2 points each

Choose the answer that best completes the question. Read each problem carefully and read through all the answers. Take your time. If a question is unclear, ask for clarification during the exam.
Mark your answers on the scantron sheet and on your copy of the exam. Keep your copy of the exam and check your grade with the posted answers on the course website and the grade posted on D2L. You will have 1 week to ask for corrections.

1. The Exam Version listed at the top is:
   (a) Version A
   (b) Version B
   (c) Version C
   (d) Version D

2. Stars A and B appear equally bright, but star A is twice as far away from us as star B. Which of the following is true?
   (a) Star B is twice as luminous as star A.
   (b) Star B is four times as luminous as star B.
   (c) Star A is twice as luminous as star B.
   (d) Star A is four times as luminous as star B.

3. The centrifugal force experienced by a body in circular motion is a reaction to:
   (a) the force of gravity.
   (b) the body’s weight.
   (c) the force that causes the motion to be circular.
   (d) the contact forces between the molecules of the material.

4. Which sequence correctly lists the spectral classes of stars in order of decreasing temperature (from hottest to coolest)?
   (a) A B F G K M O
   (b) A F O B M G K
   (c) O A B G F M K
   (d) O B A F G K M
5. The majority of the Sun’s energy comes from:
   (a) gravitational contraction.
   (b) its rapid rotation.
   (c) helium burning.
   (d) hydrogen burning.

6. Stars are made mostly of:
   (a) helium.
   (b) hydrogen.
   (c) oxygen.
   (d) nitrogen.

7. The one property of a main-sequence star that determines all its other properties is its:
   (a) luminosity.
   (b) temperature.
   (c) mass.
   (d) spectral type.

8. Hydrostatic equilibrium is a balance between:
   (a) heat and rotation.
   (b) core temperature and surface temperature.
   (c) pressure and gravity.
   (d) radiation and heat.

9. Parallax is used to directly measure:
   (a) distance.
   (b) luminosity.
   (c) velocity.
   (d) mass.

10. Roughly what percentage of stars are main-sequence stars?
    (a) 10 percent
    (b) 60 percent
    (c) 40 percent
    (d) 90 percent
11. The Doppler shift can be used to determine the _____ of an object.
   (a) energy
   [b] radial velocity
   (c) temperature
   (d) its size

12. When two atomic nuclei come together to form a new species of atom, it is called:
   (a) nuclear fission.
   (b) nuclear splitting.
   [c] nuclear fusion.
   (d) nuclear recombination.

13. Examine the figure below. What method of looking for extrasolar planets requires the planet to pass in front of the star?

   ![Diagram](image)

   (a) radial velocity method
   (b) direct imaging
   [c] transit method

14. Why is hydrogen burning the main energy source for main-sequence stars?
   (a) Hydrogen is the most common element in stars.
   (b) Hydrogen nuclei have the smallest positive charge.
   (c) Hydrogen burning is the most efficient of all fusion or fission reactions.
   [d] All the above are valid reasons.
15. How is the distance to a star related to its parallax?
   (a) Distance is directly proportional to parallax.
   (b) Distance is inversely proportional to parallax.
   (c) Distance is directly proportional to parallax squared.
   (d) Distance is inversely proportional to parallax squared.

16. What do the Copernican and Ptolemaic models have in common?
   (a) elliptical orbits
   (b) Sun as center of the universe
   (c) circular orbits
   (d) Earth as center of universe

17. Conservation of angular momentum slows a cloud’s collapse:
   (a) equally in all directions.
   (b) only when the cloud is not rotating initially.
   (c) mostly along directions perpendicular to the cloud’s axis of rotation.
   (d) mostly at the poles that lie along the cloud’s axis of rotation.

18. The Hertzsprung-Russell (H-R) diagram (see figure below) is a graph of:

   (a) mass versus brightness for stars.
   (b) size versus mass for stars.
   (c) luminosity versus surface temperature for stars.
   (d) mass versus spectral type for stars.
19. A main-sequence star is unique because:
   (a) hydrostatic equilibrium exists at all radii.
   (b) energy transport occurs via convection throughout much of its interior.
   (c) hydrogen burning occurs in its core.
   (d) it emits strong surface winds.

20. Why do O- and B-type stars have weaker hydrogen absorption lines than A-type stars?
   (a) O- and B-type stars are cooler than A-type stars.
   (b) A larger fraction of the surface hydrogen atoms in O- and B-type stars is ionized.
   (c) O- and B-type stars have converted much more of their hydrogen into heavier elements.
   (d) A-type stars have a higher mass than O- and B-type stars, and they have more hydrogen.

21. The spectral class of a star is related to its:
   (a) luminosity.
   (b) radius.
   (c) temperature.
   (d) mass.

22. What force holds planets in their orbits?
   (a) air resistance
   (b) electromagnetic
   (c) friction
   (d) gravity
23. Which star in the figure below is closest to Earth?

- (a) star A
- (b) The two stars are the same distance.
- (c) star B
- (d) not enough information

24. The **luminosity class** of a star is related to its:

- (a) distance.
- (b) density or radius.
- (c) temperature or color.
- (d) mass.
25. Examine the figure below. On a typical H-R diagram, what are the stars that have the hottest surface temperatures and the smallest radii?

(a) red giants  
(b) red dwarfs  
(c) blue giants  
(d) white dwarfs

26. Star A is a red star. Star B is a blue star. Which is hotter?

(a) star A  
(b) star B  
(c) We also need to know the luminosities of the stars to determine their temperatures.  
(d) Color is not related to temperature at all.
27. Examine the figure below. What causes molecular clouds to collapse?

(a) conservation of charge
(b) thermal energy
(c) self-gravity
(d) radiation

28. The star named Capella has an apparent magnitude of 0 while the star named Polaris has an apparent magnitude of 2, which means that Capella appears ____ Polaris in the night sky.

(a) brighter than
(b) dimmer than
(c) as bright as
(d) no way to tell

29. Which of the following did NOT require the use of a telescope to observe?

(a) spots on the Sun
(b) retrograde motion of the planets
(c) phases of Venus
(d) Jupiter’s moons

30. Which of the following methods is NOT used to transport energy from the core to the surface of the Sun?

(a) radiation
(b) convection
(c) conduction
(d) All of the above are important in the solar interior.
31. What factor is most important in determining a star’s position on the main sequence and subsequent evolution?

(a) temperature  
(b) mass  
(c) pressure  
(d) radius

32. Examine the figure below. The interior zones of the Sun are distinguished by:

(a) jumps in density between zones.  
(b) their modes of energy transport.  
(c) their temperature profiles.  
(d) all of the above

33. Once a satellite’s velocity at closest approach equals or exceeds the ______ velocity, it is in an unbound orbit.

(a) tangential  
(b) circular  
(c) linear  
(d) escape

34. The force of gravity that an object has is directly related to its:

(a) inertia.  
(b) mass.  
(c) size.  
(d) density.
35. Which scientist ended up under house arrest because of his support of the heliocentric model?

(a) Galileo Galilei  
(b) Johannes Kepler  
(c) Isaac Newton  
(d) Tycho Brahe

36. In the quantum mechanical view of the atom, an electron is best thought of as:

(a) a cloud that is centered on the nucleus.  
(b) a pointlike particle orbiting the nucleus.  
(c) free to orbit at any distance from the nucleus.  
(d) All of the above are true.

37. What happens to the gravitational energy of gas as it falls toward and eventually hits the accretion disk surrounding a protostar?

(a) It is converted into thermal energy, heating the disk.  
(b) It is converted into light energy, giving off a flash of light upon impact.  
(c) It is converted into potential energy as the gas plows through the disk and comes out the other side.  
(d) It simply dissipates.

38. Which observations made by Galileo are actually inconsistent with the geocentric model of astronomy and not just the general world view of Aristotle?

(a) craters on the Moon  
(b) orbits of Jupiter’s moons and phases of Venus  
(c) retrograde motion of Mars  
(d) sunspots

39. All of the following are useful in determining the masses of stars in a binary system EXCEPT:

(a) the period of the orbits of the two stars.  
(b) the average separation between the two stars.  
(c) the luminosities of the two stars.  
(d) the velocities of the two stars.
40. Which of the following is true about a comet that is on an elliptical orbit around the Sun?
   (a) The comet’s speed is greatest when it is farthest from the Sun.
   (b) The comet’s speed is greatest when it is nearest the Sun.
   (c) This comet’s speed is zero.
   (d) The comet’s speed is constant because its mass and the Sun’s mass stay approximately the same.

41. In a spaceship orbiting Earth, two astronauts want to measure the mass of a mouse. How can they easily do it if they are in constant free fall?
   (a) Place the mouse on a spring-loaded scale and weigh it.
   (b) Measure the gravitational attraction between the mouse and a steel ball of known mass.
   (c) Drop the mouse from the top of the spaceship to its bottom.
   (d) Push on the mouse with a known force and measure its acceleration.

42. When an electron moves from a higher energy level in an atom to a lower energy level:
   (a) the atom is ionized.
   (b) a continuous spectrum is emitted.
   (c) a photon is absorbed.
   (d) a photon is emitted.

43. Stars of similar temperatures but different sizes will have:
   (a) similar luminosities but different masses.
   (b) similar masses but different distances.
   (c) different spectral types but similar luminosities.
   (d) similar spectral types but different luminosities.

44. In the absence of air friction, a 0.001-kg piece of paper and a 0.1-kg notebook are dropped from the same height and allowed to fall to the ground. How do their accelerations compare?
   (a) The accelerations are the same.
   (b) The notebook’s acceleration is 100 times faster than the paper’s acceleration.
   (c) The notebook’s acceleration is 1,000 times faster than the paper’s acceleration.
   (d) The paper’s acceleration is 100 times faster than the notebook’s acceleration.
45. Applying Kepler’s third law to a binary star system allows us to determine:
   (a) the mass of each star.
   (b) the system’s distance.
   (c) the system’s total mass.
   (d) the system’s brightness.

46. In the proton-proton chain, the net reaction is that four hydrogen nuclei are converted to one helium nucleus and _____ are released.
   (a) visible wavelength photons
   (b) gamma-ray photons, positrons, and neutrinos
   (c) ultraviolet photons and neutrinos
   (d) X-ray photons, electrons, and neutrinos

47. What two pieces of information do we need to know about Earth in order to calculate the mass of the Sun?
   (a) The semimajor axis of Earth’s orbit and the mass of Earth.
   (b) The semimajor axis of Earth’s orbit and Earth’s orbital period.
   (c) The radius of Earth and Earth’s orbital period.
   (d) The radius of Earth and the mass of Earth.

48. The spectrum shown in the figure below is:
   (a) an absorption spectrum.
   (b) a thermal spectrum.
   (c) an emission spectrum.
   (d) not any of these types.

49. A star classified as a K0 III star is:
   (a) a giant that is cooler than the Sun.
   (b) a supergiant that is hotter than the Sun.
   (c) a main-sequence star that is hotter than the Sun.
   (d) a subgiant that is cooler than the Sun.
50. What is the difference between intrinsic brightness and luminosity?

(a) These are different names for the same property.
(b) Luminosity is how bright the star appears to us; intrinsic brightness is how much light it emits.
(c) Intrinsic Brightness is how bright the star appears to us;
(d) Luminosity is how much light it emits.
(e) Luminosity measures size; intrinsic brightness measures temperature.

Extra Credit, You can only improve your score with these questions.

51. What is your acceleration if you go from 0 to 60 mph in 4 seconds?

(a) 60 mph/s
(b) 15 mph/s
(c) 30 mph/s
(d) 8.5 mph/s

52. In the figure below, the force of gravity is drawn in the picture. This represents Earth’s gravity pulling down on the man. According to Newton’s third law, what is the other half of this pair of forces?

(a) the floor pushing up on the man
(b) the man pushing on the floor
(c) the man’s gravity pulling up on Earth
(d) the floor pushing backward on the man

53. An observer outside our Solar System, who monitors the velocity of our Sun over time, will find that its velocity varies by ±12 m/s over a period of 12 years because of:

(a) Jupiter’s gravitational pull.
(b) convection on the Sun’s surface.
(c) Earth’s gravitational pull.
(d) the sunspot cycle.