1 The semiliquid rock that is found inside the Earth
   a. is a solid suspended in a liquid.
   b. flows like a liquid under sudden pressure but is stiff like a solid under gradual pressure.
   c. flows like a liquid under gradual pressure but is stiff like a solid under sudden pressure.
   d. is a liquid suspended in a solid.

2 Had Jupiter ignited, we would be living in a multiple star system. Such systems
   a. are extremely rare.
   b. are almost universal.
   c. have never been seen.
   d. are quite common.

3 The Oort Cloud
   a. is no longer accepted as the starting point of long-period comets.
   b. is the hypothetical (but mostly unobserved) starting point of short-period comets.
   c. is the hypothetical (but mostly unobserved) starting point of long-period comets.
   d. has been confirmed now that hundreds of objects in the cloud have been observed.

4 Which of the following models for the formation of life on Earth would most likely apply if it turns out that the
   first step of forming a self-copying molecule is extremely difficult and improbable?
   a. The Panspermia Model.
   b. The Abiogenesis Chimera Model.
   c. The Abiogenesis Model.
   d. The Spontaneous Generation Model.

5 An asteroid whose impact generates an explosion similar to that of a typical nuclear weapon probably has a
diameter of about
   a. 1000 to 10,000 meters.
   b. 1 meter.
   c. 100,000 meters or larger.
   d. 50 meters.

6 The Oort cloud of our Sun reaches
   a. beyond several of the nearest stars to our Sun.
   b. most of the way to the nearest star.
   c. at least a quarter of the way to the nearest star.
   d. a negligible part of the distance from our Sun to the nearest star.

7 The Greenhouse Effect is important because it suggests an effect on
   a. the availability of greenhouses.
   b. shielding UV light from the Sun.
   c. near-Earth asteroids.
   d. the Earth’s rotation.
   e. the Earth’s climate.
8 In which of these layers of the atmosphere is it generally colder at higher altitudes?
   a. Ionosphere.
   b. Ozone Layer.
   c. Any layer.
   d. Stratosphere.
   e. Troposphere.

9 The Earth’s distance from the Sun is defined to be 1 astronomical unit. Neptune is about 30 astronomical units from the Sun. An object in the Inner Oort Cloud might be at a distance from the Sun of
   a. 3 astronomical units.
   b. 40 astronomical units.
   c. 0.5 astronomical units.
   d. 40,000 astronomical units.
   e. 15000 astronomical units.

10 Which of the following statements describes the relation between what we observe and the predictions of the nebular model of the formation of the Solar System?
   a. The model predicts icy planets nearest to the Sun and we observe icy planets there.
   b. The model predicts icy planets throughout the Solar System and we observe icy planets only far from the Sun.
   c. The model predicts icy planets throughout the Solar System and we observe icy planets everywhere.
   d. The model predicts icy planets throughout the Solar System and we observe icy planets only nearest to the Sun.
   e. The model predicts icy planets farthest from the Sun and we observe icy planets there.

11 The key advantage of Carbon over Silicon as the basic element for life is that
   a. carbon forms more stable compounds than silicon.
   b. carbon can combine with hydrogen and silicon cannot.
   c. carbon atoms can bond to other carbon atoms but silicon atoms cannot bond to other silicon atoms.
   d. carbon is more abundant than silicon.
   e. carbon-based life got started first.

12 The radiant of a meteor shower is the
   a. point in the sky the meteors seem to be coming from.
   b. angular distance that each meteor travels.
   c. point in the sky the meteors seem to be going toward.
   d. apparent radius of the shower.
   e. rate at which meteors are seen.

13 A disadvantage of the gravitational tractor approach to deflecting an asteroid is that
   a. the asteroid might be rotating.
   b. it depends on the mass of the asteroid.
   c. a massive spacecraft is needed.
   d. the asteroid might consist of loose gravel.
14 You hear about an asteroid impact threat at level 10 on the Torino Scale. You should
   a. forget about it, nothing is going to happen.
   b. think about ways to get off the planet.
   c. hang loose until the situation becomes clearer.
   d. suspect an error because the scale does not go that high.

15 In the Earth’s atmosphere, the percentage that is Nitrogen is roughly
   a. 50%.
   b. 0.04%.
   c. 20%.
   d. 1%.
   e. 80%.

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

17 The part of a protostar where the density first becomes low enough for light to escape is called the
   a. fragmentation point.
   b. outer boundary.
   c. core boundary.
   d. photosphere.
   e. central core.

18 The number of near-Earth asteroids is large because they
   a. are left over from the formation of our Moon.
   b. are in stable orbits and have nowhere else to go.
   c. are the remains of a destroyed planet near the Earth.
   d. are kicked out of the asteroid belt by Jupiter’s gravity.

19 In current Earth life, the self-copying molecule that contains the information needed to construct and operate a life-form is
   a. RNA.
   b. glucose.
   c. glycoaldehyde.
   d. DNA.
   e. chlorophyll.
20 Compared to the frequency of photons absorbed during a transition from a -6ev state to a -4ev state, transitions from the -5ev state to a -3ev state would correspond to absorbing photons whose frequency is
   a. 4 times as high.
   b. 3 times as high.
   c. 5 times as high.
   d. the same.
   e. 2 times as high.

21 According to the current definition of a planet, Pluto is not regarded as a planet because
   a. it is too small.
   b. it has not cleared its neighborhood of other orbiting objects.
   c. it has an orbit that is steeply inclined to the orbits of the rest of the planets.

22 The objects of the Kuiper belt are mostly orbiting
   a. beyond all of the Jovian planets.
   b. within the asteroid belt.
   c. between the orbits of Earth and Mars.
   d. among the Jovian planets.

23 The nucleus of a comet consists of
   a. frozen gas, ice, and dust.
   b. freely falling individual dust particles.
   c. a cloud of vaporizing gas and dust.
   d. atoms that have gained or lost electrons.
   e. mostly rock and iron.

24 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 trillion dollars ($100,000,000,000,000).
   b. one trillion dollars ($1,000,000,000,000).
   c. one billion dollars ($1,000,000,000)
   d. one hundred billion dollars ($100,000,000,000,000).

25 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 out of the plane of the Sun’s equator.
   b. This model correctly predicts planets orbiting in the plane of the Sun’s equator.
   c. This model incorrectly predicts planets orbiting in the plane of the Sun’s equator.
   d. This model incorrectly predicts planets orbiting out of the plane of the Sun’s equator.

26 Earthquakes are often caused by
   a. collapsing mountains.
   b. drought.
   c. torrential rains.
   d. slipping tectonic plates.
   e. high winds.
27 Which of the following types of radiation has the highest frequency on this list?
   a. infrared light.
   b. Radio waves.
   c. heat radiation.
   d. green light.
   e. red light.

28 You hear a loud noise outside and go outside to find a smoking rock embedded in your driveway underneath your wrecked car. The object is probably a
   a. asteroid.
   b. meteoroid.
   c. comet.
   d. meteorite.
   e. meteor.

29 Consider a planet that is similar to Earth in size and Mass with a semiliquid interior. According to our current understanding, which of the following things is also necessary for that planet to have active plate tectonics?
   a. The core temperature should be the same as the surface temperature.
   b. The core temperature should be much lower than the surface temperature.
   c. The intensity of sunlight should be the same as on Earth.
   d. The amount of liquid surface water should be the same as on Earth.
   e. The core temperature should be much higher than the surface temperature.

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

31 The Kuiper Belt is the origin of
   a. short period comets.
   b. the moons of Jupiter.
   c. long period comets.
   d. the moons of Mars.
   e. earth-crossing asteroids.

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

33 Comets that originate in the Inner Oort Cloud would be expected to have orbits that are
   a. mostly perpendicular to the plane of the solar system.
   b. mostly close to the plane of the solar system.
   c. at all angles to the plane of the solar system.
34 An RNA molecule consists of
   a. two sugar phosphate chains connected by pairs of nitrogenous bases.
   b. two long chains of nitrogenous bases connected by pairs of sugar phosphate molecules.
   c. one long chain of amino acids with sugar phosphate molecules attached to the side of it.
   d. one sugar phosphate chain with single nitrogenous bases attached to the side of it.

35 It has been argued that hydrogen-powered automobiles can solve our energy problems because we can get all of the hydrogen that we need from sea water. Which of the following comments about the energy needed to separate the hydrogen and oxygen in water is correct?
   a. It is the same as the energy released when the hydrogen is burned, so we get no net gain of energy.
   b. It is the greater than the energy released when the hydrogen is burned, so we get a net loss of energy.
   c. It is less than the energy released when the hydrogen is burned, so we get a net gain of energy.

36 When the Earth passes through the orbit of a broken-up comet, we see
   a. a meteor shower.
   b. increased levels of ozone.
   c. a lightning storm.
   d. fire on the Moon.
   e. a display of Northern Lights.

37 The two Hydrogen atoms in a water molecule are both attached
   a. to each other to form a pair that is then attached to the Oxygen atom.
   b. to the Oxygen atom, on exactly opposite sides of the Oxygen atom.
   c. to the Oxygen atom, but offset so that the molecule looks bent.

38 Mars retains a carbon dioxide atmosphere because
   a. there is no life there.
   b. there is no liquid water there.
   c. the pressure is very close to the triple point of water.
   d. it has plate tectonic activity like Earth.

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

40 The radiant of a meteor shower is the point in the sky that the
   a. Earth is moving towards during the shower.
   b. meteors seem to be going toward.
   c. Sun is moving towards during the shower.
   d. meteors are all equidistant from.
   e. original comet was moving towards when it broke up.
41 When water freezes, the resulting ice occupies
   a. the same volume that the liquid water did.
   b. less volume than the liquid water did.
   c. more volume than the liquid water did.

42 Hurricanes and other storms start when the air is unstable. Under which of the following conditions would you expect the air over the ocean to be unstable so that it is likely to give rise to storms?
   a. The temperature of the ocean water is higher than the temperature of the air above it.
   b. The temperature of the ocean water is exactly the same as the temperature of the air above it.
   c. The temperature of the ocean water is lower than the temperature of the air above it.

43 The early Earth probably had carbon
   a. in the form of coal and methane.
   b. only in the form of carbon dioxide.
   c. in the form of amino acids and other complex hydrocarbons.

44 A world with both liquid water on its surface and carbon dioxide in its atmosphere is unstable because
   a. carbon dioxide causes water to disassociate into hydrogen and Oxygen.
   b. water and carbon dioxide combine to form solid carbon hydrate, which precipitates out of the atmosphere.
   c. water dissolves carbon dioxide and takes it out of the atmosphere.
   d. water and carbon dioxide tend to combine explosively.

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

46 After the impact of an asteroid large enough to cause global effects, the main worry is smoke and dust
   a. in the Troposphere.
   b. at ground level.
   c. in the Stratosphere.
   d. in the Ionosphere.

47 Carbon is
   a. relatively uncommon — not in the top ten most common elements.
   b. the second most abundant element in the universe.
   c. a compound and not an element.
   d. the most common element in the universe.
   e. one of the four most common elements in the universe.

48 An example of a planet with no liquid water at all and a dense carbon dioxide atmosphere is
   a. Venus
   b. Mercury
   c. Mars
   d. Earth
49 As seen from far above the Earth’s North Pole, the Earth orbits the Sun counter clockwise and
   a. Mercury orbits the Sun clockwise.
   b. Venus orbits the Sun clockwise.
   c. the Jovian planets orbit the Sun clockwise.
   d. No planet orbits the Sun clockwise.

50 Seismic waves are used to determine the Earth’s
   a. interior structure.
   b. mass.
   c. rotation rate.
   d. size.
Answer Key: Exam 3, Preview Version 1

1 Choice c.  (flows like a liquid under gradual pressure but is stiff like a solid under sudden pressure.)

2 Choice d.  (are quite common.)

3 Choice c.  (is the hypothetical (but mostly unobserved) starting point of long-period comets.)

4 Choice a.  (The Panspermia Model.)

5 Choice d.  (50 meters.)

6 Choice c.  (at least a quarter of the way to the nearest star.)

7 Choice e.  (the Earth’s climate.)

8 Choice e.  (Troposphere.)

9 Choice e.  (15000 astronomical units.)

10 Choice e.  (The model predicts icy planets farthest from the Sun and we observe icy planets there.)

11 Choice a.  (carbon forms more stable compounds than silicon.)

12 Choice a.  (point in the sky the meteors seem to be coming from.)

13 Choice c.  (a massive spacecraft is needed.)

14 Choice b.  (think about ways to get off the planet.)

15 Choice e.  (80%.)

16 Choice e.  (is multiplied by 2.)

17 Choice d.  (photosphere.)

18 Choice d.  (are kicked out of the asteroid belt by Jupiter’s gravity.)

19 Choice d.  (DNA.)

20 Choice d.  (the same.)

21 Choice b.  (it has not cleared its neighborhood of other orbiting objects.)

22 Choice a.  (beyond all of the Jovian planets.)

23 Choice a.  (frozen gas, ice, and dust.)

24 Choice b.  (one trillion dollars ($1,000,000,000,000).)

25 Choice d.  (This model incorrectly predicts planets orbiting out of the plane of the Sun’s equator.)

26 Choice d.  (slipping tectonic plates.)

27 Choice d.  (green light.)

28 Choice d.  (meteorite.)

29 Choice e.  (The core temperature should be much higher than the surface temperature.)

30 Choice b.  (a spectrum.)

31 Choice a.  (short period comets.)

32 Choice c.  (granite.)

33 Choice b.  (mostly close to the plane of the solar system.)

34 Choice d.  (one sugar phosphate chain with single nitrogenous bases attached to the side of it.)

35 Choice a.  (It is the same as the energy released when the hydrogen is burned, so we get no net gain of energy.)
36 Choice a. (a meteor shower.)
37 Choice c. (to the Oxygen atom, but offset so that the molecule looks bent.)
38 Choice c. (the pressure is very close to the triple point of water.)
39 Choice e. (microwaves.)
40 Choice a. (Earth is moving towards during the shower.)
41 Choice c. (more volume than the liquid water did.)
42 Choice a. (The temperature of the ocean water is higher than the temperature of the air above it.)
43 Choice c. (in the form of amino acids and other complex hydrocarbons.)
44 Choice c. (water dissolves carbon dioxide and takes it out of the atmosphere.)
45 Choice a. (red, blue, and violet light.)
46 Choice c. (in the Stratosphere.)
47 Choice e. (one of the four most common elements in the universe.)
48 Choice a. (Venus)
49 Choice d. (No planet orbits the Sun clockwise.)
50 Choice a. (interior structure.)
Where to find these questions in the notes

1. Module 015.503-g01 Earth’s Atmosphere and Interior The Earth’s Interior
2. Module 014.403 Formation of the Solar System Jupiter Loses the Race
3. Module 013.301-g01 Comets and the Outer Solar System The Origin of Comets
4. **Module 018.509 Requirements for Life Reproduction (31%)**
5. Module 017.202 Earth Impacts Small Object Impacts
6. Module 013.501 Comets and the Outer Solar System Beyond the Oort Cloud
7. Module 015.403 Earth’s Atmosphere and Interior Greenhouse Effect
8. Module 015.301-g01 Earth’s Atmosphere and Interior Temperature Layers
9. Module 013.402 Comets and the Outer Solar System The Transition from Kuiper Belt to Oort Cloud (46%)
10. Module 014.302-g01 Formation of the Solar System Condensation of the Planets
11. Module 018.203 Requirements for Life The Chemical Basis of Life
12. Module 013.206 Comets and the Outer Solar System Meteor Showers
13. Module 017.502 Earth Impacts Asteroid Defense
14. Module 017.404 Earth Impacts Hunting Killer Asteroids
15. Module 015.104 Earth’s Atmosphere and Interior A Thin Layer of Air
16. Module 018.109 Requirements for Life Light
17. Module 014.202 Formation of the Solar System The Protostar Stage
18. Module 017.101 Earth Impacts Near Earth Objects
19. EModule 018.504 Requirements for Life Reproduction (F20113:93%)
20. Module 018.114-g01 Requirements for Life Light
22. Module 013.306 Comets and the Outer Solar System The Origin of Comets
23. Module 013.101-g01 Comets and the Outer Solar System Comets in Detail
24. **Module 017.406-g01 Earth Impacts Hunting Killer Asteroids (32%)**
25. ***Module 014.106-g01 Formation of the Solar System The Solar Nebula (20%)
26. Module 016.204 Earth’s Living Surface An Active Crust
27. ***Module 018.101-g01 Requirements for Life Light(28%)**
28. Module 013.201 Comets and the Outer Solar System Meteor Showers
29. Module 016.103-g01 Earth’s Living Surface An Active Crust
30. Module 018.115-g01 Requirements for Life Light
31. Module 013.307 Comets and the Outer Solar System The Origin of Comets (47%)
32. Module 015.501-g01 Earth’s Atmosphere and Interior The Earth’s Interior
33. *Module 013.404 Comets and the Outer Solar System The Transition from Kuiper Belt to Oort Cloud (35%)
34. Module 018.501-g01 Requirements for Life Reproduction (47%)
35. Module 018.401 Requirements for Life The Energy Sources of Life
36. Module 013.204 Comets and the Outer Solar System Meteor Showers
Module 018.302 Requirements for Life The Requirements for a Carbon Cycle

Module 016.503 Earth’s Living Surface Comparing Earth to Other Planets (30%)

Module 018.102 Requirements for Life Light

***Module 013.206 Comets and the Outer Solar System Meteor Showers (26%)

Module 018.307 Requirements for Life The Requirements for a Carbon Cycle

Module 015.203 Earth’s Atmosphere and Interior Convection

Module 018.312 Requirements for Life The Requirements for a Carbon Cycle (42%)

Module 016.303 Earth’s Living Surface The Carbon Cycle

Module 018.404 Requirements for Life The Energy Sources of Life

Module 017.303 Earth Impacts Large Object Impacts

Module 018.202 Requirements for Life The Chemical Basis of Life

Module 016.502 Earth’s Living Surface Comparing Earth to Other Planets

EModule 014.103 Formation of the Solar System The Solar Nebula (F20113:74%)

Module 015.508 Earth’s Atmosphere and Interior The Earth’s Interior