Ast 1040 Test #3

Write the color of your test booklet on the top of your bubble sheet! Be sure to put it in the correct stack when you hand it in.
Be sure to fill in your name and student ID# (and their bubbles). That's how your grade gets back to you and not someone else.

If you can't do this correctly, it will cost you two points!!!

Be sure to follow the standard bubble-sheet drill:

- use a #2 pencil (some pens get ignored by the scanner)
- completely fill in the circles
- if you want to change an answer, be sure to completely erase the old one

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) You discover a binary star system in which one member is a 15 solar mass main-sequence star and the other star is a 10 solar mass giant star. How do we believe that a star system such as this might have come to exist? 1) C

A) The main-sequence star probably is a pulsating variable star and therefore appears to be less massive than it really is.
B) Although both stars probably formed from the same clump of gas, the more massive one must have had its birth slowed so that it became a main-sequence star millions of years later than its less massive companion.
C) The giant must once have been the more massive star but transferred some of its mass to its companion.
D) Other than the very low odds of finding a system with two such massive stars, there is nothing surprising about the fact that such systems exist.
E) The two stars probably were once separate but became a binary when a close encounter allowed their mutual gravity to pull them together.

2) Which of the following correctly describes how light will be affected as it tries to escape from a massive object like a neutron star? 2) D

A) The light will be blueshifted.
B) The visible light will be redshifted, but higher frequencies, such as X-rays and gamma rays, will not be affected.
C) Light doesn't have mass; therefore, it is not affected by gravity.
D) The light will be redshifted.

3) What is the solution to the *solar neutrino problem*? 3) A

A) The electron neutrinos created in the Sun's core change into another type of neutrino that we did not originally detect.
B) We did not know how to detect neutrinos.
C) Not all fusion reactions create neutrinos.
D) The Sun is generating energy other than by nuclear fusion.
E) The Sun is generating much less energy than we think it is.

4) Which of the following statements about novae is *not* true? 4) B

A) When a star system undergoes a nova, it brightens considerably, but not as much as a star system undergoing a supernova.
B) Our Sun will probably undergo at least one nova when it becomes a white dwarf about 5 billion years from now.
C) A star system that undergoes a nova may have another nova sometime in the future.
D) The word nova means "new star" and originally referred to stars that suddenly appeared in the sky, then disappeared again after a few weeks or months.
E) A nova involves fusion taking place on the surface of a white dwarf.

5) The age of stars in a cluster can be determined by 5) D

A) fitting the position of the main sequence to the Sun.
B) counting the number of stars in each spectral class.
C) finding spectroscopic binaries in the cluster.
D) determining the main-sequence turnoff point.
E) finding pulsating variable stars in the cluster.

6) On a Hertzsprung–Russell diagram, where would you find stars that are cool and have low luminosities? 6) B

A) upper right B) lower right C) upper left D) lower left

7) Since all stars begin their lives with the same basic composition, what characteristic is most important in determining how they will differ? 7) C

A) their initial color
B) the time at which they formed
C) their initial mass
D) their location in the galaxy
E) their initial luminosity

8) Why do sunspots appear dark in pictures of the Sun? 8) D

A) They are too cold to emit any visible light.
B) They are holes in the solar surface through which we can see through to deeper, darker layers of the Sun.
C) They are extremely hot and emit all their radiation as X-rays rather than visible light.
D) They actually are fairly bright, but appear dark against the even brighter background of the surrounding photosphere.

9) Which of the following statements about the stages of nuclear burning in a massive star is *not* true? 9) A

A) Each successive stage lasts for approximately as long as the first, hydrogen fusion stage.
B) As each stage ends, the core shrinks further.
C) Each successive stage creates an element with a higher atomic mass.
D) Each successive stage of fusion requires higher temperatures than the previous stages.

10) What is the common trait of all main-sequence stars? 10) A

A) They generate energy through hydrogen fusion in their core.
B) They are in the final stage of their lives.
C) They are all spectral type G.
D) They all have approximately the same mass.

11) Why is there an upper limit to the mass of a white dwarf? 11) B

A) White dwarfs come only from stars with masses less than 1.4 solar masses.
B) The more massive the white dwarf, the greater the degeneracy pressure and the faster the speeds of its electrons. Near 1.4 solar masses, the speeds of the electrons approach the speed of light, and no more mass can be supported.
C) The upper limit to the masses of white dwarfs was determined through observations of white dwarfs in binary systems, but no one knows why the limit exists.
D) The more massive the white dwarf, the higher its temperature and hence the greater its degeneracy pressure. Near 1.4 solar masses, the temperature becomes so high that all matter effectively melts into subatomic particles.

12) A typical neutron star is more massive than our Sun and about the size (radius) of _____. 12) A

A) a small asteroid (10 km in diameter)
B) the Moon
C) Earth
D) Jupiter

13) Compared to the star it evolved from, a white dwarf is 13) E

A) the same temperature and brightness.
B) hotter and brighter.
C) cooler and brighter.
D) cooler and dimmer.
E) hotter and dimmer.

14) Sirius is a star with spectral type A and Rigel is a star with spectral type B. What can we conclude? 14) A

A) Rigel has a higher surface temperature than Sirius.
B) Sirius has a higher surface temperature than Rigel.
C) Rigel has a higher core temperature than Sirius.
D) Sirius has a higher core temperature than Rigel.

15) Imagine that our Sun were magically and suddenly replaced by a black hole of the same mass (1 solar mass). What would happen to Earth in its orbit? 15) D

A) Earth would slowly spiral inward until it settled into an orbit about the size of Mercury's current orbit.
B) Earth would orbit faster, but at the same distance.
C) Earth would almost instantly be sucked into oblivion in the black hole.
D) Nothing; Earth's orbit would remain the same.

16) If Star A is closer to us than Star B, then Star A's *parallax angle* is _____. 16) C

A) smaller than that of Star B
B) fewer parsecs than that of Star B
C) larger than that of Star B
D) equal to that of Star B since parallax is the same for all stars, regardless of their distance

17) To calculate the masses of stars in a binary system, we must measure their _____. 17) A

A) orbital period and average orbital distance
B) luminosities and distance from Earth
C) spectral types and distance from Earth
D) absolute magnitudes and luminosities

18) What is a planetary nebula? 18) A

A) the expanding shell of gas that is no longer gravitationally bound to the core of a star
B) what is left of its planets after a low-mass star has ended its life
C) the expanding shell of gas that is left when a white dwarf explodes as a supernova
D) a disk of gas surrounding a protostar that may form into planets
E) the molecular cloud from which planets form

19) The interstellar clouds called *molecular clouds* are _____. 19) C

A) the hot clouds of gas expelled by dying stars
B) the clouds in which elements such as carbon, nitrogen, and oxygen are made
C) the cool clouds in which stars form
D) clouds that are made mostly of complex molecules such as carbon dioxide and sulfur dioxide

20) If you were to come back to our solar system in 6 billion years, what might you expect to find? 20) B

A) a red giant star
B) a white dwarf
C) a black hole
D) a rapidly spinning pulsar
E) Everything will be essentially the same as it is now.

21) Which of the following statements about black holes is *not* true? 21) C

A) If you fell into a supermassive black hole (so that you could survive the tidal forces), you would experience time to be running normally as you plunged across the event horizon.
B) The event horizon of a black hole represents a boundary from which nothing can escape.
C) If the Sun magically disappeared and was replaced by a black hole of the same mass, the Earth would soon fall into the black hole.
D) If you watch an object fall into a black hole, you will never see the object cross the event horizon. However, the object will fade from view as the light it emits becomes more and more redshifted.
E) If we watch a clock fall toward a black hole, we will see it tick slower and slower.

22) Which of the following statements about apparent and absolute magnitudes is *true*? 22) E

A) The absolute magnitude of a star is dependent upon its luminosity.
B) The magnitude system that we use now is based on a system used by the ancient Greeks over 2,000 years ago that classified stars by how bright they appeared.
C) A star with an apparent magnitude of 1 appears brighter than a star with an apparent magnitude of 2.
D) A star's absolute magnitude is the apparent magnitude it would have if it were at a distance of 10 parsecs from Earth.
E) All of the above are true.

23) Which of the following statements about the sunspot cycle is *not* true? 23) C

A) The number of sunspots peaks approximately every 11 years.
B) The magnetic polarity of the Sun reverses approximately every 11 years.
C) The rate of nuclear fusion in the Sun peaks about every 11 years.
D) The number of solar flares peaks about every 11 years.
E) At solar minimum, the first sunspots usually form at mid-latitudes on the Sun.

24) Carbon fusion occurs in high-mass stars but not in low-mass stars because _____. 24) A

A) the cores of low-mass stars never get hot enough for carbon fusion
B) the cores of low-mass stars never contain significant amounts of carbon
C) only high-mass stars do fusion by the CNO cycle
D) carbon fusion can occur only in the stars known as carbon stars

25) According to our modern understanding, what is a *nova*? 25) B

A) a rapidly spinning neutron star
B) an explosion on the surface of a white dwarf in a close binary system
C) the explosion of a massive star at the end of its life
D) the sudden formation of a new star in the sky

26) What causes the radio pulses of a pulsar? 26) C

A) The neutron star's orbiting companion periodically eclipses the radio waves that the neutron star emits.
B) The vibration of the neutron star.
C) As the neutron star spins, beams of radio radiation sweep through space. If one of the beams crosses the Earth, we observe a pulse.
D) The neutron star undergoes periodic explosions of nuclear fusion that generate radio pulses.
E) A black hole near the neutron star absorbs energy and re-emits it as radio waves.

27) A main-sequence star's luminosity can directly inform us of 27) D

A) the star's surface temperature.
B) the star's distance from us.
C) the star's radius.
D) the rate at which it converts hydrogen to helium.

28) How is the lifetime of a star related to its mass? 28) A

A) More massive stars live much shorter lives than less massive stars.
B) More massive stars live slightly shorter lives than less massive stars.
C) More massive stars live slightly longer lives than less massive stars.
D) More massive stars live much longer lives than less massive stars.

29) What types of stars end their lives with supernovae? 29) D

A) all stars that are red in color
B) stars that are similar in mass to the Sun
C) all stars that are yellow in color
D) stars that are more massive than eight times the mass of the Sun
E) stars that have reached an age of 10 billion years

30) The surface of the neutron star RXJ2015 has a temperature of 10 million K. This neutron star emits radiation most strongly in 30) B

A) radio light. B) X-ray light. C) visible light. D) infrared light.

31) What change slowly occurs during the main-sequence lifetime of a star? 31) C

A) As the solar wind blows material into space, the decreasing mass reduces pressure in the core, which in turn reduces the fusion rate and the luminosity.
B) It gathers more gas from interstellar space, increasing its mass and hence the luminosity.
C) Its core temperature slowly increases, increasing the fusion rate and hence the luminosity.
D) As hydrogen is used up in the core, the fusion rate decreases and reduces the luminosity.

32) When does a star become a main-sequence star? 32) C

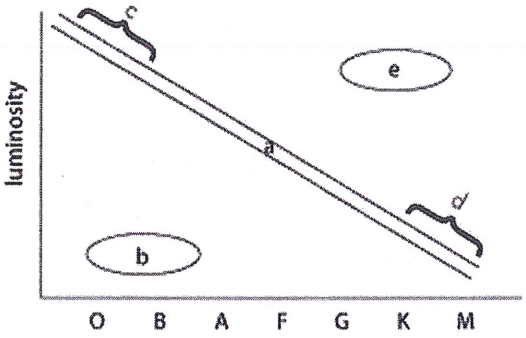
A) the instant when hydrogen fusion first begins in the star's core
B) when the protostar assembles from its parent molecular cloud
C) when the rate of hydrogen fusion in the star's core is high enough to sustain gravitational equilibrium
D) when hydrogen fusion is occurring throughout the star's interior
E) when a star becomes luminous enough to emit thermal radiation

33) What keeps the Sun's outer layers from continuing to fall inward in a gravitational collapse? 33) C

A) the strong force between protons
B) electromagnetic repulsion between protons
C) outward pressure due to super-heated gas
D) neutrinos produced by nuclear fusion drag gas outward

34) What is the source of luminosity for protostars that have not yet become hot enough for fusion in their cores? 34) B

A) fission from concentrated radioactive elements
B) gravitational energy released by infalling matter
C) fusion in their low-density outer layers
D) light absorbed from nearby stars



35) The sketch above shows groups of stars on the H-R diagram, labeled (a) through (e); note that (a) represents the *entire* main sequence while (c) and (d) represent only small parts of the main sequence. Which group represents stars that are *extremely bright and emit most of their radiation as ultraviolet light*? 35) C

A) a B) b C) c D) d E) e

36) The sketch above shows groups of stars on the H-R diagram, labeled (a) through (e); note that (a) represents the *entire* main sequence while (c) and (d) represent only small parts of the main sequence. Which group represents stars with *the longest main-sequence lifetimes*? 36) D

A) a B) b C) c D) d E) e

37) What do sunspots, solar prominences, and solar flares all have in common? 37) C

A) They are all shaped by the solar wind.
B) They all have about the same temperature.
C) They are all strongly influenced by magnetic fields on the Sun.
D) They all occur only in the Sun's photosphere.

38) What do we mean by the *main-sequence turnoff point* of a star cluster, and what does it tell us? 38) B

A) It is the point in a star cluster beyond which main-sequence stars are not found, and it tells us the cluster's distance.
B) It is the spectral type of the hottest main-sequence star in a star cluster, and it tells us the cluster's age.
C) It is the mass of the most massive star in the star cluster, and it tells us the cluster's size.
D) It is the luminosity class of the largest star in a star cluster, and it tells us the cluster's age.

39) Which of the following is closest in size (radius) to a white dwarf? 39) A

A) the Earth
B) the Sun
C) a football stadium
D) a basketball
E) a small city

40) What happens to the core of a star after the planetary nebula stage? 40) C

A) It becomes a neutron star.
B) It contracts from a protostar to a main-sequence star.
C) It becomes a white dwarf.
D) It breaks apart in a violent explosion.
E) none of the above

41) Which of the following statements about open clusters is *true*? 41) A

A) All stars in the cluster are approximately the same age.
B) All stars in the cluster will evolve similarly.
C) All stars in the cluster have approximately the same mass.
D) All stars in the cluster are approximately the same color.
E) There is an approximately equal number of all spectral type stars in the cluster.

42) Which of the following best explains why nuclear fusion requires bringing nuclei extremely close together? 42) C

A) Nuclei have to be very hot in order to fuse, and the only way to get them hot is to bring them close together.
B) Fusion can proceed only by the proton-proton chain, and therefore requires that protons come close enough together to be linked up into a chain.
C) Nuclei normally repel because they are all positively charged and can be made to stick only when brought close enough for the strong force to take hold.
D) Nuclei are attracted to each other by the electromagnetic force, but this force is only strong enough to make nuclei stick when they are very close together.

43) Why does stellar main-sequence lifetime decrease with increasing stellar mass? 43) C

A) It doesn't; higher mass stars have more hydrogen available for fusion, and thus have longer lifetimes.
B) Strong stellar winds cause higher mass stars to lose mass quickly.
C) Higher core temperatures cause fusion to proceed much more rapidly.
D) Higher outward pressure prevents the core hydrogen from being replenished by the star's outer layers.

44) What is a *protostar*? 44) A

A) a star that is still in the process of forming
B) an intermediate-mass star
C) a star that has planets
D) a star in its final stage of life

45) If the sun's surface cooled, how would its appearance change? 45) B

A) It would become bright white.
B) It would appear more red.
C) It would stay the same.
D) It would appear more blue.

46) What would happen to the core of the sun if its temperature rose slightly? 46) B

A) The rate at which fusion occurs would increase, leading to a contraction of the core, which would in turn cause the temperature to rise even further.
B) The rate at which fusion occurs would increase, leading to an expansion of the core, which would in turn cause the temperature to drop back down.
C) The rate at which fusion occurs would decrease, leading to an expansion of the core, which would in turn cause the temperature to drop back down.
D) The rate at which fusion occurs would decrease, leading to a contraction of the core, which would in turn cause the temperature to rise even further.

47) Why does a star grow larger immediately after it exhausts its core hydrogen? 47) A

A) Hydrogen fusion in a shell outside the core generates enough thermal pressure to push the upper layers outward.
B) The internal radiation generated by the hydrogen fusion in the core has heated the outer layers enough that they can expand after the star is no longer fusing hydrogen.
C) The outer layers of the star are no longer gravitationally attracted to the core.
D) Helium fusion in the core generates enough thermal pressure to push the upper layers outward.
E) Helium fusion in a shell outside the core generates enough thermal pressure to push the upper layers outward.

48) The overall result of the proton-proton chain is _____. 48) B

A) p + p becomes ^{2}H + energy
B) 4 H becomes 1 He + energy
C) 6 H becomes 1 He + energy
D) individual protons are joined into long chains of protons

49) The core of the Sun is 49) C

A) at the same temperature but much denser than its surface.
B) constantly rising to the surface through convection.
C) much hotter and much denser than its surface.
D) composed of iron.
E) at the same temperature and density as its surface.

50) Suppose that a white dwarf is gaining mass through accretion in a binary system. What happens if the mass someday reaches the 1.4 solar mass limit? 50) C

A) The white dwarf will undergo a nova explosion.
B) The white dwarf will collapse to become a black hole.
C) The white dwarf will explode completely as a white dwarf supernova.
D) The white dwarf will collapse in size, becoming a neutron star.

51) Which of the following is *not* a method astronomers use to determine the physical conditions inside the Sun? 51) C

A) detecting solar neutrinos generated in the Sun's core
B) building mathematical models that use the laws of physics
C) observing X-ray images of the solar interior using satellites
D) measuring Doppler shifts to observe solar vibrations

52) Which of the following processes is involved in the sunspot cycle? 52) A

A) the winding up of magnetic field lines inside the Sun due to its differential rotation
B) a slight gravitational contraction of the Sun
C) small variations in the rate of nuclear energy generation in the solar interior
D) a large change in the amount of visible light emitted by the Sun
E) an imbalance in the operation of the solar thermostat

53) Star A is identical to Star B, except that Star A is twice as far from us as Star B. Therefore, _____. 53) D

A) both stars have the same luminosity, but the apparent brightness of Star B is twice that of Star A
B) both stars have the same apparent brightness, but the luminosity of Star B is four times that of Star A
C) both stars have the same luminosity, but the apparent brightness of Star A is four times that of Star B
D) both stars have the same luminosity, but the apparent brightness of Star B is four times that of Star A

54) A white dwarf is 54) B

A) the name for the singularity at the center of a black hole.
B) the exposed core of a dead star, supported by electron degeneracy pressure.
C) the exposed core of a dead star, supported by neutron degeneracy pressure.
D) a hot but very small main-sequence star with a mass of less than 1.4 solar masses.
E) a cool and very small main-sequence star with a mass of less than 1.4 solar masses.

55) You see two main-sequence stars with the *same spectral type*. Star 1 is dimmer in apparent brightness than Star 2 by a factor of 100. What can you conclude, assuming there is no absorption of either star's light by interstellar gas or dust? 55) D

A) Without first knowing the distances to these stars, you cannot draw any conclusions about how their true luminosities compare to each other.
B) Star 1 is 100 times nearer than Star 2.
C) The luminosity of Star 1 is a factor of 100 less than the luminosity of Star 2.
D) Star 1 is 10 times more distant than Star 2.
E) Star 1 is 100 times more distant than Star 2.

56) What happens when a main-sequence star exhausts its core hydrogen fuel supply? 56) A

A) The core shrinks while the rest of the star expands.
B) The star becomes a neutron star.
C) The entire star shrinks in size.
D) The core immediately begins to fuse its helium into carbon.

57) What do we mean when we say that the Sun is in *gravitational equilibrium*? 57) D

A) The Sun maintains a steady temperature.
B) The Sun always has the same amount of mass, creating the same gravitational force.
C) The hydrogen gas in the Sun is balanced so that it never rises upward or falls downward.
D) There is a balance within the Sun between the outward force of gas pressure and the inward force of gravity.

58) The source of energy that keeps the Sun shining today is _____. 58) D

A) gravitational contraction
B) nuclear fission
C) chemical reactions
D) nuclear fusion

59) Which event marks the beginning of a supernova? 59) E

A) the expansion of a low-mass star into a red giant
B) the onset of helium burning after a helium flash in a star with mass comparable to that of the Sun
C) the sudden outpouring of X-rays from a newly formed accretion disk
D) the beginning of neon burning in an extremely massive star
E) the sudden collapse of an iron core into a compact ball of neutrons

60) Most interstellar clouds remain stable in size because the force of gravity is opposed by _____ within the cloud. 60) D

A) stellar winds
B) radiation pressure
C) degeneracy pressure
D) thermal pressure