1 In addition to being accurate, Tycho Brahe’s observations focused on measuring the positions of the planets
   a. when they were in retrograde motion.
   b. all the time.
   c. near the horizon.
   d. during conjunctions.
   e. during the solstices.

2 The wavelength of the sound waves that correspond to middle-C is about 4 feet. If you are standing 8 feet away from a
   piano that is playing that note, then between you and the piano there will usually be
   a. three regions of maximum pressure.
   b. maximum pressure every two seconds.
   c. one region of maximum pressure.
   d. maximum pressure every four seconds.
   e. two regions of maximum pressure.

3 The Moon turns red during a lunar eclipse because
   a. our eyes see an after-image when the light dies.
   b. it is completely covered with red dust.
   c. it is lit by a sunset all round the Earth.
   d. it is very hot and its glow is revealed.
   e. faint light is reddened more than bright light.

4 Electrons that are bound to the nucleus of an atom (so that energy is needed to remove them) can have
   a. only certain isolated positive energies.
   b. any negative energy at all.
   c. only certain isolated negative energies.
   d. any positive energy at all.

5 The ecliptic is
   a. the path of the Sun on the Celestial Sphere.
   b. the path of the Moon on the Celestial Sphere.
   c. halfway between the North and South Celestial Poles.
   d. the set of points with zero right ascension.
   e. an image of the Earth’s equator.

6 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 and moves slower than the Earth.
   c. Mercury takes less time to go around the Sun but moves slower than the Earth because it does not have as far to go.
   d. Mercury takes more time to go around the Sun but moves faster than the Earth because it keeps getting confused.

7 Who discovered Newton’s First Law of Motion?
   a. Aristotle.
   b. Galileo
   c. Tycho Brahe
   d. Kepler
   e. Newton
8 X-Ray telescopes need to use mirrors that
   a. are kept extremely cold.
   b. are kept extremely hot.
   c. are extremely large.
   d. use grazing angles of incidence.
   e. are made of wire mesh.

9 The sun sets in the
   a. Ocean.
   b. North.
   c. East.
   d. South.
   e. West.

10 Tycho Brahe’s careful observations of the planets agreed, to within observational error, with
   a. the Ptolemaic System.
   b. the Tychonic System.
   c. None of these systems.
   d. the Copernican System.

11 A unit of force is the
   a. meter.
   b. kilogram.
   c. meter per second per second.
   d. meter per second.
   e. Newton.

12 The Copernican System was first advocated in print by
   a. Tycho Brahe.
   b. Galileo Galilei.
   c. Michael Maestlin.
   d. Ptolemy.
   e. Johannes Kepler.

13 The force of gravity explains
   a. how things fall and how lightning works.
   b. how the tides and lightning work.
   c. how things fall and how the Sun shines.
   d. how planets move and how the Sun shines.
   e. how planets move and how the tides work.

14 Suppose that there is a cannon which can fire shells at any speed. If this cannon is located on the earth’s surface, its shells
   a. could go into earth orbit if fired at a high enough speed.
   b. could never go into earth orbit.
   c. always return to the earth.
15 There are important lessons to be learned from the dispute between Galileo and the Roman Inquisition: Don’t spit into the wind; Don’t tug on superman’s cape; and Don’t
   a. arrest a famous scientist.
   b. accept authority.
   c. challenge authority.
   d. present science as faith.

16 A solar sail is a large sheet of light-reflecting plastic spread on an extremely low-mass framework and attached to a spacecraft. Sunlight exerts a force on the sail and moves the spacecraft. Suppose the spacecraft has a total mass of 1000kg (including the sail) and sunlight exerts a total force of 5N on the sail. What will be the acceleration of the spacecraft?
   a. 0.02m/s²
   b. 2m/s²
   c. 0.005m/s²
   d. 5m/s²
   e. 1000m/s²

17 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. planets speeding up and slowing down.
   d. earth turning on its axis.
   e. planets turning on their axes.

18 A mirror that is supposed to bring light from a star directly overhead to a focus must be shaped like
   a. a shallow bowl with the open part facing up.
   b. a flat surface.
   c. an upside-down trough with the open part facing down.
   d. a shallow trough with the open part facing up.
   e. an upside-down bowl with the open part facing down.

19 When viewed looking down from above the Earth’s North Pole, the Earth
   a. always rotates counterclockwise.
   b. always rotates clockwise.
   c. rotates clockwise in the spring and counterclockwise in the fall.
   d. rotates clockwise in the fall and counterclockwise in the spring.
   e. does not rotate.

20 The most severe problem facing a radio telescope is
   a. spherical aberration.
   b. atmospheric turbulence.
   c. the diffraction limit.
   d. atmospheric absorption.
   e. chromatic aberration.
21 Retrograde Motion refers to the
   a. westward motion of the planets relative to the horizon.
   b. eastward motion of the planets relative to the stars.
   c. eastward motion of the Sun relative to the stars.
   d. westward motion of the planets relative to the stars.
   e. westward motion of the Moon relative to the horizon.

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

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

24 At 8pm, 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. 2:00 am.
   b. 11:00 pm.
   c. 8:00 pm the next day.
   d. 10:00 pm.
   e. It will never happen.

25 Compared to the frequency of photons emitted during a transition from a -4ev state to a -5ev state, transitions from a -3ev state to the -5ev state would emit photons whose frequency is
   a. 3 times as high.
   b. 4 times as high.
   c. 2 times as high.
   d. 5 times as high.
   e. the same.

26 Light with an emission spectrum is usually generated by
   a. hot, dense material.
   b. light from hot dense material passing through a rarefied gas.
   c. a hot, rarefied gas.
   d. a cold, rarefied gas.

27 Compared to a proton, an electron has
   a. much more mass.
   b. about the same mass.
   c. much less mass.
28 Orbiting ultraviolet observatories are most likely to end their useful life when
   a. funds to operate them run out.
   b. their orbits decay.
   c. they run out of electric power.
   d. they run out of coolant.
29 The frequency of a wave is defined to be
   a. The time for a set of crests to pass divided by the number of crests.
   b. The number of seconds that it takes for a crest to pass.
   c. The distance from a maximum to a minimum.
   d. The number of crests that pass in one second.
   e. The distance from one crest to the next.
30 A total eclipse of the Sun can be seen
   a. Only in the Northern Hemisphere.
   b. Only along a narrow path.
   c. Everywhere on the night side of the Earth.
   d. Everywhere on the day side of Earth.
   e. Only near the Earth’s equator.
31 The one-wave turning angle of a telescope mirror determines its
   a. atmospheric limit on its resolution.
   b. chromatic aberration.
   c. spherical aberration.
   d. diffraction limit on its resolution.
   e. light collection ability.
32 You see a telescope with a long tube and the eyepiece sticking out the side near the top. This telescope uses the
   a. Prime Focus.
   b. Newtonian Focus.
   c. Coudé Focus
   d. Cassegrain Focus.
33 Which of the following is a scientific statement (as defined by Popper)?
   a. There is intelligent life on other stars.
   b. Isaac Newton was the greatest scientist.
   c. There is cheese on the Moon.
   d. The Moon is made entirely of cheese.
   e. There is beauty in a sunset.
34 Just after sunset, you might find
   a. A waxing crescent Moon rising in the east.
   b. A waxing crescent Moon rising in the west.
   c. A waxing crescent Moon setting in the east.
   d. A waxing crescent Moon setting in the west.
   e. A waning crescent Moon setting in the north.
35 Which one of the following statements about the Theory of Evolution is definitely wrong?
   a. The Theory has not yet been disproved.
   b. The Theory is wrong.
   c. The Theory might be right.
   d. The Theory is well-established.
   e. The Theory is a proven fact.

36 The velocity of sound waves is roughly the same for all wavelengths. Suppose that a sound wave has a wavelength of one meter and a frequency of 1000Hz. The wavelength of a 500Hz sound wave would then be
   a. 500 m.
   b. 1000 m.
   c. 2 m.
   d. 1/2 m.
   e. 1 m.

37 Once you know to look for it, you will see that different stars have different colors. Which of the following star colors indicates the highest surface temperature?
   a. Red.
   b. Yellow.
   c. Blue.
   d. Green.
   e. Peach.

38 Eclipses happen when the Full or New Moon occurs on the
   a. Celestial Equator.
   b. Horizon.
   c. Winter Solstice.
   d. Ecliptic.
   e. Vernal Equinox.

39 Aristotle said that a moving object with nothing pushing or pulling on it will always
   a. keep moving at the same speed.
   b. follow a circular path.
   c. slow down and stop.
   d. speed up.

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

41 The red line of a spectrum is normally at a wavelength of 656 nm. In the light of a star that is moving away from us, we might expect to see that red line at a wavelength of
   a. 650nm.
   b. 660nm.
   c. 656nm.
42 Newton’s explanation of Kepler’s Laws relied upon a force that
   a. acts only on inorganic matter.
   b. acts on planets but not on comets.
   c. acts only on planets.
   d. acts on all objects.
   e. acts only on heavenly bodies.

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

44 A problem that is peculiar to infrared telescopes is a need for
   a. large reflector sizes.
   b. very long exposure times.
   c. grazing incidence mirrors.
   d. cooling to low temperature.

45 Polarized light consists of electromagnetic waves that all
   a. move in the same direction.
   b. have the same wavefronts.
   c. have electric fields in the same direction.
   d. have passed through the same narrow slit.
   e. have the same frequency.

46 If the frequency of electromagnetic radiation goes from $2 \times 10^{14}$ Hz to $6 \times 10^{14}$ Hz, the energy of each individual photon in
   a. does not change.
   b. is multiplied by 2.
   c. is divided by 2.
   d. is multiplied by 3.
   e. is divided by 3.

47 Suppose that only the force of gravity and the force that you, personally, exert are acting on an object with a mass of one kilogram. How much upward force must you exert on the object to cause it to accelerate upward at 3 meters per second per second?
   a. 1 Newton.
   b. 3 Newtons.
   c. 12.8 Newtons.
   d. 6.8 Newtons.
   e. 9.8 Newtons.
48 In Newton’s Theory,
   a. the Moon moves around the Earth which, in turn goes around the Sun.
   b. the Earth and Sun move around a common point, which, in turn, goes around the Moon.
   c. the Earth and Moon move around a common point which, in turn, goes around the Sun.
   d. the Earth moves around the Moon which, in turn, goes around the Sun.

49 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. speed up when closest to the Sun.
   d. move at constant speed.

50 A non-science (in Popper’s sense) is a discipline whose statements are
   a. not supported by evidence.
   b. imprecise or fuzzy.
   c. tentative.
   d. not tentative.
   e. obviously incorrect.

51 The focal point of a lens is
   a. the place where it sends rays that are off-axis.
   b. the center of the lens.
   c. the place where it sends all light rays.
   d. the place where it sends rays that are parallel to the axis.
   e. the center of curvature of the lens.

52 Which of the following types of radiation has the lowest frequency on this list.
   a. ultraviolet light.
   b. green light.
   c. infrared light.
   d. red light.
   e. X-Rays.
1 Choice b. (all the time.)
2 Choice e. (two regions of maximum pressure.)
3 Choice c. (it is lit by a sunset all round the Earth.)
4 Choice c. (only certain isolated negative energies.)
5 Choice a. (the path of the Sun on the Celestial Sphere.)
6 Choice a. (Mercury takes less time to go around the Sun and moves faster than the Earth.)
7 Choice b. (Galileo)
8 Choice d. (use grazing angles of incidence.)
9 Choice e. (West.)
10 Choice c. (None of these systems.)
11 Choice e. (Newton.)
12 Choice e. (Johannes Kepler.)
13 Choice e. (how planets move and how the tides work.)
14 Choice b. (could never go into earth orbit.)
15 Choice d. (present science as faith.)
16 Choice c. (0.005m/s²)
17 Choice b. (earth and the planets orbiting the Sun.)
18 Choice a. (a shallow bowl with the open part facing up.)
19 Choice a. (always rotates counterclockwise.)
20 Choice c. (the diffraction limit.)
21 Choice d. (westward motion of the planets relative to the stars.)
22 Choice b. (it used circular orbits instead of ellipses.)
23 Choice c. (the phases of Venus.)
24 Choice a. (2:00 am.)
25 Choice c. (2 times as high.)
26 Choice c. (a hot, rarefied gas.)
27 Choice c. (much less mass.)
28 Choice a. (funds to operate them run out.)
29 Choice d. (The number of crests that pass in one second.)
30 Choice b. (Only along a narrow path.)
31 Choice d. (diffractive limit on its resolution.)
32 Choice b. (Newtonian Focus.)
33 Choice d. (The Moon is made entirely of cheese.)
34 Choice d. (A waxing crescent Moon setting in the west.)
35 Choice e. (The Theory is a proven fact.)
36 Choice c. (2 m.)
37 Choice c. (Blue.)
38 Choice d. (Ecliptic.)
39 Choice c. (slow down and stop.)
40 Choice c. (about the same accuracy.)
41 Choice b. (660nm.)
42 Choice d. (acts on all objects.)
43 Choice d. (Star Sirius.)
44 Choice d. (cooling to low temperature.)
45 Choice c. (have electric fields in the same direction.)
46 Choice d. (is multiplied by 3.)
47 Choice c. (12.8 Newtons.)
48 Choice c. (the Earth and Moon move around a common point which, in turn, goes around the Sun.)
49 Choice c. (speed up when closest to the Sun.)
50 Choice d. (not tentative.)
51 Choice d. (the place where it sends rays that are parallel to the axis.)
52 Choice c. (infrared light.)
Solutions

1. Module 004 Tycho Brahe’s Role: Question 004.43
4. Module 011 Atomic Energy Levels: Question 011.31
5. Module 001 The Path of the Sun: Question 001.51
7. Module 007 The Law of Inertia: Question 007.11
8. Module 013 X-Rays: Question 013.41
9. Module 001 Apparent Motion of the Sun: Question 001.42
11. Module 007 Definitions of Force and Mass: Question 007.24
12. Module 005 Advocate for Copernicus: Question 005.32
13. Module 008 Unifying Physical Law: Question 008.22
14. Module 008 Artificial Satellites: Question 008.41
15. Module 005 The Science Writer: Question 005.44
16. Module 007 The Law of Force and Mass: Question 007.46
17. Module 004 The Copernican System: Question 004.21
18. Module 012 Focal Point of a Mirror: Question 012.21
19. Module 001 Celestial Coordinates: Question 001.25
22. Module 006 Orbits are Ellipses: Question 006.22
23. Module 005 The First Astrophysicist: Question 005.24
24. Module 001 Star Motions: Question 001.35
25. Module 011 The Reason for Spectra: Question 011.43
26. Module 010 Spectra: Question 010.32
27. Module 011 The Building Blocks: Question 011.12
28. Module 013 Ultraviolet: Question 013.31
29. Module 009 Frequency: Question 009.21
30. Module 002 Solar Eclipses: Question 002.21
31. Module 012 Telescope Limitations: Question 012.42
32. Module 012 Telescope Designs: Question 012.31
33. Module 003 How to test a statement: Question 003.21
34. Module 002 Phases of the Moon: Question 002.14
35. Module 003 Scientific Proof: Question 003.11
36. Module 009 Speed of a Wave: Question 009.36
Module 010 Temperature and Color: Question 010.21
Module 002 Predicting Eclipses: Question 002.43
Module 005 The First Physicist: Question 005.11
Module 004 Why Copernicus Lost: Question 004.32
Module 010 The Doppler Effect: Question 010.43
Module 008 Explaining Kepler’s Laws: Question 008.12
Module 001 The Celestial Sphere: Question 001.13
Module 013 Infrared: Question 013.21
Module 009 Polarization: Question 009.42
Module 011 Photons: Question 011.23
Module 007 Definitions of Force and Mass: Question 007.35
Module 008 Making New Predictions: Question 008.32
Module 006 Equal Area Rule: Question 006.31
Module 003 Non-science: Question 003.31
Module 012 Focal Point of a Lens: Question 012.12
Module 010 The Electromagnetic Spectrum: Question 010.18