
   D. Magnetosphere

22. The ___-type seismic waves can travel through liquids and solids. The ___-type seismic waves can travel through solids only.
   A. S; P
   B. S; S
   C. P; S
   D. P; P

27. The _____ are two doughnut-shaped rings of charged particles trapped by the Earth's magnetic field.
   A. Aurora Borealis and the Aurora Australis
   B. Van Allen radiation belts
   C. Jet streams
   D. Convection cells

3. Basalt, a dense congealed lava rock rich in iron, is the primary material in the Moon's
   A. Highlands.
   B. Crust.
   C. Maria.
   D. Far side's regolith

6. The primary reason the Moon lacks an atmosphere is because.
   A. The Moon is made up of the wrong kinds of rocks to release atmospheric gases.
   B. The Earth's gravity pulls away any atmosphere the Moon collects.
   C. The Moon lacks sufficient gravity to retain an atmosphere.
   D. There is no life on the Moon.
11. How many times does the Moon rotate on its axis in one orbital period?
   A. Only once.
   B. Twice.
   C. Several times.
   D. The Moon does not rotate.

12. Why do we always see only one side of the Moon?
   A. The Moon does not rotate.
   B. The Moon is tidally locked with the Earth.
   C. The far (opposite) side only faces the Earth during the daytime when the Sun's light outshines the Moon.
   D. From time to time we see all the sides of the Moon from the Earth.

13. From the observation that the same side of the Moon always faces the Earth, one can conclude that
   A. The Moon does not rotate.
   B. The Moon completes one rotation every day.
   C. The Moon completes one rotation each time it completes an orbit about the Earth.

1. Based on our understanding of our own solar system, which of the following would be most surprising to observe in an extra-solar system of planets?
   A. The planets nearest to the star have a lower density than the planets farther out.
   B. Several planets show large tilts of their rotation axis compared to the plane of their orbits.
   C. All the gas giants have moons.
   D. Several planets have dense atmospheres containing carbon compounds.

5. Given that Mercury, Mars, and some of the moons of the gas giants are covered with craters, why do we not see lots of impacts happening today?
   A. All the planetesimals have collided with planets already.
   B. We would, but the impacts have always happened at a very slow rate and built up over billions of years.
   C. Most of the impacts happen on the far sides of these bodies.
   D. The Sun's heat drove the remaining dust and gas out of the part of the solar system with planets, and gravitational interactions ejected most of the larger debris.
8. Counting out from the Sun, which planet occupies the position after Jupiter?  
A. Neptune  
B. Mars  
C. Venus  
D. Earth  
E. Saturn

9. When we see them in the night sky, which of the following objects are emitting their own light?  
A. Mars  
B. Venus  
C. The Moon  
D. The Sun  
E. All of the above

12. Which planets have densities similar to that of the Earth's?  
A. Mars and Mercury.  
B. Jupiter and Saturn.  
C. Uranus and Neptune.

13. In our Solar System, an object is called a planet if  
A. It orbits the Sun.  
B. It has the round shape.  
C. It has cleared its neighborhood.  
D. All of the above.

14. Pluto is classified as a dwarf planet because  
A. It doesn't orbit the Sun.  
B. It doesn't have the spherical shape.  
C. It has not cleared its neighborhood.  
D. All of the above.

15. A spherical region that surrounds the Solar System and extends up to about 100,000 AU from the Sun is called the  
A. Asteroid belt.  
B. Kuiper belt.  
C. Oort cloud.  
D. Solar nebula
16. What is the name of the nebula from which our Solar System was formed?
A. Pseudo nebula
B. Solar nebula
C. Orion nebula
D. Crab nebula

18. The process in which a gas cools and its molecules stick together to form liquid particles is called
A. Condensation.
B. Depression.
C. Evaporation.
D. Sublimation.

20. Exoplanets are
A. Another name for dwarf planets.
B. The outer most planets in our Solar System.
C. Minor planets in the asteroid belt.
D. Planets around stars other than the Sun.

21. Why is it difficult to observe an exoplanet directly through a telescope?
A. Exoplanets produce very little of their own light.
B. Exoplanets are small compared to their parent star, so they reflect only a small portion of the star's light.
C. Exoplanets tend to be far away from their parent stars, making it hard to get both the star and the exoplanet in the telescope's field of view.
D. It is hard to see exoplanets against the blackness of space.

22. What is gravitational lensing?
A. The use of small telescopes to enhance the brightness of stars.
B. The focusing and brightening of starlight by the gravitational field of the foreground star, when there is a perfect alignment with the observer.
C. The temporary disappearance of a star as an object passes in front of it.
D. The use of Earth's gravity to shape lenses during grinding.
24. According to the nebular hypothesis, which of the following sequences of events are chronologically correct?
A. Solar nebula, interstellar cloud, collisions between planetesimals, accretion, planets.
B. Interstellar cloud, solar nebula, accretion, collisions between planetesimals, planets.
C. Interstellar cloud, accretion, solar nebula, collisions between planetesimals, planets.
D. Accretion, solar nebula, interstellar cloud, collisions between planets, planetesimals.

28. Comets are ____ while asteroids are ____.
A. Icy; rocky
B. Large; small
C. Rocky; icy

31. Which of the following Solar System objects has a composition that most resembles the original solar nebula?
A. The terrestrial planets.
B. The jovian planets.
C. The dwarf planets.
D. The asteroids.
E. Comets.

33. Astronomers believe that the satellites of the Jovian planets were ____.
A. Formed by fission.
B. Formed by collisions with other objects.
C. Planetesimals orbiting the growing planet.
D. Formed elsewhere in the Solar System and were later captured by Jupiter's gravitational pull.

2. The red coloration seen on the Martian surface originates from
A. Past volcanic activity covering the surface of the planet with red lava.
B. When Mars' had flowing water, it also has red algae, which stained the surface rocks.
C. The atmosphere blocking out blue light, only allowing red light to reflect off of the surface.
D. The iron minerals in the surface rocks combining with oxygen in the atmosphere causing the surface to rust.
3. Which planet is about half the size of the Earth?
   A. Mercury
   B. Venus
   C. Earth
   D. Mars

5. List the terrestrial planets in increasing order of their size.
   A. Mercury, Venus, Earth, Mars
   B. Mercury, Mars, Venus, Earth
   C. Earth, Mars, Venus, Mercury
   D. Venus, Earth, Mars, Mercury

6. On which planet does plate tectonics take place?
   A. Mercury
   B. Venus
   C. Earth
   D. Mars

7. Which planet has the hottest surface temperature?
   A. Mercury
   B. Venus
   C. Earth
   D. Mars

8. The Coloris Basin found on Mercury was probably formed by what process?
   A. Plate tectonics.
   B. An impact from a planetesimal.
   C. Volcanic activity.
   D. Erosion from solar wind.

10. Which planet has a greenhouse effect?
    A. Mercury
    B. Venus
    C. Earth
    D. Mars
    E. Both B and C
11. List the terrestrial planets in decreasing order of their mass.
A. Mercury, Venus, Earth, Mars
B. Mercury, Mars, Venus, Earth
C. Earth, Venus, Mars, Mercury
D. Venus, Earth, Mars, Mercury

12. Mercury lacks an atmosphere because
A. Its close proximity to the Sun allows the Sun to gravitational pull gases directly off the surface of Mercury.
B. Impacts from planetesimals caused its original atmosphere to evaporated away.
C. Its slow rotation allows atmospheric gases to escape the planet.
D. Its smaller size means it has gravitational attraction that is too weak to hold onto an atmosphere.

13. Which terrestrial planet has the most moons?
A. Mercury
B. Venus
C. Earth
D. Mars

14. Besides the Earth, which terrestrial planet also has seasons?
A. Mercury
B. Venus
C. Mars
D. Seasons are unique to the Earth

15. Which planet shows the largest variation of day and night temperatures?
A. Mercury
B. Venus
C. Earth
D. Mars

16. Which terrestrial planet is tilted upside down?
A. Mercury
B. Venus
C. Earth
D. Mars
17. Which of the terrestrial planets have the most similar atmospheric compositions?
   A. Venus and Mars
   B. Earth and Venus
   C. Earth and Mercury
   D. Mercury and Venus
   E. Earth and Mars

23. The atmosphere of Venus consists mainly of _____.
   A. Carbon dioxide
   B. Sulfuric acid
   C. Nitrogen and oxygen
   D. Carbon monoxide
   E. Hydrogen and helium

24. The clouds of Venus consist mainly of _____.
   A. Carbon dioxide
   B. Water vapor
   C. Hydrogen and helium
   D. Sulfuric acid
   E. Carbon monoxide

25. The surface of Venus is dominated by _____.
   A. Impact craters
   B. Recent lava flows
   C. Scarps
   D. Large canyons

26. The Valles Marineris is _____ on the surface of Mars.
   A. An old riverbed
   B. A 4000 km canyon
   C. A long scarp
   D. A large volcano
31. Of all the terrestrial planets, _____ has the largest daily temperature variation.
   A. Mercury
   B. Venus
   C. Earth
   D. Mars

33. Which reason best explains why both Venus' and Mars' atmospheres are primarily carbon dioxide, but the Earth's is much less than 1% carbon dioxide?
   A. Earth’s rocks had much less carbon and oxygen in them.
   B. Venus and Mars, being smaller than Earth, can't retain the same mixture of gases as Earth.
   C. Each planet has a significantly different surface temperature.
   D. Plant life has existed on Earth for an extended amount of time.

35. Evidence that there is a considerable amount of water frozen under the surface of Mars is provided by all of the following except
   A. Squishy-looking flow patterns around crater impact sites.
   B. Features resembling channels cut by flowing water.
   C. Periodic eruptions of geysers when subsurface ice is melted by volcanic activity.
   D. Discovery by the Mars rovers of chemicals in surface rocks formed in the presence of large amounts of water.
   E. Satellite measurements of water in the polar caps.

38. Maps of Venus have been made by
   A. Landing spacecraft on the surface to take pictures.
   B. Bouncing radio waves off the planet from satellites and the Earth.
   C. Optical telescopic observations from Earth when the clouds part.
   D. Measuring seismic waves from earthquakes.

1. Which of the following lists the outer planets in order of increasing mass?
   A. Jupiter, Saturn, Neptune, Uranus
   B. Jupiter, Saturn, Uranus, Neptune
   C. Saturn, Jupiter, Uranus, Neptune
   D. Uranus, Neptune, Saturn, Jupiter
4. What type of dunes exists on Titan?
A. Sand dunes.
B. Dust dunes.
C. Ice crystal dunes.
D. We have not discovered any dunes on Titan.

6. Which of the outer planets has rings?
A. Jupiter.
B. Saturn.
C. Uranus.
D. Neptune.
E. All of the outer planets have a ring system.

7. Which is the smallest of the outer planets?
A. Saturn
B. Jupiter
C. Uranus
D. Neptune

8. What observational evidence suggests that Uranus was struck by a large planetesimal early in its formation?
A. Astronomers have identified a large impact crater on the surface of Uranus.
B. Uranus orbits the Sun in the opposite direction as the other planets.
C. Uranus' rotational axis is tipped over.
D. Uranus' moon Miranda shows a patchwork surface, suggesting a collision in its past.

10. Which planet's rotation axis is closest to its orbital plane?
A. Saturn
B. Jupiter
C. Uranus
D. Earth
E. Venus
13. Which planet has the largest satellite in the Solar System?
   A. Saturn
   **B. Jupiter**
   C. Uranus
   D. Mars
   E. Mercury

14. Which satellite has lakes of liquid methane near its poles?
   A. Ganymede
   B. Io
   C. Miranda
   D. Triton
   **E. Titan**

15. Although Saturn and Jupiter have similar compositions their outer appearances are different because
   A. Saturn's magnetic field is weaker than Jupiter's magnetic field.
   B. Saturn's smaller size means it has a weaker gravitational field and thus less dramatic atmospheric effects.
   C. Saturn has more water molecules throughout its atmosphere giving it a uniform appearance.
   **D. Saturn's cooler temperatures allow for the formation of a hazy layer of ammonia clouds that surrounds the planet.**

17. How does the mass of Jupiter compare to the rest of the planets in the Solar System?
   A. Jupiter's mass is greater than all the other planet masses combined.
   B. Jupiter and Saturn have comparable masses.
   C. Jupiter's mass is about equal to the sum of the terrestrial planet masses.
   D. Jupiter's mass is about equal to the sum of Uranus and Neptune's masses.

18. What is the largest satellite (moon) in the Solar System?
   A. Earth's moon
   B. Jupiter's moon, Ganymede
   C. Saturn's moon, Titan
   D. Neptune's moon, Triton
19. Scientists believe a liquid water ocean might exist on the moon
A. Titan.
B. Europa.
C. Mimas.
D. Ganymede.

20. What causes the blue appearance of the planet Uranus?
A. Uranus' atmosphere contains methane that strongly absorbs red colors from the sunlight.
B. The planet is covered by an ocean of water.
C. The planet is very cold.
D. The composition of Uranus' atmosphere is the same as the Earth's atmosphere that makes the sky blue.

24. The appearance of an aurora indicates that
A. The planet is being bombarded by small meteors.
B. There is a lot of lightning discharges in the planet's atmosphere.
C. The planet has a magnetic field.
D. There is intelligent life on the planet producing the aurora from below.

28. Why do astronomers believe that the Jovian planets are composed mainly of hydrogen and helium?
A. Because hydrogen and helium are the main constituents of the solar system.
B. Because the Jovian planets are very large.
C. Because the Jovian planets have low densities.
D. The Voyager missions measured the chemical compositions of the interiors of the Jovian planets.

30. Which of the following statements comparing Uranus and Neptune is correct?
A. Uranus has larger diameter and Neptune has more mass.
B. Uranus has larger diameter and more mass.
C. Neptune has larger diameter and smaller mass.
D. Neptune has larger diameter and more mass.
33. The energy that stirs the circulation in Jupiter's atmosphere comes from _____.
   A. The Sun  
   B. The planet's interior  
   C. The tidal force of the Galilean moons  
   D. The planet's magnetic field

34. The powerful _____ Jupiter is a result of the _____ and _____ in the interior of the planet.
   A. Magnetic field of; Coriolis effect; heat generated  
   B. Wind on; rotation; excess hydrogen  
   C. Magnetic field; rapid rotation; heat generated  
   D. Wind on; Coriolis effect; heat generated

35. ______ is the largest of the Galilean moons.
   A. Callisto  
   B. Europa  
   C. Ganymede  
   D. Io

37. The rings of Jupiter consist primarily of _____.
   A. Small particles  
   B. Boulder-size rocks  
   C. Solid rings  
   D. Hydrogen and helium

38. The Great Red Spot on Jupiter is _____.
   A. A large rising cloud of gas  
   B. A giant vortex that has persisted for over 300 years  
   C. A planetesimal impact site  
   D. A largo tornado sweeping the planet from north to south

40. The rings of Saturn consist primarily of _____.
   A. Hydrogen and helium  
   B. Silicate rocks  
   C. Water ice
41. The Roche limit refers to a _____.  
   A. Distance  
   B. Force  
   C. Speed  

43. Astronomers believe that the interior of Saturn's satellites is mostly ___.  
   A. Ice  
   B. Rock  
   C. Hydrogen and helium  

44. Spectral analysis of Titan's atmosphere indicates that it consists mainly of _____.  
   A. Carbon dioxide  
   B. Nitrogen  
   C. Hydrogen and helium  
   D. Oxygen  

5. Asteroids need to have enough material to have an average diameter of about ________ for gravity to pull them into a spherical shape.  
   A. 100 km  
   B. 1000 km  
   C. 5000 km  
   D. 10000 km  

6. Infrared observations are used to determine the mass of asteroids because  
   A. Asteroids reflect too little visible light to use optical telescopes for the measurements.  
   B. The infrared radiation is the glow of heat from the asteroid, and larger asteroids emit more infrared light.  
   C. The Hubble Space Telescope only has infrared cameras.  
   D. Most asteroids are made of dark minerals which are more efficient at reflecting infrared light than visible light.  

8. Asteroids  
   A. Are small bodies, typically the size of a grain of sand or a boulder.  
   B. Can range in size from a few meters to many hundreds of kilometers.  
   C. Are larger objects, a few hundred kilometers in size, but not quite large enough to be classified as a planet.
10. The tails streaming from a comet's coma are caused by
A. The comet leaving the material behind it as it travels forward.
B. Explosive forces from the hot nucleus ejecting the gas.
C. Radiation pressure and the particle wind from the Sun pushing them out.
D. The comet's magnetic field channeling and ejecting the particles of the tail.

11. Which of the following asteroids is now officially a dwarf planet?
A. Ceres
B. Itokawa
C. Ida
D. Eros
E. Methilde

13. Fragments that do not completely burn in the atmosphere and eventually fall on the Earth are called
A. Meteoroids
B. Meteorites
C. Meteors
D. Asteroids

14. A meteor shower occurs when the left over debris of a ______ intersects with our atmosphere to produce the beautiful streaks of light.
A. Star
B. Asteroid belt
C. Comet
D. Planet

15. Comets belong to the
A. Asteroid belt.
B. Kuiper belt.
C. Oort cloud.
D. Both A and B.
E. Both B and C.

17. Planet ________ creates the gaps in the asteroid belt called Kirkwood gaps.
A. Jupiter
B. Mars
C. Earth
D. Saturn
20. The short-period comets originate in _______ and the long-period comets originate in _______.
A. Kuiper belt; Oort cloud
B. Oort cloud; Kuiper belt
C. Kuiper belt; asteroid belt
D. Asteroid belt; Kuiper belt

22. Meteor showers are generally named
A. After the Greek Gods and Goddesses.
B. After the constellation from which they appear to diverge.
C. After the comet to which they belong.
D. After the planet from which they seem to come to the Earth.

23. What proves the existence of the Kuiper belt?
A. The existence of short period comets.
B. The fact that many comets orbit on the ecliptic.
C. The fact that comets are icy objects.
D. Objects of the Kuiper belt were detected by the Hubble Space Telescope.

28. Chondritic meteorites provide important clues because they are believed to
A. Contain grains from the first material that condensed out of the solar nebula.
B. Contain many rare metals.
C. be the only source of the necessary amino acids required for life.
D. be the source of all coal found on the Earth.

31. The tail of a comet always points _____.
A. Forward
B. Backward
C. Away from the Sun
D. Toward the Sun

35. Which Trans-Neptunian Object is largest in diameter?
A. Pluto
B. Sedna
C. Makemake
D. Eris
E. Orcus
1. Approximately how massive is the Sun as compared to the Earth?
   A. 100 times
   B. 300 times
   C. 3000 times
   D. 300,000 times
   E. One million times

4. If you could manage to stand on the Sun, you would weigh approximately ___ times more than your weight on the Earth.
   A. 10
   B. 30
   C. 100
   D. 300,000

6. The hottest part of the Sun is
   A. The core.
   B. The radiative zone.
   C. The photosphere.
   D. The Corona.

8. The Sun's core is generating energy in the form of ______.
   A. Gamma rays
   B. Ultraviolet
   C. X-rays
   D. Visible
   E. Radio

9. Sunspots are dark because they are
   A. Land masses like continents on the Earth.
   B. Holes in the photosphere, allowing astronomers to view into the Sun's interior.
   C. Shadows from clouds in the Sun's atmosphere.
   D. The solar wind is created in the Sun's _____.
   A. Core
   B. Radiation zone
   C. Convection zone
   D. Corona
14. What is the name of a sudden, highly energetic, eruptive explosion on the surface of the Sun?
A. Sunspot
B. Granulation
C. Flare
D. Coronal hole

16. The surface temperature of the Sun can be measured using ____.
A. Kepler's third law
B. The Doppler shift
C. Wien's law

19. The energy in the Sun's core is produced by
A. Chemical reaction of hydrogen and helium.
B. Fusion of hydrogen to helium.
C. Radioactive decay.
D. Release of gravitational potential energy.

21. The Sun's atmosphere consists of the ____ and the ____.
A. Photosphere; chromosphere
B. Photosphere; corona
C. Chromosphere; corona

24. ____ provides a way to measure the speed of seismic waves in the Sun.
A. Newton's 3rd law
B. Wien's law
C. The Doppler effect
D. Kepler's 3rd law

25. The Sun rotates ____ at its equator than at its poles.
A. Slower
B. The same
C. Faster
27. A solar prominence is essentially
A. A cloud of hot gas lifting off the surface of the Sun.
B. An eruption of gas heated by the sudden recombination of opposite polarity parts of the Sun's magnetic field.
C. A plasma confined to a magnetic tube sticking out of the surface of the Sun.
D. An aurora occurring in the Sun's atmosphere instead of the Earth's.

31. Generally speaking, activity on the surface of the Sun is primarily driven by
A. Gravity.
B. Thermodynamics.
C. Electromagnetism.
D. Nuclear reactions.

33. From the center out, the correct order of the parts of the Sun is
A. Core, convection zone, radiative zone, photosphere, chromosphere, corona.
B. Radiative zone, core, chromosphere, convection zone, photosphere, corona.
C. Core, convection zone, photosphere, chromosphere, corona, radiative zone.
D. Core, radiative zone, convection zone, photosphere, chromosphere, corona.

36. In the Sun, nuclear fusion occurs
A. In the core and the radiative zone.
B. Only in the core.
C. Throughout the entire star.

1. What is parallax?
A. The distance to an object, measured in parsecs.
B. The difference between the apparent and absolute magnitude.
C. The apparent shift in position of an object caused by a change in the observer’s position.
D. The shift in angular position of an object as the object actually moves in space.

2. Parallax measurements of the distances to the nearest stars use ____ as a baseline.
A. Earth's orbit
B. Earth's diameter
C. Earth-Moon distance
D. About the length of a football field
3. The relative brightness of the stars as we see them in our sky is represented by their
   A. Absolute magnitudes.
   B. Apparent magnitude.
   C. Surface temperature.
   D. Luminosity.

5. Luminosity (absolute brightness) of a star depends on its __________.
   A. Temperature
   B. Radius
   C. Distance from us
   D. Both A and B
   E. Both A and C

18. 80% of ______ type stars have orbiting companions.
   A. O and B
   B. A and F
   C. F and G
   D. K and M

20. The H-R diagram is a diagram plotting the stars according to their
    A. Apparent brightness and temperature.
    B. Spectral type and temperature.
    C. Brightness and luminosity class.
    D. Luminosity and temperature.
    E. Mass and diameter.

23. The star Aldebaran is cooler and much more luminous than the Sun. Where do you expect to find Aldebaran in the H-R diagram?
    A. Top left
    B. Top right
    C. Center
    D. Bottom right
    E. Bottom left
24. Which of the following statements would explain the fact that larger molecules, such as amino acids, do not produce spectral lines in the OBAFGKM classification?
A. Larger molecules require higher temperatures to show absorption lines.
B. The spectra of hydrogen and helium are sufficient to classify stars.
C. The spectra of larger molecules are too complicated.
D. Larger molecules break apart at the high temperatures of stellar atmospheres.
E. All of the above.

27. Binary star systems are very important because they allow
A. Measurement of star masses.
B. Measurement of the speed of stars.
C. More precise measurement of the distance of stars.
D. More precise measurement of the temperature of stars.
E. More precise measurement of the spectral type of stars.

28. What is the difference between spectroscopic and visual binaries?
A. Spectroscopic binaries have double spectral lines but do not move.
B. Visual binaries are pairs of stars in the same region in the sky but are not gravitationally interacting.
C. A visual binary does not show changes in the spectral lines.
D. In a visual binary we can see two distinct stars; in spectroscopic binaries, the images of the two stars can not be resolved.

31. Stars on the main sequence have different luminosities because
A. They have different chemical compositions.
B. They have different ages.
C. They are at different distances from the Sun.
D. They have different masses.
E. They have different apparent magnitudes.

36. _____ can be used to measure the _____ of nearby stars.
A. Parallax measurements; radius
B. The method of standard candles; brightness
C. Interferometry; radius
37. The parallax of a star is ____ usually measured in ____.
A. A distance; arcseconds  
**B. An angle; arcseconds**  
C. An angle; parsecs  
D. A distance; AU

42. The luminosity of a star is determined by the star's ___ and ___.
A. Brightness; temperature  
**B. Apparent brightness; surface temperature**  
C. Diameter; surface temperature  
D. Distance; surface temperature  
E. Diameter; distance

45. Analysis of stellar spectra shows that most stars consist of 71% ___, 27% ___ and a 2% mix of the other elements.
A. Hydrogen; oxygen  
**B. Hydrogen; helium**  
C. Helium; hydrogen  
D. Oxygen; nitrogen

46. The Balmer lines correspond to wavelengths in the ____ part of the spectrum of a ____ atom.
A. Ultraviolet; helium  
**B. Visible; hydrogen**  
C. Infrared; hydrogen  
D. X-ray; helium

47. Star A star is located at the top left of the H-R diagram and has the same luminosity as Star B which is located at the top right of the H-R diagram. How must these stars differ?
A. Star A is hotter and bigger than Star B.  
B. Star A is cooler and bigger than Star B.  
**C. Star A is hotter and smaller than Star B.**  
D. Star A is cooler and smaller than Star B.
58. How does Rigel, a bluish star, surface temperature compare to Betelgeuse, a reddish star.
   A. Rigel’s surface temperature is less than Betelgeuse’s.
   B. Rigel’s surface temperature is greater than Betelgeuse’s.
   C. They have the same surface temperature because they are both members of the constellation Orion.
   D. It is impossible to say without knowledge of the sizes of the stars.

2. The most important property that determines the evolution of a star is its
   A. Temperature.
   B. Composition.
   C. Mass.
   D. Location.

4. The lifetime of a star is dependent on its _____.
   A. Mass
   B. Volume
   C. Luminosity
   D. Temperature

5. What stars form the slowest?
   A. O and B
   B. A and F
   C. G and A
   D. K and M

9. The Sun will leave the main sequence in about _____ years from now.
   A. 5 million
   B. 100 billion
   C. 100 million
   D. 5 billion

11. In which stage of a star’s evolutionary cycle does it spend the most time?
    A. The pre-main sequence.
    B. The main sequence.
    C. The post-main sequence.
13. When the outer envelope of a red giant is ejected, the remaining exposed core of a low mass star is called a
A. Black hole.
B. Neutron star.
C. White dwarf.
D. Red super giant.

20. Which of the following statements about the evolution of high-mass stars is not correct?
A. High-mass stars evolve much faster than low-mass stars.
B. High-mass stars can fuse elements heavier than helium in their core.
C. High-mass stars stop fusing elements once they reach a carbon filled core.
D. High-mass stars do not have a helium flash.
E. The life of a high-mass stars ends with a supernova explosion.

22. Where do most of the elements heavier than iron form?
A. In the interior of stars.
B. In the interior of high-mass stars.
C. In supernova explosions.
D. In the interstellar clouds.

24. Which of the following statements regarding the H-R diagrams of star clusters is not correct?
A. A very young cluster will have stars that lie in the right hand side and a little above the main-sequence.
B. A very old cluster will show a turn-off point and will have many red and yellow giant stars.
C. A very young cluster will not show a turn-off point.
D. A very old cluster will have many stars in the upper left corner of the H-R diagram.
E. A very young cluster will not have all its stars on the main sequence.

27. ____ is the most significant force that determines the evolution of stars.
A. Temperature
B. Luminosity
C. Energy
D. Gravity
28. The main source of energy in main-sequence stars is ____.
   A. Fusion of hydrogen to helium
   B. Gravity
   C. The triple alpha process
   D. Chemical reaction between hydrogen and helium

29. A protostar becomes a main-sequence star when it ____.
   A. Starts fusing helium
   B. Starts fusing hydrogen to helium
   C. Starts fusing heavier elements
   D. starts glowing with infrared light

35. Hydrostatic equilibrium is the balance between ____ of a star and ____.
   A. The internal pressure; energy production
   B. Hydrogen fusion; temperature
   C. The size of the star; energy production
   D. The internal pressure; gravity

44. Supernova remnants
   A. Initially expand at thousands of km/s.
   B. May contain up to 10 solar masses of material ejected from the star.
   C. Are important for mixing material into the interstellar medium.
   D. Both A and C.
   E. A, B and C.

1. _________ are hot, compact stars whose mass is comparable to the Sun's and size to the Earth's.
   A. White dwarfs
   B. Neutron stars
   C. Pulsars
   D. Black holes

6. _________ are hot, compact remnant stars whose mass is typically between one and several times that of the Sun, but their size is only 10 km or less.
   A. White dwarfs
   B. Neutron stars
   C. Pulsars
   D. Black dwarfs
10. Two important properties of young pulsars are
A. Rapid rotation and no magnetic field.
B. No rotation and strong magnetic field.
C. Extremely rapid rotation and a weak magnetic field.
D. Extremely rapid rotation and a strong magnetic field.
E. No rotation and no magnetic field.

11. A method for identifying a black hole is to
A. Observe them directly through the space-based telescopes.
B. Look for voids (holes) in the star fields.
C. Look for its effect on nearby companions.
D. Search for radio waves from the accretion disk.

12. The escape velocity inside a black hole is
A. Zero.
B. Infinity.
C. Unknown.
D. Half the speed of light.
E. Greater than the speed of light.

17. The mass of a black hole can be determined by
A. Measuring its volume and density
B. the electromagnetic radiation it emits
C. how rapidly it is spinning
D. Applying the modified version of Kepler's 3rd law, if the black hole is in a binary system

A. gravitational
B. Electromagnetic
C. seismic
D. nuclear
22. The first pulsars were observed using ______ telescopes.
A. Optical
B. X-ray
C. Infrared
D. Radio
E. Gamma ray

2. What is the approximate diameter of the Milky Way Galaxy in light years?
A. 10
B. 100
C. 1000
D. 100,000
E. 1000,000

4. Stars in globular clusters belong to Population _______.
A. I
B. II
C. III
D. Zero

9. Astronomers measured the location of the Sun in the Milky Way Galaxy by
A. By counting the number of stars.
B. By plotting the position of globular star clusters.
C. By plotting distribution of water molecules.
D. By plotting the position of O and B stars.

11. What is the characteristic color of a reflection nebula?
A. Blue
B. Red
C. Green
D. Yellow
E. Black

12. What is the characteristic color of an emission nebula?
A. Blue
B. Red
C. Green
D. Yellow
E. Lack
15. One of the reasons that Kapteyn underestimated the size of the Milky Way and Shapley overestimated it is that they did not recognize the ____.
A. Effects of the motion of the Sun from the center
B. Dimming effect of interstellar dust
C. Age of the globular clusters
D. Existence of dark matter

19. The gas and dust in the disk of the Milky Way amount to approximately ____ of the mass of the stars.
A. 15%
B. 30%
C. 50%

21. The average distance between stars in the neighborhood of the solar system is about ___.
A. 4 AU
B. 4 light years
C. 4 kiloparsecs
D. 4 arcseconds

22. The Milky Way galaxy contains about ____ stars. Most of these stars are probably ____.
A. 100 billion; red giants
B. 100 billion; O and B type stars
C. 10 billion; white dwarfs
D. 100 billion; cool dwarfs

27. Sir William Herschel counted the number of stars in different directions, and getting similar numbers in each direction along the disk, concluded the Sun was near the center of a disk-like collection of stars. Herschel came to the wrong conclusion about the Sun’s location because
A. He was predisposed to believe the Sun was in the center of the Milky Way, and ignored data which disagreed with that conclusion.
B. He did not know that interstellar dust made it hard for him to see a large part of the Milky Way’s disk.
C. He only counted globular clusters, and not regular stars.
D. The Sun’s position in the Milky Way at that particular time was very unusual and skewed his results.
28. The Milky Way is tilted on the sky because
A. It's appearance depends entirely on where you are on the Earth.
B. The solar system is tilted compared to the disk of the galaxy.
C. The Sun's gravity deflects incoming starlight.
D. The disk of the galaxy is warped.

30. One difference between Population I and Population II stars in the Milky Way is
A. That Pop I stars produce energy by fusion and Pop II by fission.
B. That Pop I stars have very few metals and Pop II stars are metal rich.
C. That Pop I stars have orbits in the disk and Pop II stars have orbits that pass through the disk.
D. That Pop I stars produce energy by fusion and Pop II stars through gravitational contraction.

31. In general, Population I stars are _______ than Population II stars.
A. Older
B. Younger
C. The same age.

32. In general, Population I stars are _______ and Population II stars are _______.
A. Massive; dwarfs
B. Dwarfs; massive
C. Blue; red
D. Red; blue

35. In a telescopic observation of a field of stars, you see an irregularly shaped dark patch. This is most likely
A. An area where there are no stars.
B. A black hole.
C. The dusty center of a globular cluster.
D. A dark nebula.
38. According to the density-wave theory, spiral arms are blue because they
A. Contain many reflection nebulae from sites of young star formation.
B. Contain only young stars, whose formation was triggered by the explosion of older red stars just in front of the spiral arm.
C. Contain a lot of young stars formed from clouds compressed by the density wave.
D. Have too much metal content to form red stars.

39. Astronomers believe that the massive object at the center of the Milky Way is a black hole because
A. Images show an accretion disk surrounding an empty spot.
B. Gravitational wave measurements indicate a black hole is there.
C. Observations at X-ray, infrared and radio limit the size of the object to smaller than 10 AU.
D. It is necessary to explain the galaxy's rotation curve.

40. Astronomers have found the black hole at the center of the Milky Way has a mass of about _______ solar masses.
A. 40
B. 4 hundred thousand
C. 4 million
D. 4 billion

41. The _____ theory offers a likely explanation for the formation of _____.
A. High rotation speed; spiral arms
B. Density wave; galactic bulge
C. Density wave; spiral arms
D. High rotation speed; dark matter