1. The closest star to the North Celestial Pole that is visible to the naked eye is
   a. Polaris.
   b. Mizar.
   c. Sirius.
   d. Altair.
   e. Alcor.

2. 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 right of the North pole in the picture is experiencing
   a. noon.
   b. sunset.
   c. sunrise.
   d. midnight.

3. Just before sunrise, you might find
   a. A waning crescent Moon setting in the west.
   b. A waning crescent Moon setting in the east.
   c. A waning crescent Moon rising in the east.
   d. A waning crescent Moon rising in the west.
   e. A waxing crescent Moon setting in the north.

4. Ancient astronomers were puzzled by the planets because they
   a. execute retrograde loops.
   b. look like stars.
   c. rotate on their axes.
   d. show peculiar colors.
   e. rise and set.

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

6. Jupiter is farther from the Sun than Mars. Which of the following statements is true?
   a. Jupiter takes longer to go around the Sun than Mars because it has farther to go, but actually moves at the same speed as Mars.
   b. Jupiter takes less time to go around the Sun than Mars does but moves slower because Mars keeps making rest stops.
   c. Jupiter takes longer to go around the Sun than Mars because it has farther to go, but actually moves faster than Mars.
   d. Jupiter takes less time to go around the Sun than Mars and moves much faster.
   e. Jupiter takes longer to go around the Sun than Mars and moves more slowly than Mars does.
7 Aristarchus measured the angle between the Sun and the Moon when exactly half of the Moon was illuminated. If the Sun were actually just two or three times as far away as the Moon, he would have found that angle to be
a. greater than 90 degrees.
b. less than 90 degrees by an amount too small for him to measure.
c. exactly 90 degrees.
d. less than 90 degrees by an amount that was easy for him to measure.

8 At midsummer in Murmansk (which is the largest city north of the Arctic Circle), the Sun stays above the horizon for several days. This observation would conflict with the predictions of a model of the Sun’s motion that has the Sun
a. moving around the Earth.
b. moving over and under a flat Earth.
c. remaining still while the Earth goes around the Sun.

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

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

11 Which of the following statements is falsifiable?
a. Fords are not the best automobiles.
b. Henry Ford did not invent the first automobile.
c. An automobile is a self-propelled vehicle.
d. Fords are the best automobiles.
e. Henry Ford invented the first automobile.

12 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. of no importance so long as the model works.
b. a bad thing since it lets the model fit many possible measurements.
c. a good thing since it lets the model fit many possible measurements.

13 At 10pm, you see that the pointer stars of the Big dipper and the star Polaris are arranged in a vertical line. How long, give or take a few minutes, would you need to wait to see them arranged in a horizontal line?
a. 24 hours.
b. It will never happen.
c. 3 hours.
d. 12 hours.
e. 6 hours.
14 One objection to a solar system model that has the Earth moving around the Sun is that we would then see nearby stars seem to shift back and forth relative to more distant stars. The correct answer to that objection is that
   a. each star is moving in a circle exactly in step with the Earth’s motion around the Sun.
   b. all of the stars are attached to the same Celestial Sphere, so none are more distant than others.
   c. gravity bends starlight in just the right way to undo the shift.
   d. even the closest stars are so far away that the shift is very small.

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

16 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 3\textsuperscript{rd} century BCE by
   a. Claudius Ptolemaeus.
   b. Aristarchus of Samos
   c. Selucus of Seleucia.
   d. Eratosthenes of Cyrene.
   e. Aristotle.

17 If you are looking down over the north pole of the Earth, you will see the Earth rotate
   a. downward.
   b. upward.
   c. clockwise.
   d. counterclockwise.

18 The idea that science only deals with statements that are falsifiable, subject to possible disproof by observation, suggests that
   a. science produces revisable facts.
   b. science is always wrong.
   c. science only deals with guesses.

19 You see a waning Gibbous Moon directly south. What time might it be?
   a. midnight.
   b. about 10pm.
   c. sunset.
   d. sunrise.
   e. about 3am.
20 You would expect to see a waxing crescent Moon
   a. Rising in the West just before the Sun.
   b. Rising in the East just before the Sun.
   c. Setting in the West right after the Sun.
   d. Setting in the East right after the Sun.
   e. In the North at around midnight.

21 The Ptolemaic System continued to be accepted long after such people as Aristarchus and Copernicus had proposed alternatives. All of the following reasons why it lasted so long are at least partly true. Which reason is the one that would be stressed by the philosophy of science that we have been discussing?
   a. It correctly predicted what was observed and thus did not need to be replaced.
   b. Church authorities supported it and did not want it replaced.
   c. It was easier to understand and people do not like to learn new things.

22 From the duration of a lunar eclipse, the Ancient Greeks were able to calculate
   a. the size of the Moon.
   b. the distance from the Earth to the Moon.
   c. the Size of the Sun.
   d. the Size of the Earth.
   e. calculate the distance from the Earth to the Sun.

23 One reason that temperatures are higher in the summer than in the winter is that
   a. the sun is closer to our hemisphere in the summer.
   b. the sun is farther from our hemisphere in the summer.
   c. the sun is lower in the sky in the summer.
   d. the sun is higher in the sky in the summer.

24 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. fictitious measurements.
   b. arrogant claims.
   c. well-tested models.
   d. wild guesses.

25 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.

26 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. A full Moon is prettier than a crescent Moon.
   d. I saw a full Moon last night.
27 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. 364.242199 times in a year.
   b. a number of times in a year that cannot be determined from the information given.
   c. 366.242199 times in a year.
   d. 365.242199 times in a year.

28 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 nobody believes him either.
   b. Nobody bothers to check his observation and he becomes famous as the discoverer of a source of endless electrical power.
   c. Other people build the proposed device. They do not see any electrical power, and attack his report as a mistake or a fraud.
   d. 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.

29 In the time of Galileo, telescopes were
   a. in common use for looking at the heavens.
   b. unknown until Galileo invented them.
   c. forbidden by the church.
   d. known as novelty items but not used for much.

30 Which of the following astronomers is regarded as an early example of government-supported Big Science.
   a. Copernicus.
   b. Eratosthenes of Cyrene.
   c. Aristarchus of Samos.
   d. Tycho Brahe.

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

32 Which of the following time periods is closest to the time from a New Moon to the next Waxing Quarter Moon?
   a. 7.5 days.
   b. 91.3 days.
   c. 18 hours.
   d. 22.5 days.
   e. 273.9 days.

33 You see a waxing quarter Moon high in the southern night sky. What time is it?
   a. 10:00pm.
   b. 6:00pm
   c. Midnight.
   d. 5:00am
   e. 10:00am.
34 The ancient Greeks insisted that a worthwhile model of a situation had to
   a. make a good story.
   b. predict what really happens.
   c. be consistent with their religious traditions.

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

36 In comparison to the Copernican Theory, the Ptolemaic Theory made predictions that were of
   a. about the same accuracy.
   b. much higher accuracy.
   c. much less accuracy.

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

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

39 Copernicus said that the Earth and planets orbiting the Sun caused
   a. The rising and setting of the Moon.
   b. The phases of the Moon.
   c. The daily motions in the heavens.
   d. The retrograde motion of the planets.
   e. The rising and setting of the Sun.

40 Kepler found that the orbit of Mars is best described as
   a. a circle with the Sun at the center.
   b. a complicated fourth-order polynomial curve.
   c. a circle with the Sun off-center, combined with epicycles.
   d. an ellipse.

41 The time when the noon sun is highest in the sky is called
   a. the Summer Solstice.
   b. the Winter Solstice.
   c. the Spring Equinox.
42 In a solar day, the sun comes back to the same place in the sky but, in relation to the distant stars, the Earth actually rotates
   a. Less than one revolution.
   b. More or less than one revolution, depending on the season.
   c. More than one revolution.
   d. Exactly one revolution.

43 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). Which of the following would be the most likely reaction of the scientists at the meeting to this new development?
   a. There is great disinterest because there is no need to replace a theory that has passed every observational test. Nobody at all comes to Fred’s talk.
   b. There is great interest because the new theory proves that Relativity is wrong, so lots of scientists come to Fred’s talk to congratulate him.
   c. There is great hostility because the new theory challenges the established theory, so lots of scientists come to Fred’s talk to debate the issue.

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

45 An area of the sky that is marked by a recognizable pattern of stars is called
   a. a constellation.
   b. an asterism.
   c. a stellar neighborhood.
   d. an astral house.
   e. a celestial sector.

46 Compared to a sidereal month, the time from one full Moon to the next is
   a. shorter by 2.5 days.
   b. longer by 2.5 days.
   c. longer by four minutes.
   d. shorter by four minutes.
   e. exactly the same.

47 The ancient Greeks concluded that the Sun is farther from the Earth than the Moon because
   a. the Earth’s shadow falls on the Moon during a lunar eclipse.
   b. the Earth’s shadow falls on the Moon during a solar eclipse.
   c. the Moon’s shadow falls on the Earth during a solar eclipse.
   d. the Moon’s shadow falls on the Earth during a lunar eclipse.
   e. the Sun’s angular size is smaller than the angular size of the Moon.
48 At which of these times of day would you expect to find the Sun in the East?
   a. 7:00am
   b. 1:00pm.
   c. 1:00am.
   d. 7:00pm.

49 In the Ptolemaic model of the Solar System,
   a. the Earth was fixed and the planets and the Sun moved on epicycles which, in turn, went around the Earth.
   b. the Sun was fixed and the Earth and all of the planets moved on elliptical orbits around the Sun.
   c. the Earth was fixed, the Sun moved around the Earth, and the planets moved on epicycles which, in turn, went around the Sun.
   d. the Sun was fixed and the Earth and all of the planets moved on epicycles which, in turn, went around the Sun.

50 The purpose of a scientific model is
   a. to predict the results of observations on real systems.
   b. to be attractive and elegant.
   c. to be fun to play with.
Answer Key

1 Choice a. (Polaris.)
2 Choice c. (sunrise.)
3 Choice c. (A waning crescent Moon rising in the east.)
4 Choice a. (execute retrograde loops.)
5 Choice a. (Sven’s observations were reproduced by others.)
6 Choice e. (Jupiter takes longer to go around the Sun than Mars and moves more slowly than Mars does.)
7 Choice d. (less than 90 degrees by an amount that was easy for him to measure.)
8 Choice b. (moving over and under a flat Earth.)
9 Choice d. (a map of the stars.)
10 Choice d. (Alpha Orionis.)
11 Choice e. (Henry Ford invented the first automobile.)
12 Choice b. (a bad thing since it lets the model fit many possible measurements.)
13 Choice e. (6 hours.)
14 Choice d. (even the closest stars are so far away that the shift is very small.)
15 Choice d. (less than 90 degrees by an amount too small for him to measure.)
16 Choice d. (Eratosthenes of Cyrene.)
17 Choice d. (counterclockwise.)
18 Choice a. (science produces revisable facts.)
19 Choice e. (about 3am.)
20 Choice c. (Setting in the West right after the Sun.)
21 Choice a. (It correctly predicted what was observed and thus did not need to be replaced.)
22 Choice b. (the distance from the Earth to the Moon.)
23 Choice d. (the sun is higher in the sky in the summer.)
24 Choice c. (well-tested models.)
25 Choice b. (an actual observation of the natural world.)
26 Choice d. (I saw a full Moon last night.)
27 Choice c. (366.242199 times in a year.)
28 Choice d. (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.)
29 Choice d. (known as novelty items but not used for much.)
30 Choice d. (Tycho Brahe.)
31 Choice a. (the stars to come back to the same positions in the sky.)
32 Choice a. (7.5 days.)
33 Choice b. (6:00pm)
34 Choice b. (predict what really happens.)
35 Choice c. (the phases of Venus.)
36 Choice a. (about the same accuracy.)
37 Choice b. (what holds up the surface of the Earth.)
38 Choice d. (more like a circle around the foci.)
39 Choice d. (The retrograde motion of the planets.)
40 Choice d. (an ellipse.)
41 Choice a. (the Summer Solstice.)
42 Choice c. (More than one revolution.)
43 Choice a. (There is great disinterest because there is no need to replace a theory that has passed every observational test. Nobody at all comes to Fred’s talk.)
44 Choice e. (never sets.)
45 Choice a. (a constellation.)
46 Choice b. (longer by 2.5 days.)
47 Choice c. (the Moon’s shadow falls on the Earth during a solar eclipse.)
48 Choice a. (7:00 am)
49 Choice a. (the Earth was fixed and the planets and the Sun moved on epicycles which, in turn, went around the Earth.)
50 Choice a. (to predict the results of observations on real systems.)
Solutions

1. Module 003.206 The Sky: Celestial Sphere Pointer Stars
2. Module 007.404-g01 Science Model Building Time and Compass Heading
3. *Module 007.504-g01 Science Model Building Phases of the Moon (38%)
5. Module 001.201-g01 The Sky: As Certain as the Sunrise. Honesty. Reproducible
6. Module 005.605-g01 The Sky: Power of Observation Kepler’s 2nd and 3rd Laws
7. *Module 007.304 Science Model Building the Sun (36%)
8. Module 001.402 The Sky: As Certain as the Sunrise. Flat Earth Model
10. Module 003.210-g01 The Sky: Celestial Sphere Star Names
11. *Module 006.102-g01 Science Scientific Statements How to test a statement (40%)
13. Module 003.306-g01 The Sky: Celestial Sphere Star Motions
14. Module 004.303 The Sky: Wandering Planets Aristarchus
15. Module 007.303 Science Model Building the Sun
17. Module 007.401 Science Model Building Time and Compass Heading
19. Module 007.507-g01 Science Model Building Phases of the Moon
20. Module 007.503 Science Model Building Phases of the Moon (47%)
21. Module 006.303 Science Scientific Statements The Search for Error
22. *Module 007.204-g01 Science Model Building Earth-Moon System (38%)
23. Module 003.603 The Sky: Celestial Sphere. The Seasons
25. *Module 001.103-g02 The Sky: As Certain as the Sunrise. Observation
27. ***Module 003.401-g01 The Sky: Celestial Sphere Apparent Motion of the Sun (25%)
28. Module 001.204-g01 The Sky: As Certain as the Sunrise. Honesty.
29. Module 007.603-g01 Science Model Building Phases of Venus
30. Module 005.102 The Sky: Power of Observation Big Science
31. Module 003.103 The Sky: Celestial Sphere. Map (42%)
32. Module 007.502-g01 Science Model Building Phases of the Moon
33. Module 007.505-g01 Science Model Building Phases of the Moon
34. Module 001.501 The Sky: As Certain as the Sunrise. Save the appearances.
35. **Module 007.602 Science Model Building Phases of Venus (34%)
36. Module 004.602 The Sky: Wandering Planets Why Copernicus Lost
37 Module 002.203 The Sky: Spherical Earth. Self-consistency
38 Module 005.503 The Sky: Power of Observation Kepler’s First Law
39 **Module 004.502 The Sky: Wandering Planets Copernican System (31%)**
40 Module 005.401 The Sky: Power of Observation Kepler’s War with Mars
41 Module 003.602 The Sky: Celestial Sphere. The Seasons
42 Module 003.401 The Sky: Celestial Sphere Apparent Motion of the Sun
43 Module 006.301 Science Scientific Statements The Search for Error
44 Module 003.301 The Sky: Celestial Sphere Star Motions
45 Module 003.202 The Sky: Celestial Sphere. Constellations
46 Module 007.509 Science Model Building Phases of the Moon
47 Module 007.202-g01 Science Model Building Earth-Moon System
48 Module 001.101-g02 The Sky: As Certain as the Sunrise. Where?
49 Module 004.201 The Sky: Wandering Planets Ptolemaic model
50 Module 007.101 Science Model Building Scientific Models