Astronomy 104, Spring 2023

Test 3

CORRECT SOLUTIONS

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.

There were many scrambled versions.
Here is a solved copy of one of the versions.

1 **Depends on the version.**
2 **Depends on the version.**
3 **Depends on the version.**

E **A planetary nebula's central star is …**

A: a black hole.

B: a main sequence star.

C: a neutron star.

D: a red giant.

E: a white dwarf.

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

A: U.

B: H.

C: Fe.

D: C.

E: He.

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

A: The rate of its rotation at birth.

B: Its mass.

C: Its location in its host galaxy.

D: The strength of its magnetic field.

E: It chemical composition at birth.

A **What distinguishes main sequence stars?**

A: They fuse hydrogen into helium in their cores.

B: They do not have any energy source left.

C: They fuse helium into oxygen and other nuclei.

D: They produce energy by nuclear decay.

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

B **What is a quasar?**

A: A pair of colliding stars.

B: A very active young galactic nucleus.

C: A special type of supernova.

D: A heavier-than-normal star (mass>100 solar mass) blowing up.

E: A neutron star whose N-S axis is oriented towards us as it rotates.

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

A: Hydrogen burning into water.

B: Radioactive decays.

C: Helium fused into heavier elements.

D: Oxydation of helium.

E: Hydrogen fused into helium.

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

A: Helium to carbon fusion.

B: Radioactive decays.

C: Burning hydrogen.

D: Hydrogen to helium fusion.

E: They have none, they are only slowly cooling off.

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

A: Vertical: luminosity, horizontal: temperature.

B: Vertical: apparent brightness, horizontal: color.

C: Vertical: spectral type, horizontal: apparent brightness.

D: Vertical: spectral type, horizontal: temperature.

E: Vertical: absolute magnitude, horizontal: parallax.

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

A: up left.

B: on the main sequence.

C: down right.

D: up right.

E: down left.

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

A: An open cluster.

B: A supernova remnant.

C: A diffuse nebula.

D: A planetary nebula.

E: A globular cluster.

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

A: Interstellar gas clouds.

B: Large voids in the Universe lacking galaxies.

C: X-rays are absorbed in dark matter.

D: The velocity curves of galaxies are essentially straight.

E: Black lanes across edge-on galaxies.

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

A: Fusion.

B: Radioactive decay.

C: Fission.

D: The triple-alpha process: helium turning into carbon.

E: Burning.

B **Which one is correct?**

A: Stars differ a lot in mass, but not in luminosity.

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 much in both luminosity and in mass.

E: Normal stars do not differ much in either luminosity or mass, but red giants do.

C **Most stars in the HRD are located …**

A: in the solar system.

B: in the red giant branch.

C: on the main sequence.

D: in the solar neighborhood.

E: in the top left.

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

A: The red giant stage lasts 10 times longer.

B: 98%

C: 0.001%

D: 10%

E: 0%. (Most stars do not become red giants at all.)

A **In 5 billion years, the Sun will become …**

A: a red giant.

B: interstellar gas as it will have blown up.

C: a supernova.

D: a large planet.

E: a brown dwarf.

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

A: helium.

B: a mix of carbon and oxygen.

C: a mix of hydrogen and helium.

D: hydrogen.

E: iron.

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

A: The planet system of the star.

B: The chemical composition of the star.

C: The metallicity of the star.

D: The age when the star collides with another one.

E: The star's mass.

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

A: Their energy source is hydrogen to helium fusion in their centers.

B: They are all very old.

C: They were born from gas that contained a large amount of metals.

D: They produce energy while all the other stars do not.

E: They are all very young.

C **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 energy is used up.

D: Stars with mass > 1.44 solar when all hydrogen is used up.

E: All stars when all their energy is used up.

B **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 small mass, because it contains more hydrogen.

D: Equal: heavy stars have more fuel but use it faster in proportion.

E: The one with a large mass, because it is hotter.

D **Which stars become red giants?**

A: Those with a large portion of metals in their core.

B: None: red giants are not, in fact, stars.

C: Those lighter than the Chandrashekar limit.

D: All.

E: Those heavier than the Chandrashekar limit.

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

A: Those lighter than 1.44 solar masses.

B: Those heavier than 1.44 solar masses.

C: All.

D: Those heavier the 100 solar masses.

E: None. Supernovae are not stars.

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

A: Because their gravitational pull has been detected.

B: Because stars vanish around them.

C: Because they are invisible.

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

E: Because they block the light of stars behind them.

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

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

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

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

D: Clusters of galaxies contain too many members.

E: The magnetic field in galaxy clusters cannot be explained otherwise.

E **Hubble's law implies that …**

A: the Solar System is slowly blowing up.

B: galaxies do not move in the Universe.

C: the Galaxy is slowly getting bigger.

D: our galaxy is in the center of the universe.

E: all galaxies started to move apart at the same time.

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

A: Wrong: the expansion of the Universe has been disproved.

B: Right: the far edge of the Galaxy is receding fast from us.

C: Right: all stars are receding from us.

D: Wrong: that would be too small an effect to detect.

E: Wrong: the Universe is expanding but objects in it do not change.

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

A: All galaxies all have redshifts proportional to their distances.

B: All objects in the Universe have redshifts proportional to their distances.

C: Closeby (d<100 Mpc) galaxies have redshifts proportional to their distances.

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

E: 14 billion years ago all the Universe was concentrated at one point.

B **What is "cosmic background radiation"?**

A: Radiation from planets of the solar system.

B: Microwaves that arrive from all direction in the sky.

C: Radiation from inside Earth.

D: The Sun keeps losing hydrogen to space.

E: X-ray radiation from unknown sources in space.

B **What is a Cepheid?**

A: A galaxy with a supermassive black hole in its center.

B: A type of a pulsating variable star.

C: A type of a supernova, which explodes due to mass exchange between partners of a close binary.

D: A constellation.

E: A type of an open star cluster.

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

A: 0.1%.

B: 100%.

C: 0.01%.

D: 20%.

E: 90%.

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

A: Its proper motion.

B: The length of the period of its pulsation.

C: The surface temperature.

D: Its parallax.

E: The size.

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

A: Parallax.

B: Redshift.

C: Radar.

D: Using the HRD.

E: Cepheids.

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

A: Because their parallaxes are easily measurable.

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

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

D: Because they are all very heavy.

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

C **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.

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

A: In the spiral arms.

B: In the disk.

C: Only close to the center.

D: Everywhere.

E: In the halo.

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

A: In the disk only.

B: Only in the Solar Neighborhood.

C: Close to the center only.

D: Both the disk and in the halo, evenly distributed.

E: In the halo only.

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

A: Its mass.

B: Its distance.

C: Its chemical composition.

D: The number of stars in the cluster.

E: Its age.

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

A: The age of globular clusters is unknown.

B: They are older than the age of the Universe.

C: They are very young as stars go.

D: They are very old as stars go.

E: There are all sorts of globular clusters, young and old.

C **A pulsar gives us one pulse …**

A: when hot bubbles of gas rise from its interior.

B: when chuncks of matter fall into it.

C: when it rotates once.

D: when it reaches maximum diameter in its pulsation.

E: when it orbits another star once.

A **The central star of a planetary nebula is …**

A: A white dwarf.

B: A brown dwarf.

C: A main sequence star.

D: A supernova.

E: A red giant.

E **The chemical composition of a 0.5 solar mass white dwarf would be …**

A: Metals heavier than iron.

B: Hydrogen and helium.

C: Pure hydrogen.

D: Mostly iron.

E: Carbon and oxygen.

A **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: Gravitational energy.

D: Hydrogen to helium fusion.

E: The energy of radioactive decays.

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

A: It is a pair of colliding stars.

B: The core of a heavy star collapses.

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.

B **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: When matter falls into the black hole, it radiates just before falling in.

C: It obscures the light of stars that are behind it.

D: They have a strong magnetic field.

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

B **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 composition of meteorites.

C: Radiation broke up rocks on the surface of the Moon.

D: The existence of water on Earth.

E: The existence of gold on Earth.

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

A: In empty space.

B: In dust clouds reflecting starlight.

C: In dense cores of molecular clouds.

D: In supernova remnants.

E: In planetary nebulae.

C **Molecular clouds are …**

A: made of dust particles.

B: the result of SN explosions.

C: cold.

D: as dense as air.

E: hot.

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

A: It was a spontaneous collapse.

B: A sudden strengthening of the magnetic field of the Galaxy.

C: The capture of the Earth.

D: A collision with another star.

E: A nearby supernova explosion.