

PHY 101: Introduction to Astronomy
Final exam Dec 11, 2023
No electronic devices or notes of any kind.
Exam, Form: A

Name: _____
Student Number: _____
TA: _____
Date: _____

Section 1. Matching of scientific terms and concepts (5 pts.)

- | | |
|--------------------|---|
| _____ abate | (a) an end or extremity |
| _____ luminous | (b) strongly encourage |
| _____ oblique | (c) the intrinsic nature or indispensable quality of something |
| _____ vertex | (d) emitting light as a result of being heated |
| _____ vanquish | (e) the point in the sky or celestial sphere directly above an observer |
| _____ intrinsic | (f) existing now; possibly to be changed later |
| _____ disposition | (g) the way in which something is placed or arranged |
| _____ parsec | (h) slanting |
| _____ horoscope | (i) each of four quarters of a circle |
| _____ incandescent | (j) a meeting point of two lines that form an angle |
| _____ terminus | (k) defeat thoroughly |
| _____ corroborate | (l) belonging naturally |
| _____ exhort | (m) cause to become smaller or less intense |
| _____ presumption | (n) confirm or give support to |
| _____ untenable | (o) a unit of distance used in astronomy, equal to about 3.26 light years |
| _____ zenith | (p) bright or shining |
| _____ provisional | (q) oppose successfully |
| _____ essence | (r) an idea that is taken to be true, and often used as the basis for other ideas |
| _____ quadrant | (s) unable to be defended against attack or objection |
| _____ thwart | (t) a forecast of a person's future based on the positions of the stars and planets |

Section 2. Multiple choice (30 pts.)

1. You are all in this classroom facing the same direction. Approximately where is Orion located right now (Dec. 11, 2023)?
 - (a) ahead of you
 - (b) behind you
 - (c) above you
 - (d) to your left
 - (e) to your right
2. A solar eclipse might happen on a night when the moon phase is
 - (a) new
 - (b) crescent
 - (c) half
 - (d) full
 - (e) in fact, a solar ecilpse can happen when the moon is in any of these phases
3. When standing at the latitude of the antarctic circle, the sun will pass through your zenith (be directly overhead)
 - (a) once per year
 - (b) twice per year
 - (c) once each day for half of the year
 - (d) once each day during the whole year
 - (e) never
4. Suppose it is the time of year that the sun is just entering Cancer. If the moon happens to be in its full phase, then the moon must be entering
 - (a) Aries
 - (b) Cancer
 - (c) Libra
 - (d) Capricorn
 - (e) it depends on the particular year
5. How long does it take for the moon to progress through the entire zodiac (sidereal month)?
 - (a) less than 25 days
 - (b) about $27 \frac{1}{3}$ days
 - (c) about $29 \frac{1}{2}$ days
 - (d) just under one year
 - (e) between one and three years
6. How long does does it take for the moon to go through all its phases (synodic month)?
 - (a) less than 25 days
 - (b) about $27 \frac{1}{3}$ days
 - (c) about $29 \frac{1}{2}$ days
 - (d) just under one year
 - (e) between one and three years

7. Which planet has an orbital period around the sun of approximately 88 days
- (a) Mercury
 - (b) Venus
 - (c) Mars
 - (d) Jupiter
 - (e) Saturn
8. The planets ordinarily progress through the zodiac; which of the following planets exhibits the most frequent retrograde motion when viewed from Earth?
- (a) Mercury
 - (b) Venus
 - (c) Mars
 - (d) Jupiter
 - (e) Saturn
9. Which of the planets can never appear in opposition to the sun (on the opposite side of the sky)?
- (a) Venus
 - (b) Mars
 - (c) Jupiter
 - (d) Saturn
 - (e) In fact, all of these can appear in opposition to the sun
10. When Venus appears in its full phase from earth, it must be at
- (a) apogee
 - (b) perigee
 - (c) perihelion
 - (d) aphelion
 - (e) in fact, all of the above are possible
11. Suppose you are standing in Oranjestad (the Capital of Aruba, which is located at 12 degrees north latitude)? About how many degrees above the southern horizon will the sun be at local noon on the day of the winter solstice (Dec. 21)?
- (a) 74
 - (b) 54
 - (c) 34
 - (d) 14
 - (e) 4
12. What is the traditional day that the Christian church celebrates the Annunciation: when Gabriel came to announce the birth of Jesus to the Virgin Mary?
- (a) Winter solstice
 - (b) Vernal equinox
 - (c) Summer solstice
 - (d) Autumnal equinox
 - (e) it depends on the year

13. Which of these lists of authors is -not- in correct chronological order?
- (a) Aristotle, Copernicus, Leavitt
 - (b) Ptolemy, Kepler, Shapely
 - (c) Bede, Waldseemüller, Galileo
 - (d) Copernicus, Galileo, Slipher
 - (e) in fact, all of these are in correct chronological order
14. 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
15. Within which branch of theoretical philosophy did Ptolemy situate astronomy?
- (a) theology
 - (b) mathematics
 - (c) physics
 - (d) rhetoric
 - (e) logic
16. A temperate region of the Earth has as its boundaries
- (a) the tropic of cancer and the tropic of Capricorn
 - (b) the tropic of Cancer and the arctic circle
 - (c) the equator and the tropic of Cancer
 - (d) the arctic circle and the north pole
 - (e) the equator and the south pole
17. Jill, on Earth, sees a gibbous moon one night. At the same time Jack, an astronaut on the moon, sees
- (a) a new Earth
 - (b) a crescent Earth
 - (c) a half Earth
 - (d) a gibbous Earth
 - (e) a full Earth
18. The speed of a planet orbiting the sun is fastest when it is at its
- (a) apogee
 - (b) perigee
 - (c) aphelion
 - (d) perihelion
 - (e) actually, the planets all experience uniform circular motion

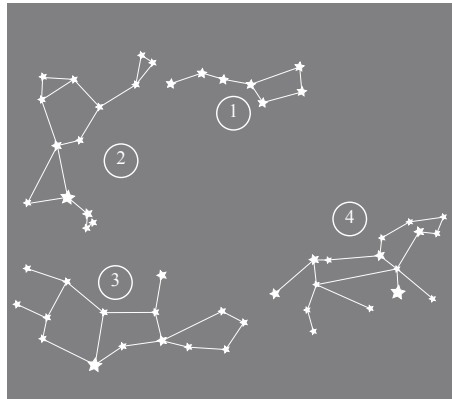
19. Two satellites orbit Saturn. The ratio of their orbital distances is 4:1. The ratio of their orbital periods is
- (a) 3:1
 - (b) 8:1
 - (c) 9:1
 - (d) 27:1
 - (e) none of the above
20. Which of the following is a platonic solid? For this question, you may circle up to five answers.
- (a) tetrahedron
 - (b) cube
 - (c) octahedron
 - (d) dodecahedron
 - (e) icosahedron
21. Which of the following did Galileo -not- conclude based on his telescopic observations?
- (a) the distant Nebulae exhibit a redshift—which implies the expansion of the universe
 - (b) Jupiter is orbited by four moons—the so-called “Medician stars”
 - (c) there is a mountain on our moon that is about 4 miles tall
 - (d) the Milky Way Galaxy is comprised of many many stars
 - (e) in fact, Galileo drew all of these conclusions from his observations
22. If the mass of the earth and the moon were both were doubled, then the gravitational force of the earth pulling on the moon would
- (a) be different than the force of the moon acting on the earth
 - (b) remain the same
 - (c) be doubled
 - (d) be tripled
 - (e) be quadrupled
23. Which of the following is Newton’s first law of motion?
- (a) the planets orbit the sun in elliptical orbits with the sun at one of the foci
 - (b) an object in motion tends to retain its state of motion if acted on by no forces
 - (c) an object’s acceleration is proportional to the total force acting on it
 - (d) for every force there is an equal and opposite force
 - (e) none of the above
24. The universal law of gravitation
- (a) was developed by Newton in order to explain Kepler’s three laws of planetary motion
 - (b) claims that all masses attract all other masses
 - (c) was proposed in the 17th century
 - (d) is an inverse square law of force
 - (e) all of the above

25. 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
26. Suppose that a spiral nebula exhibits a larger redshift on its left side than on its right sides. From this you can reasonably conclude that the nebula is
- (a) stationary and not rotating about its axis
 - (b) receding and rotating about its axis
 - (c) approaching and not rotating
 - (d) receding and not rotating
 - (e) approaching and rotating
27. 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
28. If Hubble's constant is about 70 kilometers per second per mega-parsec, and a distant galaxy is measured to be receding from the earth at 2100 kilometers per second, then about how far away is the galaxy?
- (a) 3 mega-parsecs
 - (b) 30 mega-parsecs
 - (c) 70 mega-parsecs
 - (d) 210 mega-parsecs
 - (e) greater than 500 mega-parsecs
29. According to Lemaitre, which of the following is infinite?
- (a) the number of stars in the universe
 - (b) the odd cardinal numbers.
 - (c) the number of sand grains in the Earth
 - (d) the size of the universe
 - (e) all of the above
30. The ratio of the circumference to the diameter of a circle that is drawn on the surface of a sphere is
- (a) less than π
 - (b) equal to π
 - (c) greater than π
 - (d) it depends on the size of the sphere
 - (e) seven

31. Lemaitre writes that, in the opinion of the scientist Buffon,
- (a) the nebulae formed by condensation of a swarm of particles throughout the universe
 - (b) beings who are more intelligent than man dwell on planets more distant from our sun
 - (c) just as Jupiter orbits the sun, so also the sun orbits the center of our galaxy
 - (d) the Earth formed because of a collision between the sun and a comet
 - (e) none of the above
32. According to Lemaitre, the radius of curvature of space
- (a) can be calculated using Einstein's equations of general relativity
 - (b) depends on the density of matter and energy filling space
 - (c) has been increasing for some time now
 - (d) all of the above
 - (e) none of the above
33. 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 (5 pts.)

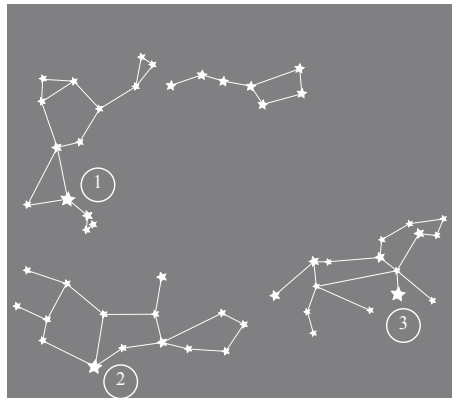
Four Stories



Name the Constellations:

- ① _____
- ② _____
- ③ _____
- ④ _____

Dipper for a Damsel in Distress



Name the Bright Stars:

- ① _____
- ② _____
- ③ _____

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Figure 1:

1.

Section 4. Copernicus' worldview (3 pts.)

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 the letter *S* on the sun
- (b) draw the letter *P* on "Pisces"
- (c) draw the letter *A* on the location of the Earth at the moment of the autumnal equinox
- (d) draw the letter *E* at the location of the Earth today
- (e) draw the letter *Z* on the zodiac constellation in front of which the sun is located today
- (f) when viewed downward from Polaris, in which direction does the Earth spin *about its own axis*? CW or CCW?

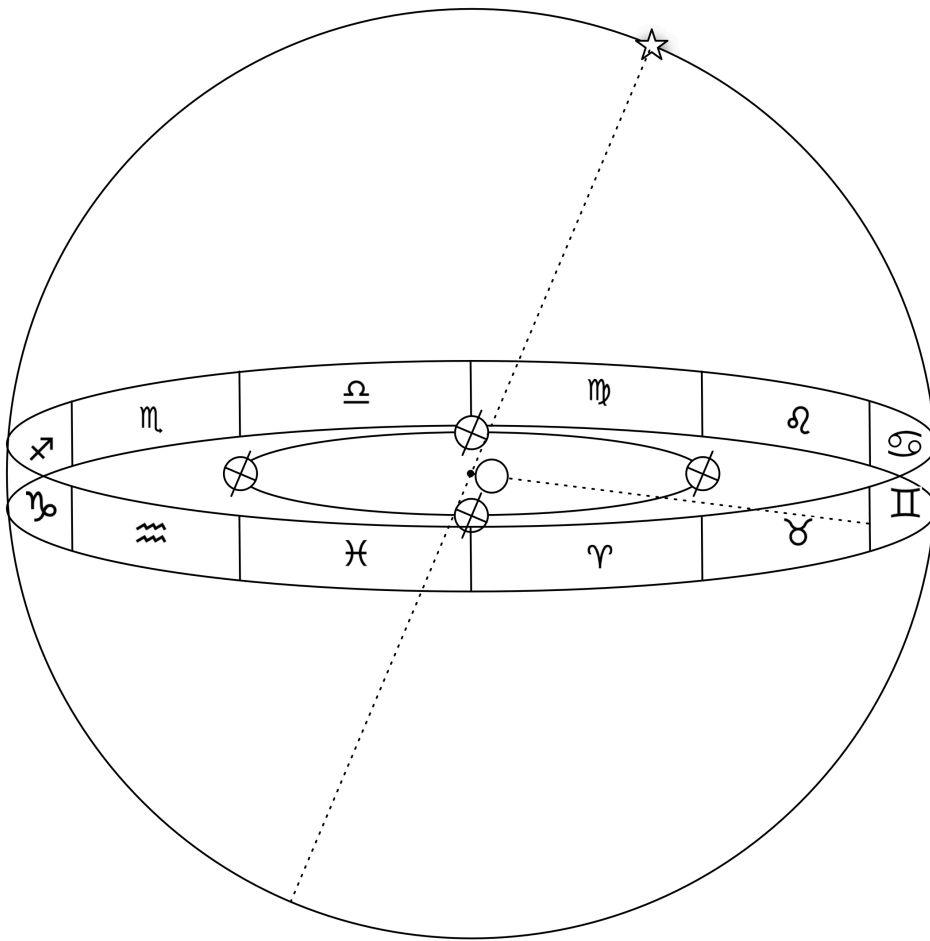


Figure 2: The celestial sphere, based on Copernicus's *Revolutions of the heavenly spheres*

Section 5. Essay question (4 pts.)

Answer the following essay question using correct grammar, clear reasoning, and graceful style.

1. In his book *Galaxies*, which you read a selection from this semester, Hubble argued that the apparent brightness of a galaxy is a good indicator of its distance from us. How did he arrive at this opinion? Explain as clearly and concisely as possible his line of reasoning. Be sure to identify the assumptions that he used to arrive at this conclusion.