1. You would expect to see a waxing crescent Moon
   a. Setting in the East right after the Sun.
   b. In the North at around midnight.
   c. Rising in the West just before the Sun.
   d. Rising in the East just before the Sun.
   e. Setting in the West right after the Sun.

2. The thing that is useful about a scientific model of a physical system is that it
   a. predicts the results of observations on real systems.
   b. provides the opportunity to make an artistic statement.
   c. reveals the true nature of the real system.
   d. can be tested without observing the real system.

3. Which of the following phases of the Moon would be seen high in the south at dawn?
   a. waxing quarter.
   b. full.
   c. waning crescent.
   d. waning quarter.
   e. waxing crescent.

4. Which of the following statements is an observation of the natural world?
   a. The Moon cannot be full and not full at the same time.
   b. The newspaper says that the Moon was full last night.
   c. I saw a full Moon last night.
   d. A full Moon is prettier than a crescent Moon.

5. At which of these times of day would you expect to find the Sun in the East?
   a. Midnight.
   b. 6:00am.
   c. Noon.
   d. 6:00pm.

6. You read in an Astronomy book that our Milky Way Galaxy consists of about 200 billion stars. How do you suppose this number was determined?
   a. By counting the stars in our immediate neighborhood and assuming that to be typical of every neighborhood.
   b. By picking a number more or less at random since nobody could ever check it.
   c. By using a model of the galaxy that correctly accounts for everything that has been measured so far.
   d. By using a computer and a large telescope to count them all.

7. Kepler was an early advocate of the Copernican Theory. When he applied it to Tycho’s observations, it
   a. was as accurate as the observations.
   b. failed and was completely discarded.
   c. worked perfectly.
   d. failed but led to a better theory.
8 The ecliptic is
   a. the path of the Sun on the Celestial Sphere.
   b. an image of the Earth’s equator.
   c. the set of points with zero right ascension.
   d. the path of the Moon on the Celestial Sphere.
   e. halfway between the North and South Celestial Poles.

9 The Ptolemaic model of the Solar system accounted for the daily rising and setting of the Sun by assuming that
   a. The Sun drops below the surface of the Earth when it sets and travels underground to get back to where it rises each day.
   b. The Sun moves around the Earth once a day.
   c. The Earth rotates on its axis once a day.
   d. The Earth moves around the Sun once a day.

10 A time of 24 hours is
    a. exactly equal to a solar day.
    b. slightly different from both a solar day and a sidereal day.
    c. exactly equal to a sidereal day.

11 Aristotle said that the spherical shape of the Earth was
    a. the natural result of gravity pulling everything toward a center.
    b. unstable since small deviations from it would grow larger.
    c. something that could not be explained or understood.
    d. due to air pressure pushing everything inward.

12 One advantage of the spherical Earth model is that it completely explains
    a. the retrograde motion of the planets.
    b. the existence of oceans.
    c. what causes the Sun to rise and set.
    d. what holds up the surface of the Earth.

13 A sidereal day is the time it takes for
    a. the Moon to come back to the same positions in the sky.
    b. the stars to come back to the same positions in the sky.
    c. the Sun to come back to the same position in the sky.

14 Aristarchus measured the angle between the Sun and the Moon when exactly half of the Moon was illuminated.
   He found this angle to be
    a. less than 90 degrees by an amount that was easy for him to measure.
    b. exactly 90 degrees.
    c. less than 90 degrees by an amount too small for him to measure.
    d. greater than 90 degrees.
15 Sarah reports that she saw a green star close to the star Betelgeuse. Actually she did not even look there. The most likely outcome of her fraud is that:
   a. Other people look near Betelgeuse. They do not see the green star, and attack her report as a mistake or a fraud.
   b. Other people look near Betelgeuse. They see the star and confirm her report. She becomes famous as the discoverer of the first green star.
   c. Nobody bothers to check her observation and nobody believes her either.
   d. Nobody bothers to check her observation and she becomes famous as the discoverer of the first green star.

16 You are looking down on the Earth from a spacecraft hovering far above. After watching for a while, you notice that, from your perspective, it is rotating counterclockwise. The part of the Earth that is directly below you must be the Earth’s
   a. Equator.
   b. South Pole.
   c. North Pole.

17 The changing phases of the Moon are caused by
   a. the motion of the Moon around the Earth.
   b. the rotation of the earth on its axis.
   c. the changing distance to the Moon.
   d. the tilt of the Earth’s axis.
   e. the motion of the earth around the Sun.

18 The Ptolemaic model of the Solar System has each planet moving along a
   a. circular epicycle whose center, in turn, moves around the Sun.
   b. circular path around the Sun.
   c. circular epicycle whose center, in turn, moves around the Earth.
   d. circular path around the Earth.

19 In comparison to the established, earth-centered theory, the Copernican Theory of planetary motion made predictions that were of
   a. about the same accuracy.
   b. much higher accuracy.
   c. much less accuracy.

20 Einstein’s Theory of Gravity has passed every well-understood observational test for over 100 years. However there are some observations, which are not well-understood. For example, the Pioneer space probe is showing tiny deviations from its predicted course as it leaves the neighborhood of our solar system. A new theory, called "Modified Newtonian Dynamics," actually does not do as well as Einstein’s Theory at predicting most things, but it does predict those tiny deviations and also accounts for several other, apparently unrelated, anomalous observations as well. From what we have said about the way scientists think, which of the following receptions would you expect this new theory to get?
   a. There is great hostility because the new theory challenges the established theory.
   b. There is great disinterest because there is no need to replace a theory that has passed every well-understood observational test.
   c. There is great interest because the new theory suggests that Einstein’s Theory might be wrong.
   d. There is great disinterest because the new theory does not account for as many observational tests as Einstein’s Theory does.
21 One reason that temperatures are lower in the winter than in the summer is that
   a. the sun is lower in the sky in the winter.
   b. the sun is farther from our hemisphere in the winter.
   c. the sun is higher in the sky in the winter.
   d. the sun is closer to our hemisphere in the winter.

22 Tycho Brahe’s main contribution to the understanding of planetary motion was to
   a. propose a new theory.
   b. disprove Ptolemy’s theory.
   c. make extensive observations.
   d. explain the observations.
   e. confirm Copernicus’ theory.

23 The Ptolemaic System was replaced when
   a. Copernicus produced a system with the Sun at the center.
   b. Astronomers realized that Aristarchus had been right when he said it was unreasonable for the giant Sun
to orbit the tiny Earth.
   c. it came into conflict with reproducible observations.

24 There are 365.242199 solar days in a year. From this fact, you can conclude that, relative to the distant stars,
earth rotates closest to
   a. 365.242199 times in a year.
   b. 364.242199 times in a year.
   c. 366.242199 times in a year.
   d. a number of times in a year that cannot be determined from the information given.

25 The time from one Full Moon to the next is 29.5 days. The length of a sidereal month is
   a. 29.5 days.
   b. 27 days.
   c. 29.7 days.
   d. 29.3 days.
   e. 32 days.

26 From the way that solar eclipses happen, the ancient Greeks concluded that
   a. the Sun is closer to the Earth and larger than the Moon.
   b. the Sun is closer to the Earth and smaller than the Moon.
   c. the Sun is farther from the Earth and larger than the Moon.
   d. the Sun is farther from the Earth and smaller than the Moon.

27 According to Kepler’s Laws of Planetary Motion, as planets orbit the Sun, they
   a. speed up when farthest from the Sun.
   b. speed up when in retrograde motion.
   c. move at constant speed.
   d. speed up when closest to the Sun.
28 The ancient Greeks concluded that the Sun is larger than the Earth because
   a. total lunar eclipses never happen.
   b. a total lunar eclipse happens only over a very small part of the Earth.
   c. a total solar eclipse happens only over a very small part of the Earth.
   d. a total lunar eclipse happens everywhere on Earth at once.
   e. a total solar eclipse happens everywhere on Earth at once.

29 The first major failure of the Ptolemaic Theory to predict the results of observations was
   a. the Moons of Jupiter.
   b. the retrograde motion of the planets.
   c. the mountains of the Moon.
   d. the phases of Venus.
   e. the precise observations of Tycho Brahe.

30 In the picture that we used in class, with the Sun above the top of the picture and the Earth shown with its
   North Pole facing you, the part of the Earth that is to the left of the North pole in the picture is experiencing
   a. midnight.
   b. sunrise.
   c. sunset.
   d. noon.

31 Planets move mostly eastward relative to the distant stars but, once during each trip around the Celestial
   Sphere, they loop back westward for a while. This motion is called
   a. planetary reversal.
   b. overtaking behavior.
   c. paradoxical motion.
   d. epicyclic motion.
   e. retrograde motion.

32 Kepler’s First Law of Planetary Motion is that the orbit of each planet is
   a. an ellipse with the Sun at the center.
   b. a circle with the Sun offset from the center.
   c. an ellipse with the Sun at one focus.
   d. a circle with the Sun at the center.

33 Which of the following statements is falsifiable?
   a. All of the fish in Lake Nyak are ugly.
   b. There are green fish in Lake Nyak.
   c. There are no green fish in Lake Nyak.

34 The closest star to the North Celestial Pole that is visible to the naked eye is
   a. Mizar.
   b. Polaris.
   c. Sirius.
   d. Altair.
   e. Alcor.
35 Stars that appear close together in the sky are
   a. never close to each other in space.
   b. sometimes close to each other in space.
   c. always close to each other in space.

36 At 10pm, you see that the pointer stars of the Big dipper and the star Polaris are arranged in a vertical line. what time would you see them arranged in a horizontal line?
   a. It will never happen.
   b. 1:59:00 a.m. the next day.
   c. 3:59:00 a.m. the next day.
   d. 11:59:40 p.m. that same day.
   e. 9:56:00 p.m. the next day.

37 Aristarchus measured the angle between the Sun and the Moon when exactly half of the Moon was illuminated. If he had measured the angle when 3/4 of the Moon was illuminated, he would have found that angle to be
   a. exactly 90 degrees.
   b. less than 90 degrees by an amount too small for him to measure.
   c. less than 90 degrees by an amount that was easy for him to measure.
   d. greater than 90 degrees.

38 The observation that there are constellations that can be seen from Egypt but not from Greece convinced the ancient Greeks that
   a. the Earth is flat.
   b. the Earth is round.
   c. stars hang close to the Earth.

39 The first major failure of the Ptolemaic Theory to predict the results of observations was
   a. the retrograde motion of the planets.
   b. the mountains of the Moon.
   c. the phases of Venus.
   d. the Moons of Jupiter.

40 Which of the following statements is the most likely to be a reproducible observation:
   a. I saw the Sun rise and set during the same clear 24-hour day in the continental United States.
   b. I saw the Sun rise and set during the same clear 24-hour day.
   c. I saw the Sun rise and set during the same clear 24-hour day in the United States.
   d. I saw the Sun rise and set during the same 24-hour day.

41 The idea that science only deals with statements that are falsifiable, subject to possible disproof by observation, suggests that
   a. science is always wrong.
   b. science produces revisable facts.
   c. science only deals with guesses.
42 Suppose that someone who works at the U.S. Naval Observatory says that he saw the Moon rise at 6:45pm on April 25, 2008. This statement is most likely
   a. a proven mathematical theorem.
   b. an actual observation of the natural world.
   c. an unsupported opinion.
   d. the result of a calculation.

43 Sven, a well-known Loch Ness Monster fanatic, often reports seeing the monster but is usually ignored. One evening, while watching the monster swim around in the light of the setting sun, Sven notices that the tide is out and there is a quarter Moon in the sky. He tells this story to a newspaper reporter who humors him and shows up to look for the monster the next time there is a low tide at sunset with a quarter moon. Sure enough, the monster appears. A local university then sends a biologist with a truckload of cameras at the next sunset-low-tide-quarter-moon and the monster again shows up on cue. Sven’s observations of the monster are now accepted by the scientific community because
   a. Sven saw the monster many times.
   b. Sven’s observations were reproduced by others.
   c. Sven told a good story with lots of details.
   d. Scientists really like monster stories.

44 You see a waning Gibbous Moon directly south. What time might it be?
   a. sunset.
   b. about 10pm.
   c. about 3am.
   d. sunrise.
   e. midnight.

45 Although most records from that time were lost in the burning of the Great Library at Alexandria, most historians say that the first actual measurement of the Earth’s circumference was made in the 3rd century BCE by
   a. Aristotle.
   b. Aristarchus of Samos
   c. Claudius Ptolemaeus.
   d. Selucus of Seleucia.
   e. Eratosthenes of Cyrene.

46 As seen from North America, the constellation Cassiopeia
   a. sets in the north.
   b. sets in the west.
   c. sets in the east.
   d. sets in the south.
   e. never sets.

47 The Celestial Sphere is
   a. the Sun.
   b. the surface of the Earth.
   c. an orbiting basketball.
   d. a map of the stars.
48 Copernicus said that the rotation of the Earth on its axis caused the
   a. motion of the Sun along the ecliptic.
   b. eclipses of the Moon
   c. phases of the Moon.
   d. retrograde motion of the planets.
   e. daily motions in the heavens.

49 You see a waning quarter Moon high in the night sky. What time is it?
   a. 6:00pm.
   b. 10:00am.
   c. 5:00am.
   d. 8:00pm.
   e. Midnight.

50 A star that is named Delta Cepheus is most likely
   a. a fairly dim star in the constellation Centaurus.
   b. a fairly dim star in the constellation Cepheus.
   c. the brightest star in the constellation Cepheus.
   d. the brightest star in the constellation Centaurus
Answer Key: Spring 2017 HX1B

1 Choice e. (Setting in the West right after the Sun.)
2 Choice a. (predicts the results of observations on real systems.)
3 Choice d. (waning quarter.)
4 Choice c. (I saw a full Moon last night.)
5 Choice b. (6:00am)
6 Choice c. (By using a model of the galaxy that correctly accounts for everything that has been measured so far.)
7 Choice d. (failed but led to a better theory.)
8 Choice a. (the path of the Sun on the Celestial Sphere.)
9 Choice b. (The Sun moves around the Earth once a day.)
10 Choice a. (exactly equal to a solar day.)
11 Choice a. (the natural result of gravity pulling everything toward a center.)
12 Choice d. (what holds up the surface of the Earth.)
13 Choice b. (the stars to come back to the same positions in the sky.)
14 Choice c. (less than 90 degrees by an amount too small for him to measure.)
15 Choice a. (Other people look near Betelgeuse. They do not see the green star, and attack her report as a mistake or a fraud.)
16 Choice c. (North Pole.)
17 Choice a. (the motion of the Moon around the Earth.)
18 Choice c. (circular epicycle whose center, in turn, moves around the Earth.)
19 Choice a. (about the same accuracy.)
20 Choice b. (There is great disinterest because there is no need to replace a theory that has passed every well-understood observational test.)
21 Choice a. (the sun is lower in the sky in the winter.)
22 Choice c. (make extensive observations.)
23 Choice c. (it came into conflict with reproducible observations.)
24 Choice c. (366.242199 times in a year.)
25 Choice b. (27 days.)
26 Choice c. (the Sun is farther from the Earth and larger than the Moon.)
27 Choice d. (speed up when closest to the Sun.)
28 Choice c. (a total solar eclipse happens only over a very small part of the Earth.)
29 Choice d. (the phases of Venus.)
30 Choice c. (sunset.)
31 Choice e. (retrograde motion.)
32 Choice c. (an ellipse with the Sun at one focus.)
33 Choice c. (There are no green fish in Lake Nyak.)
34 Choice b. (Polaris.)
35 Choice b. (sometimes close to each other in space.)
36 Choice c. (3:59:00 a.m. the next day.)
37 Choice d. (greater than 90 degrees.)
38 Choice b. (the Earth is round.)
39 Choice c. (the phases of Venus.)
40 Choice a. (I saw the Sun rise and set during the same clear 24-hour day in the continental United States.)
41 Choice b. (science produces revisable facts.)
42 Choice b. (an actual observation of the natural world.)
43 Choice b. (Sven’s observations were reproduced by others.)
44 Choice c. (about 3am.)
45 Choice e. (Eratosthenes of Cyrene.)
46 Choice e. (never sets.)
47 Choice d. (a map of the stars.)
48 Choice e. (daily motions in the heavens.)
49 Choice c. (5:00am.)
50 Choice b. (a fairly dim star in the constellation Cepheus.)
Where to find these questions in the notes

1. Module 007.503 Science Model Building Phases of the Moon (47%)
2. Module 007.101-g01 Science Model Building Scientific Models
3. Module 007.506 Science Model Building Phases of the Moon (46%)
5. Module 001.101-g01 The Sky: As Certain as the Sunrise. Where?
6. Module 002.502-g01 The Sky: Spherical Earth. Radius
7. Module 005.301 The Sky: Power of Observation Putting Copernicus to the Test
8. Module 003.501 The Sky: Celestial Sphere. The Path of the Sun
9. Module 004.202-g01 The Sky: Wandering Planets Ptolemaic model
10. Module 003.404 The Sky: Celestial Sphere Apparent Motion of the Sun
13. Module 003.103 The Sky: Celestial Sphere. Map (42%)
14. Module 007.303 Science Model Building the Sun
16. Module 007.402 Science Model Building Time and Compass Heading
17. Module 007.501 Science Model Building Phases of the Moon
18. *Module 004.201-g01 The Sky: Wandering Planets Ptolemaic model (40%)
20. Module 006.302-g01 Science Scientific Statements The Search for Error
22. Module 005.201 The Sky: Power of Observation Tycho’s observations
23. Module 006.304 Science Scientific Statements The Search for Error
24. ***Module 003.401-g01 The Sky: Celestial Sphere Apparent Motion of the Sun (25%)
25. Module 007.510 Science Model Building Phases of the Moon
26. Module 007.201 Science Model Building Earth-Moon System
27. Module 005.601 The Sky: Power of Observation Kepler’s 2nd and 3rd Laws
28. *Module 007.201-g01 Science Model Building Earth-Moon System (39%)
29. **Module 007.602 Science Model Building Phases of Venus (34%)
30. Module 007.403-g01 Science Model Building Time and Compass Heading
31. Module 004.101-g01 The Sky: Wandering Planets Retrograde motion
32. Module 005.501 The Sky: Power of Observation Kepler’s First Law
33. EModule 006.105 Science Scientific Statements How to test a statement (85%)
34. Module 003.206 The Sky: Celestial Sphere Pointer Stars
35. Module 003.203 The Sky: Celestial Sphere. Patterns
36. Module 003.304-g01 The Sky: Celestial Sphere Star Motions
**Module 007.304-g01 Science Model Building the Sun (33%)**

Module 001.504 The Sky: As Certain as the Sunrise. Flat Earth Model

Module 007.602-rev Science Model Building Phases of Venus (?)

Module 001.301 The Sky: As Certain as the Sunrise. Detail.

Module 006.402 Science Scientific Statements The Scientific Fact Problem

*Module 001.103-g02 The Sky: As Certain as the Sunrise. Observation

Module 001.201-g01 The Sky: As Certain as the Sunrise. Honesty. Reproducible

Module 007.507-g01 Science Model Building Phases of the Moon

Module 002.402 The Sky: Spherical Earth. Circumference

Module 003.303 The Sky: Celestial Sphere Star Motions

Module 003.101 The Sky: Celestial Sphere. Map

Module 004.504 The Sky: Wandering Planets Copernican System

*Module 007.505 Science Model Building Phases of the Moon (38%)

Module 003.209 The Sky: Celestial Sphere Star Names