1 Copernicus said that the retrograde motion of the planets was caused by the
   a. planets moving on epicycles.
   b. earth and the planets orbiting the Sun.
   c. earth turning on its axis.
   d. planets turning on their axes.
   e. planets speeding up and slowing down.

2 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. epicyclic motion.
   c. paradoxical motion.
   d. overtaking behavior.
   e. retrograde motion.

3 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 experiencing sunset would be
   a. above the North Pole in the picture.
   b. to the right of the North Pole in the picture.
   c. below the North Pole in the picture.
   d. to the left of the North Pole in the picture.

4 The Celestial Sphere is
   a. the surface of the Earth.
   b. a map of the stars.
   c. an orbiting basketball.
   d. the Sun.

5 Which of Kepler’s Laws governs how a particular planet speeds up and slows down?
   a. The Period-Radius Relation.
   b. The Law of Inertia.
   c. The Law of Averages.
   d. The Equal Area Law.
   e. Orbits are Ellipses.

6 You see a waxing Gibbous Moon directly south. What time might it be?
   a. sunset.
   b. midnight.
   c. about 3am.
   d. about 10pm.
   e. sunrise.
7 Just before sunrise, you might find
   a. A waning crescent Moon setting in the west.
   b. A waning crescent Moon rising in the east.
   c. A waxing crescent Moon setting in the north.
   d. A waning crescent Moon rising in the west.
   e. A waning crescent Moon setting in the east.

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

9 One observation that Aristotle used to justify a spherical model of the Earth was that
   a. eastern constellations are seen higher in the sky in Greece than in Egypt.
   b. eastern constellations are seen higher in the sky in Egypt than in Greece.
   c. southern constellations were seen higher in the sky in Egypt than in Greece.
   d. southern constellations were seen higher in the sky in Greece than in Egypt.

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

11 One property of a model such as the shape of the Earth is the number of adjustable parameters it has — the
    number of numbers that are needed to determine the model. If this number is very large, that is regarded as
    a. a bad thing since it lets the model fit many possible measurements.
    b. of no importance so long as the model works.
    c. a good thing since it lets the model fit many possible measurements.

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

13 Because the Earth goes around the Sun, we see the Sun move
   a. westward along the Celestial Equator.
   b. eastward along the ecliptic.
   c. eastward along the Celestial Equator.
   d. above and below the ecliptic.
   e. westward along the ecliptic.
14 Which of the following time periods is closest to the time from a New Moon to the next Waning Quarter Moon?
   a. 7.5 days.
   b. 22.5 days.
   c. 273.9 days
   d. 91.3 days.
   e. 18 hours.

15 Copernicus said that the rotation of the Earth on its axis caused the
   a. retrograde motion of the planets.
   b. eclipses of the Moon
   c. phases of the Moon.
   d. motion of the Sun along the ecliptic.
   e. daily motions in the heavens.

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

17 As the two foci of an ellipse are brought together, the shape of the ellipse becomes
   a. more like a triangle drawn around the foci.
   b. more like a line between the foci.
   c. more like a sphere around the foci.
   d. more like a circle around the foci.

18 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. Scientists really like monster stories.
   b. Sven’s observations were reproduced by others.
   c. Sven told a good story with lots of details.
   d. Sven saw the monster many times.

19 The idea of a scientific fact presents difficulties for the falsificationist philosophy that we have been discussing because that philosophy insists that every scientific statement is
   a. infallible.
   b. just a guess.
   c. subject to change.

20 A time of 24 hours is
   a. slightly different from both a solar day and a sidereal day.
   b. exactly equal to a solar day.
   c. exactly equal to a sidereal day.
21 A reporter at the newspaper says that she saw a full moon last night. That statement is most likely
a. based on some authoritative reference such as the U.S. Naval Observatory.
b. a proven mathematical theorem.
c. an actual observation of the natural world.
d. an unsupported opinion of the newspaper editor.

22 The time it takes for the Celestial sphere to rotate once relative to the Earth is called
a. an astronomical day.
b. a solar day.
c. a sidereal day.
d. a polar day.
e. a Celestial day.

23 We can use the pointer stars in the Big Dipper to locate a point in the sky near the
a. East Celestial Pole.
c. Star Sirius.
d. Celestial Equator.
e. South Celestial Pole.

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

25 One reason that the Copernican System failed to fit Tycho’s observations was that
a. it placed the Earth at the center of the universe.
b. it used elliptical orbits instead of circles.
c. it placed the Sun at the center of the system.
d. it used circular orbits instead of ellipses.

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

27 An area of the sky that is marked by a recognizable pattern of stars is called
a. an astral house.
b. an asterism.
c. a stellar neighborhood.
d. a constellation.
e. a celestial sector.
28 The Ptolemaic System was replaced when
   a. Astronomers realized that Aristarchus had been right when he said it was unreasonable for the giant Sun to orbit the tiny Earth.
   b. Copernicus produced a system with the Sun at the center.
   c. it came into conflict with reproducible observations.

29 The ancient Greeks insisted that a worthwhile model of a situation had to
   a. be consistent with their religious traditions.
   b. predict what really happens.
   c. make a good story.

30 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. less than 90 degrees by an amount that was easy for him to measure.
   b. greater than 90 degrees.
   c. exactly 90 degrees.
   d. less than 90 degrees by an amount too small for him to measure.

31 The Winter Solstice is the time when
   a. the noon sun is highest in the sky.
   b. the sun crosses the Celestial Equator.
   c. the noon sun is lowest in the sky.

32 Fred reports that a special arrangement of wire coils can draw electrical power from the air. He really built the device and was very surprised when it really did produce electrical power. The most likely outcome of his report is that:
   a. Nobody bothers to check his observation and he becomes famous as the discoverer of a source of endless electrical power.
   b. Nobody bothers to check his observation and nobody believes him either.
   c. Other people build the proposed device. It generates power just as he said and he becomes famous as the discoverer of a source of endless electrical power.
   d. Other people build the proposed device. They do not see any electrical power, and attack his report as a mistake or a fraud.

33 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.
   b. I saw the Sun rise and set during the same clear 24-hour day in the continental United States.
   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.

34 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. greater than 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. exactly 90 degrees.
35 Einstein’s Theory of Relativity has passed every observational test for over 100 years. Among other things, it predicts that no material object can go faster than the speed of light. Fred Zveistein (twice as smart as Einstein) has a new theory that predicts that some material objects can go faster than light. Fred presents his new theory at a scientific meeting (in 2009). These meetings have several talks going on at the same time, so people normally move from one room to another to hear the talks they are interested in. When Fred gets up to talk, everyone leaves the room to go to other talks. The reason for this behavior is that
   a. the other scientists are angry with Fred for challenging the established theory.
   b. there is no interest in replacing a theory that has passed every observational test.
   c. there is no interest in seeing the established theory proven wrong.

36 The Greek theory of Gravity as a force pulling everything toward the center of the universe implied that the Earth should be fixed at the center of the universe. Which of the following models of the Solar System was in accord with that theory?
   a. the model of Aristarchus that the Earth goes around the Sun.
   b. the Copernican System.
   c. none of these models.
   d. the final version of the Ptolemaic System.

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

38 Which of the following computer programs is the most likely to be considered a scientific model?
   a. A simulation game in which people can spend a day at the beach.
   b. An animated screen-saver that shows waves crashing on the beach.
   c. A simulation, using currently accepted physical laws, of waves crashing on the beach.

39 Mercury is closer to the Sun than Earth. Which of the following statements is true?
   a. Mercury takes less time to go around the Sun and moves faster than the Earth.
   b. Mercury takes more time to go around the Sun but moves faster than the Earth because it keeps getting confused.
   c. Mercury takes more time to go around the Sun and moves slower than the Earth.
   d. Mercury takes less time to go around the Sun but moves slower than the Earth because it does not have as far to go.

40 If you are looking down over the north pole of the Earth, you will see the Earth rotate
   a. downward.
   b. clockwise.
   c. counterclockwise.
   d. upward.
41 At which of these times of day would you expect to find the Sun in the West?
   a. 6:00am
   b. Noon.
   c. Never.
   d. Midnight.
   e. 6:00pm.

42 The earliest known measurement of the circumference of the Earth used
   a. noon Sun angles to determine the longitudes of two different locations.
   b. the angle between the Sun and the quarter Moon at two locations to determine the angle between the Earth radii to those locations.
   c. noon Sun angles at two locations to determine the angle between the Earth radii to those locations.
   d. the angle between the Sun and the quarter Moon to determine the angle between the Sun radii to the Earth and Moon.
   e. the duration of a lunar eclipse to determine the angle swept out by the Moon during the eclipse.

43 In addition to measuring the positions of all the planets all the time, Tycho Brahe measured them to an accuracy of
   a. 1/10 degree of arc.
   b. 1/3600 degree of arc.
   c. 1/60 degree of arc.
   d. one degree of arc.
   e. five degrees of arc.

44 The brightest star in the constellation Orion might be named
   a. Alpha Centauri.
   b. Alpha Orionis.
   c. Epsilon Orionis.
   d. Delta Cepheus.

45 Astronomy is known for claiming to have measured many things that cannot possibly be probed directly. These measurements are made by combining actual measurements with
   a. well-tested models.
   b. arrogant claims.
   c. fictitious measurements.
   d. wild guesses.

46 One reason that temperatures are higher in the summer than in the winter is that
   a. the sun is farther from our hemisphere in the summer.
   b. the sun is higher in the sky in the summer.
   c. the sun is closer to our hemisphere in the summer.
   d. the sun is lower in the sky in the summer.
47 Just after sunset, you might find
   a. A waxing crescent Moon setting in the east.
   b. A waxing crescent Moon rising in the west.
   c. A waxing crescent Moon setting in the west.
   d. A waning crescent Moon setting in the north.
   e. A waxing crescent Moon rising in the east.

48 In the falsificationist philosophy of science that we have been discussing, all but one of the following types of statements are possible. Which one is NOT possible?
   a. Well-tested and proven to be false.
   b. Untested and true.
   c. Untested and false.
   d. Well-tested and proven to be true.

49 The astronomers of Copernicus’s time rejected his model of the Solar System mostly because
   a. it did not account for observations any better than the Ptolemaic System
   b. the Ptolemaic System was supported by the Church.
   c. they failed to understand it.

50 Which of the following statements is falsifiable?
   a. All of the fish in Lake Nyak are beautiful.
   b. There are fish in Lake Nyak.
   c. All of the fish in Lake Nyak are green.
1 Choice b. (earth and the planets orbiting the Sun.)
2 Choice e. (retrograde motion.)
3 Choice d. (to the left of the North Pole in the picture.)
4 Choice b. (a map of the stars.)
5 Choice d. (The Equal Area Law.)
6 Choice d. (about 10pm.)
7 Choice b. (A waning crescent Moon rising in the east.)
8 Choice c. (waxing quarter.)
9 Choice c. (southern constellations were seen higher in the sky in Egypt than in Greece.)
10 Choice d. (The Sun moves around the Earth once a day.)
11 Choice a. (a bad thing since it lets the model fit many possible measurements.)
12 Choice b. (never sets.)
13 Choice b. (eastward along the ecliptic.)
14 Choice b. (22.5 days.)
15 Choice e. (daily motions in the heavens.)
16 Choice c. (27 days.)
17 Choice d. (more like a circle around the foci.)
18 Choice b. (Sven’s observations were reproduced by others.)
19 Choice c. (subject to change.)
20 Choice b. (exactly equal to a solar day.)
21 Choice c. (an actual observation of the natural world.)
22 Choice c. (a sidereal day.)
23 Choice b. (North Celestial Pole.)
24 Choice c. (the Sun is farther from the Earth and larger than the Moon.)
25 Choice d. (it used circular orbits instead of ellipses.)
26 Choice d. (the phases of Venus.)
27 Choice d. (a constellation.)
28 Choice c. (it came into conflict with reproducible observations.)
29 Choice b. (predict what really happens.)
30 Choice b. (greater than 90 degrees.)
31 Choice c. (the noon sun is lowest in the sky.)
32 Choice c. (Other people build the proposed device. It generates power just as he said and he becomes famous as the discoverer of a source of endless electrical power.)
33 Choice b. (I saw the Sun rise and set during the same clear 24-hour day in the continental United States.)
34 Choice b. (less than 90 degrees by an amount too small for him to measure.)
35 Choice b. (there is no interest in replacing a theory that has passed every observational test.)
36 Choice c. (none of these models.)
37 Choice e. (3:59:00 a.m. the next day.)
38 Choice c. (A simulation, using currently accepted physical laws, of waves crashing on the beach.)
39 Choice a. (Mercury takes less time to go around the Sun and moves faster than the Earth.)
40 Choice c. (counterclockwise.)
41 Choice e. (6:00 pm.)
42 Choice c. (noon Sun angles at two locations to determine the angle between the Earth radii to those locations.)
43 Choice c. (1/60 degree of arc.)
44 Choice b. (Alpha Orionis.)
45 Choice a. (well-tested models.)
46 Choice b. (the sun is higher in the sky in the summer.)
47 Choice c. (A waxing crescent Moon setting in the west.)
48 Choice d. (Well-tested and proven to be true.)
49 Choice a. (it did not account for observations any better than the Ptolemaic System)
50 Choice c. (All of the fish in Lake Nyak are green.)
Where to find these questions in the notes

1 Module 004.501 The Sky: Wandering Planets Copernican System (36%)
2 Module 004.101-g01 The Sky: Wandering Planets Retrograde motion
3 Module 007.403 Science Model Building Time and Compass Heading
4 Module 003.101 The Sky: Celestial Sphere. Map
5 **Module 005.602 The Sky: Power of Observation Kepler’s 2nd and 3rd Laws (28%)
6 Module 007.507 Science Model Building Phases of the Moon
7 *Module 007.504-g01 Science Model Building Phases of the Moon (38%)
8 Module 007.506-g01 Science Model Building Phases of the Moon
9 Module 002.302 The Sky: Spherical Earth. Evidence
10 Module 004.202-g01 The Sky: Wandering Planets Ptolemaic model
12 Module 003.303 The Sky: Celestial Sphere Star Motions
13 **Module 003.503 The Sky: Celestial Sphere. The Path of the Sun (31%)
14 Module 007.501-g01 Science Model Building Phases of the Moon
15 Module 004.504 The Sky: Wandering Planets Copernican System
16 Module 007.510 Science Model Building Phases of the Moon
17 Module 005.503 The Sky: Power of Observation Kepler’s First Law
18 Module 001.201-g01 The Sky: As Certain as the Sunrise. Honesty. Reproducible
19 Module 006.401 Science Scientific Statements The Scientific Fact Problem
20 Module 003.404 The Sky: Celestial Sphere Apparent Motion of the Sun
21 Module 001.104-g02 The Sky: As Certain as the Sunrise. Observation.
22 Module 003.104 The Sky: Celestial Sphere. Map
23 Module 003.205 The Sky: Celestial Sphere Pointer Stars
24 Module 007.201 Science Model Building Earth-Moon System
25 Module 005.402 The Sky: Power of Observation Kepler’s War with Mars
26 Module 007.602-rev Science Model Building Phases of Venus (?)
27 Module 003.202 The Sky: Celestial Sphere. Constellations
28 Module 006.304 Science Scientific Statements The Search for Error
29 Module 001.501 The Sky: As Certain as the Sunrise. Save the appearances.
30 **Module 007.304-g01 Science Model Building the Sun (33%)
31 Module 003.601-g01 The Sky: Celestial Sphere. The Seasons
32 Module 001.204-g01 The Sky: As Certain as the Sunrise. Honesty.
33 Module 001.301 The Sky: As Certain as the Sunrise. Detail.
34 Module 007.303 Science Model Building the Sun
35 Module 006.302 Science Scientific Statements The Search for Error
36 **Module 004.402 The Sky: Wandering Planets Copernicus doubts (30%)
Module 003.304-g01 The Sky: Celestial Sphere Star Motions
Module 007.102 Science Model Building Scientific Models
Module 005.604 The Sky: Power of Observation Kepler’s 2nd and 3rd Laws
Module 007.401 Science Model Building Time and Compass Heading
Module 001.102-g01 The Sky: As Certain as the Sunrise. Where?
Module 002.403 The Sky: Spherical Earth. Circumference
Module 005.204 The Sky: Power of Observation Tycho’s observations
Module 003.210-g01 The Sky: Celestial Sphere Star Names
Module 002.501 The Sky: Spherical Earth. Radius
Module 003.603 The Sky: Celestial Sphere. The Seasons
Module 007.504 Science Model Building Phases of the Moon
*Module 006.401-g01 Science Scientific Statements The Scientific Fact Problem (36%)
Module 004.604 The Sky: Wandering Planets Why Copernicus Lost
EModule 006.104 Science Scientific Statements How to test a statement(84%)