

# **Astronomy 104, Spring 2023**

## **Test 3**

**Print your name:**

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**Make sure your scantron has your name and code on it.**

**Show a picture ID,  
and  
turn in the test paper with the scantron.**

**Fill in the answers on the test paper.**

**Answer these questions on the scantron as indicted:**

- 1 Answer E**
- 2 Answer C**
- 3 Answer C**

**4 Production, out of nucleus X, of nuclei other than X cannot produce heat.**

**What is X?**

- A: C.
- B: H.
- C: Fe.
- D: U.
- E: He.

**5 Which stars become red giants?**

- A: Those with a large portion of metals in their core.
- B: All.
- C: Those lighter than the Chandrashekar limit.
- D: None: red giants are not, in fact, stars.
- E: Those heavier than the Chandrashekar limit.

**6 What stars become planetary nebulae and at what stage of their life?**

- A: Stars with mass  $> 1.44$  solar when all energy is used up.
- B: All stars when all their energy is used up.
- C: Stars with mass  $< 1.44$  solar when all energy is used up.
- D: Stars with mass  $> 1.44$  solar when all hydrogen is used up.
- E: Stars with mass  $< 1.44$  solar when all hydrogen is used up.

**7 What heats a red giant (at a late stage of its evolution)?**

- A: Gravitational energy.
- B: Hydrogen to helium fusion.
- C: It has no energy source now, but it is still hot and cooling off slowly.
- D: Fusion of nuclei heavier than helium but lighter than iron.
- E: The energy of radioactive decays.

**8 Which method is most accurate to determine the distance to neighboring galaxies?**

- A: Redshift.
- B: Cepheids.
- C: Radar.
- D: Using the HRD.
- E: Parallax.

**9 What percent of the matter of the Galaxy do stars and interstellar gas and dust constitute, taken together?**

- A: 0.1%.
- B: 20%.
- C: 0.01%.
- D: 100%.
- E: 90%.

**10 What property of a Cepheid variable is related to its absolute brightness?**

- A: The length of the period of its pulsation.
- B: Its proper motion.
- C: The surface temperature.
- D: The size.
- E: Its parallax.

**11 What can you read off the HRD of a star cluster?**

- A: Its chemical composition.
- B: Its age.
- C: Its mass.
- D: Its distance.
- E: The number of stars in the cluster.

**12 What does Hubble's law say, precisely?**

- A: Closeby ( $d < 100$  Mpc) galaxies have redshifts proportional to their distances.
- B: 14 billion years ago all the Universe was concentrated at one point.
- C: Far-away ( $d > 10$  Mpc) galaxies all have redshifts proportional to their distances.
- D: All galaxies all have redshifts proportional to their distances.
- E: All objects in the Universe have redshifts proportional to their distances.

**13 Hubble's law implies that ...**

- A: galaxies do not move in the Universe.
- B: our galaxy is in the center of the universe.
- C: the Solar System is slowly blowing up.
- D: all galaxies started to move apart at the same time.
- E: the Galaxy is slowly getting bigger.

**14 Where in a galaxy will you find newly formed stars?**

- A: Everywhere.
- B: Only close to the center.
- C: In the halo.
- D: In the disk.
- E: In the spiral arms.

**15 What triggered the collapse of the gas cloud that gave birth to the Sun?**

- A: The capture of the Earth.
- B: A sudden strengthening of the magnetic field of the Galaxy.
- C: It was a spontaneous collapse.
- D: A collision with another star.
- E: A nearby supernova explosion.

**16 How do we know that a supernova exploded in our area just before the birth of the Sun?**

- A: The existence of oxygen on Earth.
- B: The existence of gold on Earth.
- C: The existence of water on Earth.
- D: Radiation broke up rocks on the surface of the Moon.
- E: The composition of meteorites.

**17 What two quantities are plotted on the HRD?**

- A: Vertical: apparent brightness, horizontal: color.
- B: Vertical: spectral type, horizontal: apparent brightness.
- C: Vertical: luminosity, horizontal: temperature.
- D: Vertical: spectral type, horizontal: temperature.
- E: Vertical: absolute magnitude, horizontal: parallax.

**18 What is a Type-Ia supernova?**

- A: It is a pair of colliding stars.
- B: A red giant with mass larger than the Chandrashekar limit.
- C: A close binary of a white dwarf and an expanding red giant.
- D: The core of a heavy star collapses.
- E: A red giant with mass smaller than the Chandrashekar limit.

**19 What determines the length of life of a star?**

- A: Its chemical composition at birth.
- B: Its mass.
- C: The strength of its magnetic field.
- D: Its location in its host galaxy.
- E: The rate of its rotation at birth.

**20 What is a Cepheid?**

- A: A type of a pulsating variable star.
- B: A type of a supernova, which explodes due to mass exchange between partners of a close binary.
- C: A galaxy with a supermassive black hole in its center.
- D: A type of an open star cluster.
- E: A constellation.

**21 A planetary nebula's central star is ...**

- A: a red giant.
- B: a main sequence star.
- C: a neutron star.
- D: a white dwarf.
- E: a black hole.

**22 Where would you find interstellar gas and dust in the Galaxy?**

- A: In the disk only.
- B: In the halo only.
- C: Both the disk and in the halo, evenly distributed.
- D: Only in the Solar Neighborhood.
- E: Close to the center only.

**23 A pulsar gives us one pulse ...**

- A: when chunks of matter fall into it.
- B: when it rotates once.
- C: when it reaches maximum diameter in its pulsation.
- D: when hot bubbles of gas rise from its interior.
- E: when it orbits another star once.

**24 Which stars end their lives blow up as supernovae?**

- A: All.
- B: None. Supernovae are not stars.
- C: Those heavier the 100 solar masses.
- D: Those heavier than 1.44 solar masses.
- E: Those lighter than 1.44 solar masses.

**25 What is “cosmic background radiation”?**

- A: X-ray radiation from unknown sources in space.
- B: The Sun keeps losing hydrogen to space.
- C: Microwaves that arrive from all direction in the sky.
- D: Radiation from inside Earth.
- E: Radiation from planets of the solar system.

**26 What is the energy source of red giants (in particular, AGB stars)?**

- A: Oxydation of helium.
- B: Hydrogen fused into helium.
- C: Helium fused into heavier elements.
- D: Radioactive decays.
- E: Hydrogen burning into water.

**27 Which one is correct?**

- A: Normal stars do not differ much in either luminosity or mass, but red giants do.
- B: Stars differ a lot in luminosity, but not as much in mass.
- C: Stars do not differ much in either luminosity or in mass.
- D: Stars differ a lot in mass, but not in luminosity.
- E: Stars differ much in both luminosity and in mass.

**28 What do you know about the age of globular clusters?**

- A: They are older than the age of the Universe.
- B: The age of globular clusters is unknown.
- C: They are very young as stars go.
- D: There are all sorts of globular clusters, young and old.
- E: They are very old as stars go.

**29 Why are Type-Ia supernovae useful for measuring distances?**

- A: Because their spectral type is related to their absolute magnitude on the HRD.
- B: Because they are all very heavy.
- C: Because their parallaxes are easily measurable.
- D: Because their absolute magnitudes are all the same and they are visible from large distances.
- E: Because their spectral lines are sharp and so their redshift can be measured precisely.

**30 Where are stars born in our Galaxy at present?**

- A: In the star cluster around the center.
- B: In the spiral arms.
- C: Nowhere.
- D: In the center.
- E: In the halo.

**31 Molecular clouds are ...**

- A: the result of SN explosions.
- B: hot.
- C: cold.
- D: made of dust particles.
- E: as dense as air.

**32 In 5 billion years, the Sun will become ...**

- A: a brown dwarf.
- B: a supernova.
- C: interstellar gas as it will have blown up.
- D: a red giant.
- E: a large planet.

**33 What determines what sort of an object remains after a dead star?**

- A: The age when the star collides with another one.
- B: The metallicity of the star.
- C: The star's mass.
- D: The chemical composition of the star.
- E: The planet system of the star.

**34 What is the energy source of white dwarfs?**

- A: Burning hydrogen.
- B: They have none, they are only slowly cooling off.
- C: Radioactive decays.
- D: Hydrogen to helium fusion.
- E: Helium to carbon fusion.

**35 How do we know that there is dark matter in galaxy clusters?**

- A: The magnetic field in galaxy clusters cannot be explained otherwise.
- B: Clusters of galaxies contain too many members.
- C: Galaxy clusters are held together by the gravity of some unseen mass.
- D: Clusters of galaxies block the light stronger than one would expect by counting the galaxies only.
- E: As atoms fall into dark matter they radiate in the ultraviolet.

**36 Which object can be the place of starbirth?**

- A: A supernova remnant.
- B: An open cluster.
- C: A diffuse nebula.
- D: A globular cluster.
- E: A planetary nebula.

**37 Most stars in the HRD are located ...**

- A: in the solar system.
- B: in the solar neighborhood.
- C: in the top left.
- D: on the main sequence.
- E: in the red giant branch.



**38 Which star lives longer, one with a small or a large mass?**

- A: The one with a large mass, because it contains more hydrogen.
- B: The one with a small mass, because it is much dimmer.
- C: The one with a large mass, because it is hotter.
- D: The one with a small mass, because it contains more hydrogen.
- E: Equal: heavy stars have more fuel but use it faster in proportion.

**39 The expansion of the universe causes redshift in stellar spectra. Right?**

- A: Wrong: the expansion of the Universe has been disproved.
- B: Wrong: the Universe is expanding but objects in it do not change.
- C: Right: all stars are receding from us.
- D: Wrong: that would be too small an effect to detect.
- E: Right: the far edge of the Galaxy is receding fast from us.

**40 How do we know that quasars must be huge black holes?**

- A: Because they block the light of stars behind them.
- B: Because they radiate so much power that cannot be produced in any other object.
- C: Because their gravitational pull has been detected.
- D: Because stars vanish around them.
- E: Because they are invisible.

**41 Which of the following is not a nuclear reaction?**

- A: The triple-alpha process: helium turning into carbon.
- B: Burning.
- C: Fission.
- D: Radioactive decay.
- E: Fusion.

**42 In the final state of the evolution of the Sun, its chemical composition will be**

...

- A: a mix of hydrogen and helium.
- B: iron.
- C: a mix of carbon and oxygen.
- D: helium.
- E: hydrogen.

**43 How long is the red giant stage for a star, compared to the main sequence stage?**

- A: 98%
- B: 10%
- C: The red giant stage lasts 10 times longer.
- D: 0%. (Most stars do not become red giants at all.)
- E: 0.001%

**44 The central star of a planetary nebula is ...**

- A: A supernova.
- B: A main sequence star.
- C: A brown dwarf.
- D: A red giant.
- E: A white dwarf.

**45 Which of the following is evidence for the existence of dark matter?**

- A: Large voids in the Universe lacking galaxies.
- B: The velocity curves of galaxies are essentially straight.
- C: Interstellar gas clouds.
- D: X-rays are absorbed in dark matter.
- E: Black lanes across edge-on galaxies.

**46 How come we can see black holes, when they are black?**

- A: Because they are not in fact black but radiate X-rays due to a quantum process.
- B: It obscures the light of stars that are behind it.
- C: But we don't: they exist only in theory but have not been observed.
- D: They have a strong magnetic field.
- E: When matter falls into the black hole, it radiates just before falling in.

**47 What makes the stars on the main sequence different from all the others?**

- A: They produce energy while all the other stars do not.
- B: Their energy source is hydrogen to helium fusion in their centers.
- C: They were born from gas that contained a large amount of metals.
- D: They are all very young.
- E: They are all very old.

**48 What is a quasar?**

- A: A very active young galactic nucleus.
- B: A heavier-than-normal star (mass>100 solar mass) blowing up.
- C: A neutron star whose N-S axis is oriented towards us as it rotates.
- D: A special type of supernova.
- E: A pair of colliding stars.

**49 Where is a red giant on the HRD?**

- A: down right.
- B: on the main sequence.
- C: up right.
- D: down left.
- E: up left.

**50 In what type of environment are stars born?**

- A: In dense cores of molecular clouds.
- B: In planetary nebulae.
- C: In empty space.
- D: In dust clouds reflecting starlight.
- E: In supernova remnants.

**51 The chemical composition of a 0.5 solar mass white dwarf would be ...**

- A: Pure hydrogen.
- B: Mostly iron.
- C: Hydrogen and helium.
- D: Metals heavier than iron.
- E: Carbon and oxygen.

**52 What distinguishes main sequence stars?**

- A: They do not have any energy source left.
- B: They produce energy by nuclear fission, the same reaction as in a nuclear reactor.
- C: They produce energy by nuclear decay.
- D: They fuse helium into oxygen and other nuclei.
- E: They fuse hydrogen into helium in their cores.