

Astronomy 104, Spring 2023

Test 3

Print your name:

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

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

**It is advisable but not required
to fill in the answers on the test paper.**

Answer these questions on the scantron as indicted:

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

4 A planetary nebula's central star is ...

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

5 What is a quasar?

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

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

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

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

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

8 Why are Type-Ia supernovae useful for measuring distances?

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

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

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

10 What does Hubble's law say, precisely?

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

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

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

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

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

13 Molecular clouds are ...

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

14 Which of the following is evidence for the existence of dark matter?

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

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

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

16 Where is a red giant on the HRD?

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

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

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

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

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

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

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

20 Where in a galaxy will you find newly formed stars?

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

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

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

22 In 5 billion years, the Sun will become ...

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

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

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

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

25 What is a Cepheid?

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

26 A pulsar gives us one pulse ...

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

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

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

28 Hubble's law implies that ...

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

29 Which stars become red giants?

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

30 Production, out of nucleus X, of nuclei other than X cannot produce heat. What is X?

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

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

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

32 Where are stars born in our Galaxy at present?

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

33 Which object can be the place of starbirth?

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

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

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

35 What is the energy source of white dwarfs?

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

36 What distinguishes main sequence stars?

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

37 What determines the length of life of a star?

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

38 What two quantities are plotted on the HRD?

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

39 What is “cosmic background radiation”?

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

40 Which stars end their lives blow up as supernovae?

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

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

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

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

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

43 The central star of a planetary nebula is ...

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

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

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

45 Which one is correct?

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

46 What do you know about the age of globular clusters?

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

47 Most stars in the HRD are located ...

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

48 Which of the following is not a nuclear reaction?

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

49 In the final state of the evolution of the Sun, its chemical composition will be ...

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

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

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

51 What is a Type-Ia supernova?

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

52 In what type of environment are stars born?

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