1 Because the radiant of the Lyrid meteor shower is in the constellation Lyra, you can conclude that
   a. the comet that gave rise to the Lyrids originally came from Lyra.
   b. the comet that gave rise to the Lyrids was moving in the direction of Lyra when it broke up.
   c. the Sun is moving in the direction of the constellation Lyra.
   d. the Earth is moving toward Lyra when it passes through the remains of the comet.

2 If we wish to find life with a carbon-return process similar to the one here on Earth, we should look for planets
   a. with thin, unstable surfaces.
   b. with thick, stable surfaces.
   c. with volcanoes.

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

4 The Oort Cloud is located
   a. between the orbits of Uranus and Neptune.
   b. far beyond the orbit of Pluto.
   c. between the orbits of Mars and Jupiter.
   d. in the same general area as Pluto.

5 In Astronomy, the term “Microlensing” refers to the
   a. bending of light from a distant star by the atmosphere of a nearer object such as a planet.
   b. blocking of light from a distant star by the atmosphere of a nearer object such as a planet.
   c. making of really small telescopes.
   d. bending of light from a distant star by the gravity of a nearer object such as a planet.
   e. blocking of light from a distant star by the solid surface of a nearer object such as a planet.

6 An example of a planet with no liquid water at all and a dense carbon dioxide atmosphere is
   a. Venus
   b. Mercury
   c. Earth
   d. Mars

7 In the original Solar Nebula, objects that condensed near the protoSun tended to be mostly rock and iron rather
   than volatile gases and water because, in that part of the nebula
   a. it was cold enough for rock and iron to condense.
   b. there were no volatile gases and water.
   c. it was too cold for volatile gases and water to condense.
   d. it was too hot for volatile gases and water to condense.
8 Icy objects condensed from the outskirts of the Solar Nebula to form
   a. the interstellar dust.
   b. The moons of the Jovian Planets.
   c. the Kuiper belt.
   d. the asteroid belt.
   e. The Oort Cloud.

9 A large asteroid impact can affect the Earth’s climate primarily by
   a. producing strong winds from its passage.
   b. blocking the sunlight with its smoke and dust.
   c. poisoning the air with its fumes.
   d. heating the air with the heat of impact.

10 Short-period comets are thought to be
   a. long period comets deflected by Neptune.
   b. Kuiper belt objects deflected by Jupiter.
   c. Asteroid belt objects deflected by Jupiter.
   d. long period comets deflected by Jupiter.
   e. Kuiper belt objects deflected by Neptune.

11 The ion tail of a comet
   a. shoots out in random directions.
   b. consists of straight streamers.
   c. is curved and fuzzy-looking.
   d. is a ball around the nucleus.

12 When the fireball of its entry into the atmosphere was spotted from a KLM airliner, asteroid 2008 TC₃ had officially become a
   a. meteor.
   b. meteoroid.
   c. meteorite.
   d. comet.

13 Pressure waves are transmitted through
   a. liquids but not solids.
   b. solids but not liquids.
   c. both solids and liquids.

14 Compared to the frequency of photons absorbed during a transition from a -5ev state to a -4ev state, transitions from the -5ev state to a -3ev state would correspond to absorbing photons whose frequency is
   a. the same.
   b. 2 times as high.
   c. 5 times as high.
   d. 4 times as high.
   e. 3 times as high.
15 A very large number of new asteroids have been discovered since 1990 primarily because
   a. more astronomers have been looking for them.
   b. orbiting infrared observatories have been used to look for them.
   c. space probes have been used to look for them.
   d. telescopes started using digital imaging instead of film.

16 The most common element in the universe is
   a. silicon.
   b. hydrogen.
   c. helium.
   d. water.
   e. carbon.

17 The Greenhouse Effect is important because it suggests an effect on
   a. shielding UV light from the Sun.
   b. near-Earth asteroids.
   c. the availability of greenhouses.
   d. the Earth’s climate.
   e. the Earth’s rotation.

18 All of the following elements occur in living things. Which one is essential for forming complex compounds?
   a. Hydrogen
   b. Oxygen
   c. Carbon
   d. Nitrogen

19 When tectonic plates move past each other, they usually cause
   a. forest fires.
   b. earthquakes.
   c. tornados.
   d. floods.
   e. hurricanes.

20 When the light from a star is spread out into a rainbow of colors, the resulting picture is called
   a. an absorption diagram.
   b. an energy level diagram.
   c. a spectrum.
   d. a speculum.
   e. a frequency diagram.

21 In the Earth’s atmosphere, the percentage that is water vapor is roughly
   a. 50%.
   b. 20%.
   c. 0.04%.
   d. 80%.
   e. 1%.
22 An inventor proposes to generate electrical energy by hooking an electric generator to a water wheel. The water wheel takes water stored in a reservoir behind a dam and lowers it to the level of the water at the foot of the dam. Unfortunately there is a drought and the reservoir is drying up. To solve this problem, the inventor proposes to use the electricity from his generator to run a pump that takes water from the foot of the dam and puts it back up into the reservoir. Assume that he manages to eliminate all energy-wasting effects such as friction.

a. This idea will work because it takes less energy to raise the water up than it releases when it comes down. The scheme will generate energy for other uses.

b. This idea will fail because it takes more energy to raise the water up than it releases when it comes down. The scheme will actually consume energy.

c. This idea will fail because it takes exactly the same amount of energy to raise the water up as it releases when it comes down. The scheme will not generate energy for other uses.

23 Which of the following types of radiation has the highest frequency on this list?

a. red light.

b. Radio waves.

c. infrared light.

d. heat radiation.

e. green light.

24 As of 2009, the search for near-Earth asteroids that could threaten global effects has most likely

a. found about 90% of them.

b. found only a small fraction of them.

c. found all of them.

d. found none of them since it has not started yet.

25 When detailed tracking of asteroid 2008 TC₃ showed that it would hit the Earth, the asteroid officially became a

a. meteoroid.

b. comet.

c. meteorite.

d. meteor.

26 Had Jupiter ignited, we would be living in a multiple star system. Such systems

a. are extremely rare.

b. have never been seen.

c. are almost universal.

d. are quite common.

27 The semiliquid rock that is found inside the Earth

a. is a liquid suspended in a solid.

b. flows like a liquid under sudden pressure but is stiff like a solid under gradual pressure.

c. is a solid suspended in a liquid.

d. flows like a liquid under gradual pressure but is stiff like a solid under sudden pressure.

28 The oxygen atom in a water molecule

a. carries a negative electrical charge.

b. carries an electrical charge that depends on what other atoms or molecules are nearby.

c. is electrically neutral.

d. carries an electrical charge that oscillates rapidly between positive and negative.

e. carries a positive electrical charge.
29 The Kuiper Belt is mostly located
   a. beyond the orbit of Neptune.
   b. between the orbits of Jupiter and Uranus.
   c. between the orbits of Mars and Jupiter.
   d. between the orbits of Uranus and Neptune.

30 Because different molecules vibrate with distinctive radio frequencies, it is possible for radio telescopes to identify the chemical compounds that are present in interstellar clouds. When they do this they find
   a. no compounds at all.
   b. about the same numbers of Silicon compounds and Carbon compounds.
   c. mostly Silicon compounds.
   d. mostly Carbon compounds.

31 One model for the formation of the Solar System is that the planets formed from a cloud of material extracted from the Sun by a chance encounter with a passing star.
   a. This model correctly predicts planets orbiting in the plane of the Sun’s equator.
   b. This model incorrectly predicts planets orbiting out of the plane of the Sun’s equator.
   c. This model correctly predicts planets orbiting out of the plane of the Sun’s equator.
   d. This model incorrectly predicts planets orbiting in the plane of the Sun’s equator.

32 Which of the following types of radiation has the lowest frequency on this list?
   a. green light.
   b. X-rays.
   c. red light.
   d. heat radiation.
   e. infrared light.

33 Suppose that an asteroid, about 1 kilometer in diameter, shows a 1 in 100 probability of an Earth impact fifty years in the future. Assume that an impact will trigger climate changes that would kill one billion (1,000,000,000) people. Also assume that each of these deaths represents $100,000 in lost production. Using the cold economic logic that we discussed in class, how much money should be budgeted to deflect the asteroid?
   a. one hundred billion dollars ($100,000,000,000).
   b. one billion dollars ($1,000,000,000).
   c. one trillion dollars ($1,000,000,000,000).
   d. one hundred trillion dollars ($100,000,000,000,000).

34 An asteroid whose impact generates an explosion similar to that of a typical nuclear weapon probably has a diameter of about
   a. 50 meters.
   b. 1000 to 10,000 meters.
   c. 100,000 meters or larger.
   d. 1 meter.
35 Underneath the Atlantic Ocean is an undersea mountain range called the MidAtlantic Ridge. That ridge is caused by
   a. The remains of an ancient collision between the North American Plate and the Eurasian Plate.
   b. An upward current in the Earth’s Mantel.
   c. A continuing collision between the North American Plate and the Eurasian Plate.
   d. The remains of an ancient asteroid impact.
   e. The pressure exerted by the water in the Atlantic Ocean

36 A DNA molecule consists of
   a. two sugar phosphate chains connected by single amino acids.
   b. two long chains of amino acids connected by pairs of sugar phosphate molecules.
   c. two sugar phosphate chains connected by pairs of nitrogenous bases.
   d. two long chains of nitrogenous bases connected by sugar phosphate molecules.

37 When ice melts, the resulting liquid water occupies
   a. the same volume that the ice did.
   b. less volume than the ice did.
   c. more volume than the ice did.

38 A hydrogen bond is the result of
   a. the electrical attraction between a hydrogen atom on one molecule and an oppositely charged part of another molecule.
   b. one atom donating a hydrogen ion (or proton) to another.
   c. the hydrogen atom on one molecule bonding to a hydrogen atom on another.
   d. two molecules sharing a hydrogen ion (or proton).

39 The number of protostars that can be seen right now is
   a. large because they are much brighter than ordinary stars.
   b. small because they do not last very long before they turn into stars.
   c. large because they last a long time.
   d. small because they are not very bright.

40 Sedna is thought to be
   a. in the asteroid belt.
   b. in the Outer Oort Cloud.
   c. in the Main Kuiper Belt.
   d. in the Inner Oort Cloud.
   e. a Scattered Disk Object.

41 Of the following methods for eliminating an asteroid threat, which one would be affected least by the unknown composition and condition of the asteroid?
   a. Deflect or shatter the asteroid by crashing a whole fleet of missiles into it.
   b. Attach a line to the asteroid and pull it off course by towing it with a massive spacecraft.
   c. Deflect or shatter the asteroid with a series of nuclear explosions.
   d. Land on an iron asteroid, attach a rocket to it, and use its gravitational attraction to pull the target asteroid off course.
   e. Land on the asteroid and attach a rocket to it, and use the rocket’s thrust to drive the asteroid off course.
42 In which of these layers of the atmosphere is it generally warmer at higher altitudes?
   a. Troposphere.
   b. Mesosphere.
   c. Stratosphere.
   d. Ozone Layer.
   e. Any layer.

43 Which of the following substances is the largest fraction of our atmosphere?
   a. Carbon Dioxide
   b. Nitrogen
   c. Water
   d. Argon
   e. Oxygen

44 Colder air always
   a. rises.
   b. goes eastward.
   c. goes westward.
   d. moves in circles.
   e. sinks.

45 The Inner Oort Cloud is located
   a. between the orbit of Neptune and the inner edge of the Kuiper Belt.
   b. between the outer edge of the Kuiper Belt and the orbit of Pluto
   c. in the same general area as Pluto.
   d. beyond the Kuiper Belt.

46 The Earth’s crust is mostly made of
   a. liquid iron.
   b. solid iron.
   c. granite.
   d. semiliquid rock.

47 Most plants here on Earth are green because the process of converting carbon dioxide and water into organic matter uses only
   a. red light.
   b. green light.
   c. red, blue, and violet light.
   d. red, blue, green, and violet light.
   e. blue and violet light.

48 The nucleus of a comet consists of
   a. a cloud of vaporizing gas and dust.
   b. frozen gas, ice, and dust.
   c. mostly rock and iron.
   d. atoms that have gained or lost electrons.
   e. freely falling individual dust particles.
49 Which of the following systems do most living things on Earth now use to reproduce themselves?
   a. Each RNA molecules acts as a pattern to make copies of itself.
   b. Each DNA molecules splits in half and each half acts as a pattern to complete its other half.
   c. Each enzyme acts as a pattern to make copies of itself.

50 As seen from far above the Earth’s South Pole, the Earth orbits the Sun clockwise and
   a. the Jovian planets orbit the Sun counterclockwise.
   b. Mercury orbits the Sun counterclockwise.
   c. No planet orbits the Sun counterclockwise.
   d. Venus orbits the Sun counterclockwise.
1 Choice d. (the Earth is moving toward Lyra when it passes through the remains of the comet.)
2 Choice a. (with thin, unstable surfaces.)
3 Choice e. (is divided by 2.)
4 Choice b. (far beyond the orbit of Pluto.)
5 Choice d. (bending of light from a distant star by the gravity of a nearer object such as a planet.)
6 Choice a. (Venus)
7 Choice d. (it was too hot for volatile gases and water to condense.)
8 Choice c. (the Kuiper belt.)
9 Choice b. (blocking the sunlight with its smoke and dust.)
10 Choice e. (Kuiper belt objects deflected by Neptune.)
11 Choice b. (consists of straight streamers.)
12 Choice a. (meteor.)
13 Choice c. (both solids and liquids.)
14 Choice b. (2 times as high.)
15 Choice d. (telescopes started using digital imaging instead of film.)
16 Choice b. (hydrogen.)
17 Choice d. (the Earth’s climate.)
18 Choice c. (Carbon)
19 Choice b. (earthquakes.)
20 Choice c. (a spectrum.)
21 Choice e. (1%.)
22 Choice c. (This idea will fail because it takes exactly the same amount of energy to raise the water up as it releases when it comes down. The scheme will not generate energy for other uses.)
23 Choice e. (green light.)
24 Choice a. (found about 90% of them.)
25 Choice a. (meteoroid.)
26 Choice d. (are quite common.)
27 Choice d. (flows like a liquid under gradual pressure but is stiff like a solid under sudden pressure.)
28 Choice a. (carries a negative electrical charge.)
29 Choice a. (beyond the orbit of Neptune.)
30 Choice d. (mostly carbon compounds.)
31 Choice b. (This model incorrectly predicts planets orbiting out of the plane of the Sun’s equator.)
32 Choice d. (heat radiation.)
33 Choice c. (one trillion dollars ($1,000,000,000,000).)
34 Choice a. (50 meters.)
35 Choice b. (An upward current in the Earth’s Mantel.)
36 Choice c. (two sugar phosphate chains connected by pairs of nitrogenous bases.)
37 Choice b. (less volume than the ice did.)
38 Choice a. (the electrical attraction between a hydrogen atom on one molecule and an oppositely charged part of another molecule.)
39 Choice a. (large because they are much brighter than ordinary stars.)
40 Choice d. (in the Inner Oort Cloud.)
41 Choice d. (Land on an iron asteroid, attach a rocket to it, and use its gravitational attraction to pull the target asteroid off course.)
42 Choice c. (Stratosphere.)
43 Choice b. (Nitrogen)
44 Choice e. (sinks.)
45 Choice d. (beyond the Kuiper Belt.)
46 Choice c. (granite.)
47 Choice c. (red, blue, and violet light.)
48 Choice b. (frozen gas, ice, and dust.)
49 Choice b. (Each DNA molecule splits in half and each half acts as a pattern to complete its other half.)
50 Choice c. (No planet orbits the Sun counterclockwise.)
Where to find these questions in the notes

1. Module 013.205-g01 Comets and the Outer Solar System Meteor Showers
2. Module 018.313 Requirements for Life The Requirements for a Carbon Cycle
3. Module 018.109-g01 Requirements for Life Light
4. Module 013.301 Comets and the Outer Solar System The Origin of Comets
5. Module 013.504 Comets and the Outer Solar System Beyond the Oort Cloud
6. Module 016.502 Earth’s Living Surface Comparing Earth to Other Planets
7. Module 014.301 Formation of the Solar System Condensation of the Planets
8. Module 014.505 Formation of the Solar System The Fates of Dirty Snowballs
9. Module 017.304 Earth Impacts Large Object Impacts
10. Module 013.308 Comets and the Outer Solar System The Origin of Comets (43%)
11. *Module 013.103 Comets and the Outer Solar System Comets in Detail (37%)
12. Module 013.201-g01 Comets and the Outer Solar System Meteor Showers
13. Module 015.509 Earth’s Atmosphere and Interior The Earth’s Interior
14. Module 018.113 Requirements for Life Light
15. Module 017.105 Earth Impacts Near Earth Objects
16. Module 018.201 Requirements for Life The Chemical Basis of Life
17. Module 015.403 Earth’s Atmosphere and Interior Greenhouse Effect
18. Module 016.301 Earth’s Living Surface The Carbon Cycle
19. Module 016.203 Earth’s Living Surface An Active Crust
20. Module 018.115-g01 Requirements for Life Light
21. *Module 015.102-g01 Earth’s Atmosphere and Interior A Thin Layer of Air (35%)
22. Module 018.402-g01 Requirements for Life The Energy Sources of Life
23. ***Module 018.101-g01 Requirements for Life Light (28%)
24. Module 017.401-g01 Earth Impacts Hunting Killer Asteroids
25. Module 013.202-g01 Comets and the Outer Solar System Meteor Showers
26. Module 014.403 Formation of the Solar System Jupiter Loses the Race
27. Module 015.503-g01 Earth’s Atmosphere and Interior The Earth’s Interior
28. **Module 018.302 Requirements for Life The Requirements for a Carbon Cycle (33%)
29. Module 013.305 Comets and the Outer Solar System The Origin of Comets
30. Module 018.204-g01 Requirements for Life The Chemical Basis of Life
31. ***Module 014.106-g01 Formation of the Solar System The Solar Nebula (20%)
32. Module 018.103 Requirements for Life Light
33. **Module 017.406-g01 Earth Impacts Hunting Killer Asteroids (32%)
34. Module 017.202 Earth Impacts Small Object Impacts
35. EModule 016.102-g01 Earth’s Living Surface An Active Crust
36. Module 018.501 Requirements for Life Reproduction
Module 018.308 Requirements for Life The Requirements for a Carbon Cycle
Module 018.303 Requirements for Life The Requirements for a Carbon Cycle
Module 014.204 Formation of the Solar System The Protostar Stage
***Module 013.402-g01 Comets and the Outer Solar System The Transition from Kuiper Belt to Oort Cloud (24%)
Module 017.501-g01 Earth Impacts Asteroid Defense
Module 015.303-g01 Earth’s Atmosphere and Interior Temperature Layers
Module 015.103 Earth’s Atmosphere and Interior A Thin Layer of Air
Module 015.202 Earth’s Atmosphere and Interior Convection
Module 013.401 Comets and the Outer Solar System The Transition from Kuiper Belt to Oort Cloud
Module 015.501-g01 Earth’s Atmosphere and Interior The Earth’s Interior
Module 018.404-g01 Requirements for Life The Energy Sources of Life
Module 013.101-g01 Comets and the Outer Solar System Comets in Detail
EModule 018.503 Requirements for Life Reproduction (F20113:86%,86%)
EModule 014.103-g01 Formation of the Solar System The Solar Nebula (F20113:71%,74%)