

Astronomy 3 Winter 2017  
Midterm 2

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Section 1C

Use a #2 pencil; make marks clean and dark. be sure to bubble in your name, ID # and form on the scantron; and write your name on this page.

Read all choices carefully; choose the best answer.

$$1 \text{ AU} = 1.5 \times 10^8 \text{ km}$$

$$c = 300,000 \text{ km/s}$$

$$1 \text{ light-year} = 9.5 \times 10^{12} \text{ km}$$

$$1 \text{ parsec} = 3.3 \text{ light years}$$

$$d = 1 / p$$

$$L = 4\pi\sigma T^4$$

1. Which of the following most likely explains why Venus does not have a global magnetic field like Earth?
  - A) Its rotation is too slow.
  - B) It does not have a metallic core.
  - C) Unlike Earth, Venus does not have a liquid outer core.
  - D) It has too thick of an atmosphere.
  
2. Based on all we know about the terrestrial worlds, what single factor appears to play the most important role in a terrestrial planet's geological destiny?
  - A) its size
  - B) its composition
  - C) its distance from the Sun
  - D) whether or not it has liquid water
  
3. Why is Mars red?
  - A) Chemical reactions between surface rock and atmospheric oxygen literally rusted the surface.
  - B) Martian volcanoes released a much redder lava than volcanoes on Earth.
  - C) The red color of Mars is a result of the scattering of light in the Martian sky.
  - D) The red color is caused by water ice chemically bound in surface rock.
  
4. Many scientists suspect that Venus has a stronger and thicker crust (lithosphere) than Earth. If this is true, which of the following could explain it?
  - A) The high surface temperature that has "baked out" all the liquid water from Venus's crust and mantle.
  - B) The smaller size of Venus, which has allowed it to lose much more internal heat than Earth.
  - C) The slow rotation of Venus.
  - D) The apparent lack of plate tectonics on Venus.
  
5. How do we know that the southern hemisphere of Mars is older than the northern hemisphere?
  - A) It is more heavily cratered.
  - B) Most of the volcanic features are found there.
  - C) The northern hemisphere is flooded with lava.
  - D) The elevation is higher.

6. The atmospheric pressure on Venus
- A) causes variations in surface temperature.
  - B) is much lower than on Earth.
  - C) shows an extreme change with the seasons.
  - D) is much higher than on Earth.
  - E) is about the same as on Mercury.
7. Which of the following does not have a major effect in shaping planetary surfaces?
- A) magnetism
  - B) volcanism
  - C) erosion
  - D) impact cratering
  - E) tectonics
8. Jupiter and the other jovian planets are noticeably oblate because
- A) they are tidally distorted by the pulls for their satellite systems.
  - B) they all have strong magnetic fields that deform their shape.
  - C) their powerful gravity acts stronger on the closer poles than the distant equator.
  - D) they are fluid bodies that are spinning rapidly.
  - E) All of the above are correct.
9. The rings of Saturn
- A) form a solid rock
  - B) are composed of millions of small icy particles.
  - C) are an optical illusion.
  - D) are composed of Earth-sized particles.
  - E) are actually highly elongated ellipses.
10. Saturn's rings may have originated from:
- A) cometary material captured by Saturn's gravity.
  - B) the destruction of a moon or planetoid from tidal stresses within the Roche limit
  - C) material released from Saturn during a collision with a planet-sized object.
  - D) material released from volcanic activity on Saturn.

11. The main greenhouse gases in the atmosphere of the terrestrial planets are:
- A) Oxygen and nitrogen
  - B) Methane and ozone
  - C) Carbon dioxide and water vapor
  - D) Hydrogen and helium
12. Essentially, the Great Red Spot is
- A) always located within 10 degrees of Jupiter's north pole.
  - B) Neptune's largest atmospheric feature.
  - C) travelling north and south across Jupiter's face.
  - D) a large cyclonic storm (hurricane).
  - E) composed primarily of iron oxide.
13. The two outer Jovian planets appear bluish in color because
- A) dust motes in their atmospheres scatter blue well, just as in our own blue sky.
  - B) methane gas in their atmospheres absorbs red light well.
  - C) from their distance, the Sun would appear hotter and bluer than from Earth.
  - D) ammonia absorbs blue light well.
  - E) hydrogen and helium are both blue in large concentrations.
14. What is the most important reason why an icy moon is more likely to be geologically active than a rocky moon of the same size?
- A) Ice is affected by tidal forces to a greater extent than rock.
  - B) Ice is less rigid than rock.
  - C) Ice is less dense than rock.
  - D) Ice has a lower melting point than rock.
  - E) Ice contains more radioactive elements than rock.
15. Why do asteroids and comets differ in composition?
- A) Comets formed from the Jovian nebula, while asteroids did not.
  - B) Asteroids are much larger than comets.
  - C) Asteroids and comets formed at different times.
  - D) Asteroids formed inside the frost line, while comets formed outside.
  - E) Comets are much larger than asteroids.

16. Why does the plasma tail of a comet always point away from the Sun?
- A) The solar wind electromagnetically "blows" the ions directly away from the Sun.
  - B) Radiation pressure from the Sun's light pushes the ions away.
  - C) Gases from the comet, heated by the Sun, push the tail away from the Sun.
  - D) It is allergic to sunlight.
  - E) The conservation of the angular momentum of the tail keeps it always pointing away from the Sun.
17. What is thought to cause Io's volcanism?
- A) tidal stresses from both Jupiter and Europa
  - B) impact energy left over from SL-9
  - C) Jupiter's gravity
  - D) radioactive decay of Uranium in its dense core
  - E) Jupiter's magnetosphere
18. Suppose we discover a comet whose orbit was very highly eccentric, retrograde, had a very large tilt with respect to the ecliptic plane, and a period of 2,000 years. Where is the most likely place of origin for this comet?
- A) the Kuiper Belt
  - B) the Oort Cloud
  - C) the giant planet family
  - D) outside the Solar System
19. One of the major reasons that professional astronomers are interested in comets is
- A) They are pretty.
  - B) They tell us about the gravity field of the outer solar system.
  - C) Their orbits can tell us about the solar wind.
  - D) They represent the primordial material of the original cloud from which the solar system formed (the solar nebula).
20. The temperature of the Sun's photosphere is about
- A) 3,200 K.
  - B) 5,800 K.
  - C) 11,000 K.
  - D) one million K.
  - E) ten million K.

21. Two stars appear from Earth to be equally bright – that is, they have the same apparent brightness. Star B is three times further away than is star A. Which of the following is TRUE?
- A) Star B is three times more luminous and has a larger parallax than star A.
  - B) Star B is nine times more luminous and has a smaller parallax than star A.
  - C) Star B is nine times less luminous and has a smaller parallax than star A.
  - D) Star B is equally as luminous but has a smaller parallax than star A.
  - E) Star B is three times less luminous and has a smaller parallax than star A.
22. The outward pressure of hot gas in the Sun
- A) is increasing the Sun's diameter.
  - B) is balanced by the inward gravitational pressure.
  - C) is cooling the photosphere.
  - D) is responsible for variations in the sunspot cycle.
  - E) weakens the magnetic field.
23. The most common element in the sun is
- A) helium
  - B) iron
  - C) hydrogen
  - D) water
  - E) nitrogen
24. Sunspots are dark splotches on the Sun. Which statement is true?
- A) They are extremely cold objects, as cold as Pluto.
  - B) They are hotter than the surrounding areas of the Sun.
  - C) They are associated with areas of very low magnetic fields.
  - D) They are solid bodies floating on the surface of the Sun.
  - E) They are extremely hot, but cooler than the surrounding areas of the Sun.
25. The numbers of sunspots and their activity peak about every
- A) six months
  - B) 36 days
  - C) 76 years
  - D) year
  - E) eleven years

26. Suppose a large solar flare is detected optically. How long until radio interference arrives?
- A) simultaneously
  - B) about 12 hours
  - C) 8.5 minutes later
  - D) no relation between the two
  - E) about four days
27. What natural barrier must be overcome for two protons to collide and fuse together?
- A) dark energy
  - B) the strong nuclear force
  - C) gravity
  - D) the weak nuclear force
  - E) electromagnetic repulsion
28. The critical temperature the core must reach for a star to shine by fusion is
- A) 5,800 K.
  - B) 11,000 K.
  - C) 127,000 K.
  - D) 10 million K.
  - E) 100 million K.
29. In the proton-proton cycle, the helium atom and neutrino have less mass than the original hydrogen. What happens to the "lost" mass?
- A) It is converted to energy.
  - B) It is transformed into electrons.
  - C) It is recycled back into hydrogen.
  - D) It is ejected into space.
  - E) Conservation of mass dictates no mass can be lost.
30. Today, the primary source of the Sun's energy is
- A) the weak force creating energy from uranium decay.
  - B) oxidation of carbon in the core.
  - C) dark energy.
  - D) the strong force fusing hydrogen into helium.
  - E) gravitational collapse of the helium inward.

31. The energy that fuels the Sun is generated:
- A) only on its surface.
  - B) only in its core.
  - C) both in its core and on its surface.
  - D) in its core, on the surface, and in the solar wind.
32. What best describes the chemical composition of the CENTER of the Sun today?
- A) It is 90% hydrogen.
  - B) It is 90% hydrogen and most of the rest of helium.
  - C) It is 50% hydrogen and almost 50% helium.
  - D) It is 90% helium and most of the rest is hydrogen.
  - E) Only a few percent of the atoms are hydrogen because everything is completely ionized.
33. The light radiated from the Sun's surface reaches Earth in about 8 minutes, but the energy of that light was released by fusion in the solar core about
- A) a hundred years ago.
  - B) ten years ago.
  - C) one year ago.
  - D) a million years ago.
  - E) a thousand years ago.
34. What processes are involved in the sunspot cycle?
- A) the winding of magnetic field lines due to differential rotation
  - B) variations of the solar thermostat
  - C) gravitational contraction of the Sun
  - D) wave motions in the solar interior
35. The Sun will likely stop being a main-sequence star in
- A) 5000 years
  - B) 5 million years
  - C) 50 million years
  - D) 5 billion years
  - E) 50 billion years

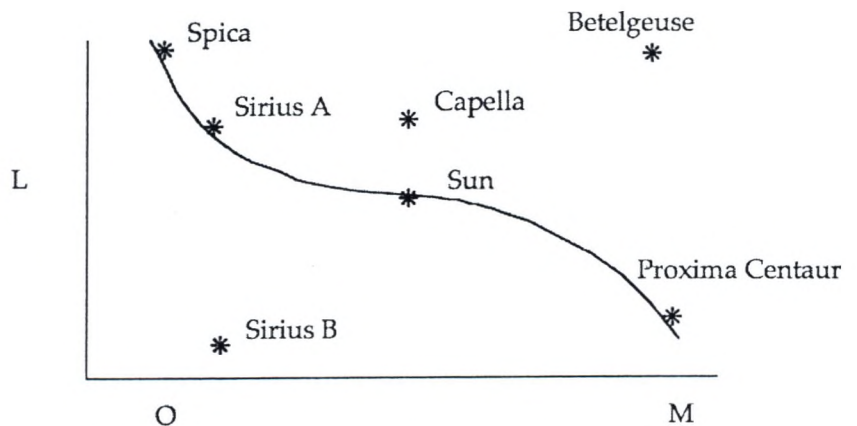


36. You observed three different star clusters and found that the brightest main-sequence stars in cluster 1 had spectral type A, the brightest main-sequence stars in cluster 2 had spectral type B, and the brightest main-sequence stars in cluster 3 had spectral type G. Which star cluster is the oldest?
- A) Cluster1  
 B) Cluster2  
 C) Cluster3  
 D) It is impossible to determine their ages given only the spectral types.
37. A star has a parallax of .05", its distance is
- A) 5 light years  
 B) 20 light years  
 C) 66 parsecs  
 D) 200 parsecs  
 E) 660 light years.
38. In general, what can be said about type O and B stars compared to type K and M stars?
- A) They are neither hotter nor cooler, younger nor older.  
 B) They are hotter and older.  
 C) They are hotter and younger.  
 D) They are cooler and older.  
 E) They are cooler and younger.

Use this H-R diagram to answer #40-#43.

39. Which star has to be young?

- A) Sun  
 B) Betelgeuse  
 C) Sirius B  
 D) Spica



40. Which star is a white dwarf?

- A) Sirius B
- B) Spica
- C) Sirius A
- D) Capella
- E) Sun

41. Which star has the smallest radius?

- A) Sirius B
- B) Sirius A
- C) Sun
- D) Betelgeuse

42. Which star has the largest radius?

- A) Sirius B
- B) Sirius A
- C) Sun
- D) Betelgeuse

43. No stars have been found with masses greater than 100 times our Sun because

- A) they shine exclusively at X-ray wavelengths and become difficult to detect.
- B) molecular clouds do not have enough material to form such massive stars.
- C) they would fragment into binary stars because of their rapid rotation.
- D) they would generate so much power that they would blow themselves apart.
- E) they are not bright enough to be seen nearby.

44. A star will spend most of its life

- A) in a sustained helium flash lasting billions of years.
- B) on the main sequence.
- C) as a protostar.
- D) in repeated swellings to the red giant.
- E) inside its planetary nebula.

45. A red giant has the same surface temperature as a main-sequence M star, but  $10^4$  times the luminosity. It therefore has spectral type:
- A) O
  - B) B
  - C) A
  - D) G
  - E) M
46. We know the stars called red giants are much larger than the Sun because
- A) They are cool and luminous, so the Stefan-Boltzmann law argues they must be large.
  - B) They are hot and luminous, so the Stefan-Boltzmann law argues they must be large.
  - C) They are cool and faint, so the Stefan-Boltzmann law argues they must be large.
  - D) They are hot and faint, so the Stefan-Boltzmann law argues they must be large.
47. What happens when a star exhausts its core hydrogen supply?
- A) It expands, becoming bigger but dimmer.
  - B) Its core contracts, but its outer layers expand and the star becomes bigger but cooler and therefore remains at the same brightness.
  - C) Its core contracts, but its outer layers expand and the star becomes bigger and brighter.
  - D) It contracts, becoming hotter and brighter.
  - E) It contracts, becoming smaller and dimmer.
48. If the interior temperature of a star decreases, the star will first
- A) Do nothing – i.e. remain the same
  - B) contract
  - C) expand
  - D) cease to exist as a star but cool to become a brown dwarf
  - E) increase its rate of fusion reactions.
49. Why doesn't the Sun presently create energy by fusing helium into heavier elements?
- A) The Sun's core isn't hot and dense enough.
  - B) There is no helium in the Sun's core.
  - C) When helium fuses, no energy is ever released.
  - D) Helium nuclei cannot fuse to make heavier atom.
  - E) Neutrinos inside the Sun prevent helium fusion.

50. The helium fusion process results in the production of
- A) hydrogen.
  - B) oxygen
  - C) nitrogen
  - D) iron
  - E) carbon
51. What is a planetary nebula?
- A) what is left of the planets around a star after a low-mass star has ended its life
  - B) the expanding shell of gas that is no longer gravitationally held to the remnant of a low-mass star
  - C) the molecular cloud from which protostars form
  - D) the expanding shell of gas that is left when a white dwarf explodes as a supernova
  - E) a disk of gas surrounding a protostar that may form into planets
  - F)
52. Compared to the star it evolved from, a white dwarf is
- A) Hotter and brighter
  - B) Hotter and dimmer
  - C) Cooler and brighter
  - D) Cooler and dimmer
  - E) The same temperature and brightness.

Lost in Space! Some things are worse than an exam. Just as you thought the exam was about over, you were plucked from Earth by a strange alien being. After performing gruesome experiments on your body and your mind, the alien gave you a "life-support belt" and dumped you somewhere in the solar system. This happened few times. A brief description of each place at which you were left by the alien follows. Identify your location each time.

53. You are walking around on a solid surface; the surface gravity is comfortable, but it is "hot as hell". It feels as if your eyeballs are being squeezed, and your insides are queasy (due to the high pressure – almost like being deep in the ocean). Your life-support belt is corroding. The Sun, barely visible through the haze, is near your meridian; you hope for nightfall (unaware that it would provide no substantial relief), but you already have been stuck on this planet for 72 hours, and the Sun seems not to have moved through the sky (and, if it moved at all, it moved eastward from the meridian).

- A) Earth
- B) Mars
- C) Mercury
- D) Venus
- E) Jupiter

54. Talk about vertigo! You've been dropped at the edge of a cliff, looking down for what seems to be miles! There's only one way to go from here: up! But it's going to be quite a climb, requiring all of the mountaineering skills you've ever heard of. The atmosphere here is very thin even at the mean surface level of this place; at altitude you'll never get a lungful. No matter, though; you could not breathe this atmosphere anyway, since it contains no oxygen; it's mostly carbon dioxide. You climb and climb; this mountain must be three times the height of Everest, and much broader at its base! You can find water ice as well. When you try to melt it, however, it does not turn to liquid (it sublimates to gas). Oh well, just keep climbing. But what will you do when you get to the top?

- A) Earth
- B) Mars
- C) Mercury
- D) Venus
- E) Neptune

55. Your first airless world! (The life-support belt seems somewhat out of adjustment, so you constantly feel as if you're going to explode.) Because of the lack of atmosphere, you must be very careful not to look at the Sun so that you will not be blinded by the ultraviolet and X-ray radiation; however, you are able to determine that the Sun has about the same angular size that you are used to on Earth. Also, because there is no air, you notice that the shadows are completely pitch-dark and there are no sounds at all. Although this world is clearly lifeless, you are surprised to find footprints and car tracks etched in the surface.

- A) Earth
- B) Mars
- C) Mercury
- D) Moon
- E) Venus

56. It's cold! You are sitting on what appears to be an ice-covered world (water ice). The Sun is low on the horizon and circles the horizon about once every 24 hours. You are pleased to find that the air is quite satisfactory; oxygen seems plentiful, and you are able to breathe even without the life-support belt.

- A) Mars
- B) Mercury
- C) Moon
- D) Earth
- E) Venus