PHY 101: Introduction to Astronomy
Fall 2021 Final Exam
Dec. 13, 10:30 a.m. - 12:15 pm
No electronic devices or notes of any kind; just this test and your pencil.
Exam, Form: A

Name: _____

Student Number: _____

TA: _____

Date: _____

Section 1. Matching of scientific terms and concepts (13 pts.). Note: there are definitions on the next page!

_____ conspicuous
_____ temperate
_____ palpable
_____ oblivion
_____ emancipation
_____ immutable
_____ adventitious
_____ manifold
_____ fiction
_____ commingle
_____ celestial
_____ basal
_____ cosmography
_____ antiquity
_____ sidereal
_____ ecliptic
_____ causation
_____ cosmogony
_____ interpose
_____ kalends
_____ chord
_____ recur
_____ virtue
_____ savant
_____ continuum
_____ Magellanic

(a) a very learned person
(b) plain to see or comprehend
(c) mix; blend
(d) the action of causing something
(e) happen again periodically or repeatedly
(f) belonging or relating to heaven
(g) relating to a region that has mild temperatures
(h) something that is invented or untrue
(i) extinction
(j) a straight line joining the ends of an arc
(k) first day of the month in the Roman calendar
(l) a sequence of adjacent elements that are not perceptibly different from each other
(m) liberation
(n) relating to the Large or Small Magellanic cloud
(o) the science that deals with the general features of the universe, including the earth
(p) relating to the distant stars
(q) the ancient past; before the Middle Ages
(r) a great circle on the celestial sphere representing the sun's apparent path during the year
(s) happening according to chance rather than design or inherent nature
(t) the branch of science that deals with the origin of the universe
(u) a quality considered good or desirable
(v) belonging to a bottom layer or foundation
(w) standing out so as to be clearly visible
(x) unchanging over time or unable to be changed
(y) having many different forms or elements
(z) place or insert between one thing and another

Section 2. Multiple choice (44 pts. (2 points each))

1. Approximately where is the constellation Orion located right now—at around 11 am on Monday, December 13?
   (a) just below the horizon toward the east
   (b) a bit above the horizon toward the east
   (c) just about overhead, but a little bit toward the west
   (d) just above the horizon to the west
   (e) basically below my feet
2. Which of these is in the correct chronological order of authors?
   (a) Aristotle, Leavitt, Galileo
   (b) Galileo, Ptolemy, Kepler
   (c) Bede, Lemaitre, Kepler
   (d) Slipher, Hubble, Bede
   (e) Ptolemy, Waldseemueller, Shapely
3. Which of the following was taught by Aristotle?
   (a) the earth is flat
   (b) the earth is one of the planets
   (c) the World is made up of countless unbreakable atoms
   (d) the World is eternal: it had no beginning and will have no end
   (e) all of the above
4. Which of the following does Aristotle cite as evidence that the Earth is round?
   (a) the altitude of the north star above the northern horizon decreases as one travels southwards
   (b) dropped objects will naturally form a sphere around the central point toward which they fall
   (c) the shadow cast by the earth on the moon during a lunar eclipse is curved
   (d) all of the above
   (e) none of the above
5. Which of the following arguments did Ptolemy deploy to argue that the Earth must be at the center of the celestial sphere?
   (a) if it were not, then the stars might appear larger or smaller, depending on their proximity to the Earth
   (b) the shadows of a sundial at sunrise and sunset DO lie in a straight line on the equinox
   (c) if it were not, then the equinox would not lie midway between the solstices
   (d) if it were not, then the horizon would not bisect the zodiac
   (e) all of the above

6. The day of Christ's incarnation (when God took on flesh) is traditionally celebrated on December 25. This is because
   (a) the Bible says that Jesus was born on December 25
   (b) that is the darkest day—the winter solstice—according to the Julian calendar
   (c) the Roman Catholic Church arbitrarily assigned this day during the Dark Ages
   (d) December 25 falls midway between the ancient rite of Festivus and the day of Kwanzaa
   (e) this date was decided in 1821 at the third general Baptist convention in Fort Lauderdale
7. Martin Waldseemueller
   (a) made a famous map of the world which included the lands that he called America
   (b) was influenced by the work of Homer and Ptolemy
   (c) was ordained as a priest
   (d) all of the above
   (e) none of the above
8. Approximately how many degrees above the southern horizon will the sun be found at noon on the summer solstice for an observer standing in Los Angeles, California (located at 34 degrees north latitude)?
   (a) 55
   (b) 60
   (c) 70
   (d) 80
   (e) 90
9. Which of the following was -not- one of the seven traditional liberal arts
   (a) grammar
   (b) geometry
   (c) music
   (d) falconry
   (e) astronomy
10. Which planet has an orbital period (about the sun) of approximately 2 years?
   (a) Mercury
   (b) Venus
   (c) Mars
   (d) Jupiter
   (e) Saturn
11. Mars is farthest from earth when it appears
   (a) red
   (b) largest
   (c) to rise in the evening
   (d) to set in the evening
   (e) actually, Mars is always at the same distance from the Earth

12. The speed of a planet orbiting the sun is slowest when it is at its
    (a) apogee
    (b) perigee
    (c) aphelion
    (d) perihelion
    (e) actually, the planets all experience uniform circular motion

13. With which of the following statements would Johannes Kepler agree?
    (a) a gravitational force attracts the planets towards the sun
    (b) the planets ride about the sun on solid crystalline celestial spheres
    (c) the planets orbit the sun in an elliptical fashion, with the sun at one of the foci
    (d) the World and all that is in it was formed by the radioactive decay of a primeval atom
    (e) actually, Kepler would agree with all of these statements

14. Which of the following did Galileo conclude, based on his telescopic observations?
    (a) there are mountains on the moon that exceed a mile in height
    (b) the Milky way is comprised of thousands of stars
    (c) nebulae are comprised of stars
    (d) Jupiter has four moons
    (e) all of the above

15. Jill, on Earth, sees a crescent moon one night. At the same time Jack, on the moon, sees
    (a) a new Earth
    (b) a crescent Earth
    (c) a half Earth
    (d) a gibbous Earth
    (e) a full Earth

16. According to Newton's theory of universal gravitation, the sun attracts the Earth. So why doesn't the Earth fall into the sun?
    (a) the gravitational pull by the sun gets weaker whenever the earth is at perihelion, so the earth never hits the sun
    (b) the earth is moving so fast -around- the sun that it never falls -into- the sun
    (c) the gravitational force of Jupiter keeps the Earth from falling into the sun
    (d) the Earth cancels the sun's gravitational pull
    (e) actually, the Earth -has- fallen into the sun

17. Cepheid variable stars
    (a) all have the same intrinsic brightness
    (b) were first discovered by Henrietta Leavitt
    (c) have never been observed in our own Galaxy
    (d) have an intrinsic brightness that changes from day to day
    (e) all of the above

18. The speeds of various nebulae were first determined by Vesto Slipher by measuring their
    (a) red shift
    (b) luminosity
    (c) mass
    (d) distance
    (e) temperature

19. A spectrometer relies on the fact that white light
    (a) is refracted by a prism
    (b) behaves like both a wave and a particle
    (c) can be separated into its various colors when it strikes a prism
    (d) loses energy after it is emitted by a distant star
    (e) all of the above

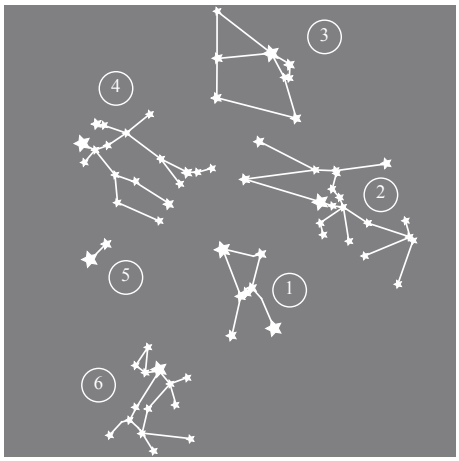
20. In order to know the distance to a cepheid variable star, one must measure its
    (a) apparent brightness and period
    (b) apparent brightness alone
    (c) temperature and color
    (d) temperature alone
    (e) all of the above would work

21. If nebula $M1$ is three times as far away from the earth as nebula $M2$, then according to Hubble's law $M1$ is receding from the earth
    (a) at the same speed as $M2$
    (b) twice as fast as $M2$
    (c) three times as fast as $M2$
    (d) seventy times as fast as $M2$
    (e) actually, $M1$ must be approaching the earth

22. According to Lemaitre, the universe came into existence
    (a) as an act of creation about ten thousand years ago
    (b) not in an instant; rather it has always existed in more or less the same form
    (c) as a result of the radioactive decay of an extremely high atomic number primeval atom
    (d) is comprised of matter which is being continually created in little cracks in the universe that are formed as it rapidly expands
    (e) none of the above

Section 3. Constellation and bright star identification (13 pts.)

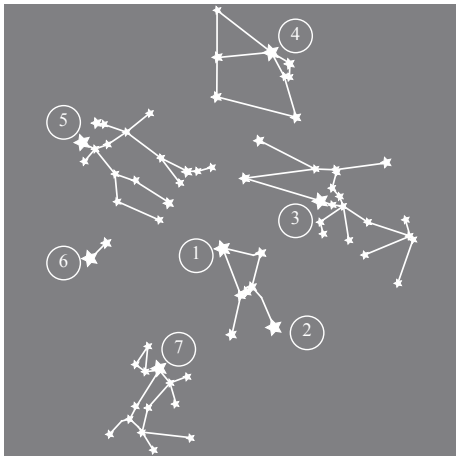
Four Stories



Name the Constellations:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Orion's Hunting Party



Name the Bright Stars:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

63

Figure 1:

1.

Section 4. Copernicus' worldview (14 pts. (2 points each))

1. Appropriately label the items listed below on the diagram on the following page. You will be graded on neatness, accuracy, and legibility.

   (a) draw a little star on sun

   (b) label the constellation "aquarius"

   (c) draw the letter V on the location of the Earth at the moment of the vernal equinox

   (d) draw the letter E at the location of the Earth today

   (e) label the constellation in front of which we see the sun today

   (f) make a little sketch of the Big Dipper at the proper location on the celestial sphere

   (g) Suppose you were standing atop the celestial sphere at the location of Polaris and looking down at the sun. Does the earth move around the sun in the clockwise (CW) or counterclockwise (CCW) direction?

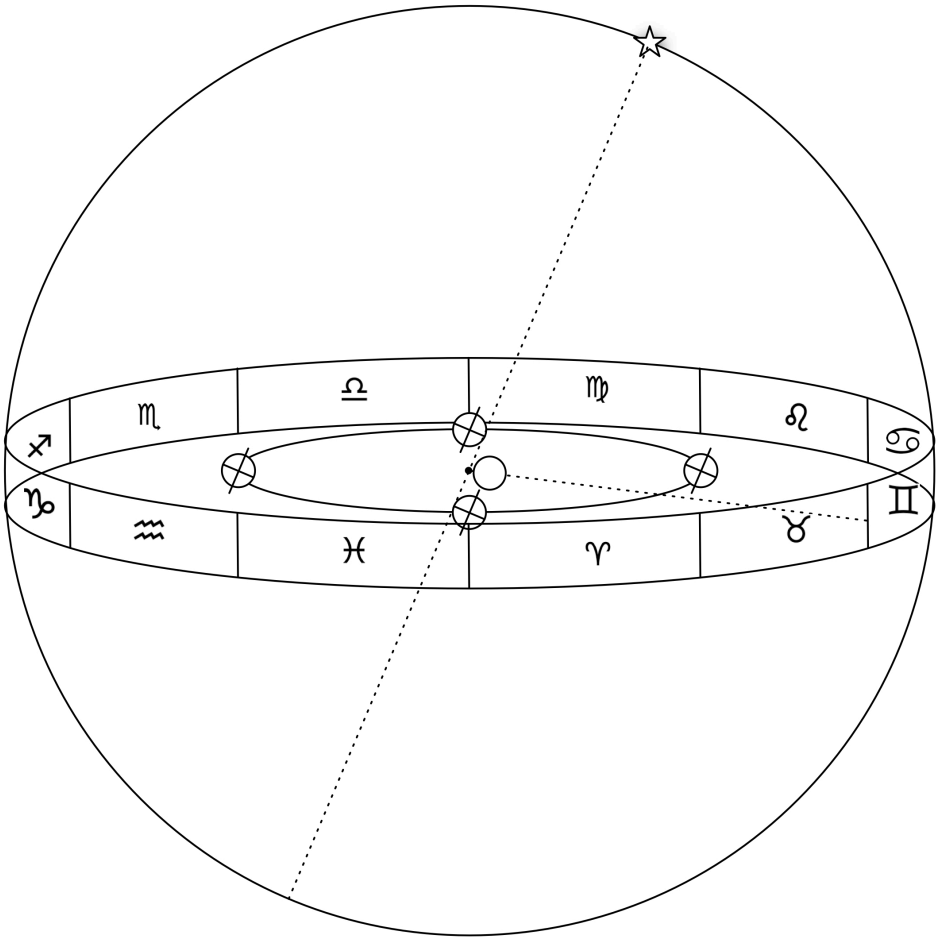


Figure 2: The celestial sphere, based on Copernicus's *Revolutions of the heavenly spheres*

Section 5. Essay question (16 pts)

Answer the following essay question using correct grammar, clear reasoning, and graceful style. Be sure to provide specific evidence, examples or arguments to clarify any assertions that you make.

1. The term "gravity" has been used throughout history from ancient to modern times. But the ancients meant something very different than the moderns by the term "gravity". Describe, to the best of your ability, the evolution of the meaning of the term "gravity". In particular, you should explain the views of of (i) Aristotle, (ii) Newton, and (ii) Einstein on gravity. With which of these thinkers do you most agree or sympathize? Why?