Page 1 of 12

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.

Fill in the answers on the test paper.

Answer these questions on the scantron as indicted:

- 1 Answer E
- 2 Answer C
- 3 Answer A

4 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: Clusters of galaxies block the light stronger than one would expect by counting the galaxies only.

D: As atoms fall into dark matter they radiate in the ultraviolet.

E: Galaxy clusters are held together by the gravity of some unseen mass.

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

A: But we don't: they exist only in theory but have not been observed.

B: Because they are not in fact black but radiate X-rays due to a quantum process.

- C: It obscures the light of stars that are behind it.
- D: They have a strong magnetic field.
- E: When matter falls into the black hole, it radiates just before falling in.

6 What is the energy source of white dwarfs?

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

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

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

8 Which one is correct?

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

9 Molecular clouds are ...

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

10 Which object can be the place of starbirth?

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

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

A: Because their absolute magnitudes are all the same and they are visible from large distances.

B: Because their spectral type is related to their absolute magnitude on the HRD.

- C: Because their parallaxes are easily measurable.
- D: Because they are all very heavy.

E: Because their spectral lines are sharp and so their redshift can be measured precisely.

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

- A: Because they block the light of stars behind them.
- B: Because stars vanish around them.
- C: Because their gravitational pull has been detected.

D: Because they radiate so much power that cannot be produced in any other object.

E: Because they are invisible.

13 What determines the length of life of a star?

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

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

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

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

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

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

•••

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

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

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

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

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

19 A pulsar gives us one pulse ...

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

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

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

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

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

22 What does Hubble's law say, precisely?

- A: 14 billion years ago all the Universe was concentrated at one point.
- B: All galaxies all have redshifts proportional to their distances.

C: Far-away (d>10 Mpc) galaxies all have redshifts proportional to their distances.

- D: Closeby (d<100 Mpc) galaxies have redshifts proportional to their distances.
- E: All objects in the Universe have redshifts proportional to their distances.

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

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

24 What distinguishes main sequence stars?

- A: They do not have any energy source left.
- B: They fuse helium into oxygen and other nuclei.
- C: They fuse hydrogen into helium in their cores.
- D: They produce energy by nuclear decay.

E: They produce energy by nuclear fission, the same reaction as in a nuclear reactor.

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

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

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

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

27 Which of the following is not a nuclear reaction?

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

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

29 Where is a red giant on the HRD?

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

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

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

31 Which stars end their lives blow up as supernovae?

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

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

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

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

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

34 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.

35 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: They were born from gas that contained a large amount of metals.
- C: Their energy source is hydrogen to helium fusion in their centers.
- D: They are all very old.
- E: They are all very young.

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

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

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

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

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

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

39 Hubble's law implies that ...

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

40 Most stars in the HRD are located ...

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

41 What is a Cepheid?

- A: A type of an open star cluster.
- B: A constellation.

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 galaxy with a supermassive black hole in its center.

42 What two quantities are plotted on the HRD?

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

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

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

44 What is a quasar?

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

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

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

46 What is "cosmic background radiation"?

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

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

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

48 In what type of environment are stars born?

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

49 Where are stars born in our Galaxy at present?

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

50 What is a Type-Ia supernova?

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

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

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

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

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