1 The first generally accepted example of Sea-floor spreading was under the
   a. Gulf of Mexico.
   b. Atlantic Ocean.
   c. English Channel.
   d. Indian Ocean.
   e. Pacific Ocean.

2 An annual meteor shower occurs when
   a. our Sun passes through a spiral arm.
   b. the Earth passes through comet debris.
   c. the Solar Wind hits the Earth’s atmosphere.
   d. a nearby star explodes.
   e. asteroids hit the Earth.

3 In the original Solar Nebula, objects that condensed far from the protoSun tended to include large amounts of
   frozen gas and water ice because, in that part of the nebula
   a. there was a great deal of gas and water.
   b. it was cold enough for gases and water to condense.
   c. it was too hot for rock and iron to condense.
   d. there was little rock and iron.

4 The molecules of both liquid water and ice are held together by
   a. the attraction between the hydrogen atoms on one water molecule and the oppositely charged oxygen atom on another.
   b. weak electrical fluctuations in one water molecule and the opposite electrical fluctuations that it induces in another.
   c. sharing electrons between water molecules.
   d. transferring electrons between water molecules to make electrically charged ions.

5 The radiant of a meteor shower is the point in the sky that the
   a. original comet was moving towards when it broke up.
   b. meteors seem to be going toward.
   c. meteors are all equidistant from.
   d. Earth is moving towards during the shower.
   e. Sun is moving towards during the shower.

6 An advantage of carbon dioxide as the starting form of carbon for use by living things is that it
   a. freezes to form dry ice.
   b. is the result of burning carbon.
   c. dissolves in liquid water.

7 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.
8 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 Model.
   c. The Abiogenesis Chimera Model.
   d. The Spontaneous Generation Model.

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

10 The reason the temperature rises as you go higher in the stratosphere is that the Sun’s
   a. high energy particles heat the upper part of the Ionosphere.
   b. ultraviolet light heats the Ozone Layer.
   c. visible light heats the land.

11 In a region of the atmosphere in which the temperature rises with increasing altitude
   a. you expect no changes.
   b. you expect rapid changes.

12 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. 40,000 astronomical units.
   b. 3 astronomical units.
   c. 0.5 astronomical units.
   d. 15000 astronomical units.
   e. 40 astronomical units.

13 Green plants obtain the energy they need from
   a. the soil they are planted in.
   b. hot water.
   c. sunlight.

14 A descending convection current in the Earth’s mantle is expected to cause
   a. a deep ocean trench where tectonic plates are pulled together.
   b. a mid-ocean ridge where tectonic plates are pulled together.
   c. a mid-ocean ridge where tectonic plates are spreading apart.
   d. a magnetic domain in the Earth’s core.
   e. a deep ocean trench where tectonic plates are spreading apart.
15 Silicon atoms can bond to other silicon atoms to form polysilylene molecules in much the same way that carbon atoms can bond to other carbon atoms to form sugars and other hydrocarbon molecules. What is the key difficulty with basing life on silicon and polysilylenes instead of on carbon compounds such as glucose?
   a. Glucose stores more energy than polysilylenes.
   b. polysilylenes cannot contain hydrogen.
   c. polysilylenes cannot release energy by oxidation.
   d. polysilylenes tend to explode in the presence of oxygen.
   e. Silicon is less abundant than carbon.

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

17 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. comet.
   c. meteoroid.
   d. meteorite.

18 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 greater than the energy released when the hydrogen is burned, so we get a net loss of energy.
   b. It is the same as the energy released when the hydrogen is burned, so we get no net gain of energy.
   c. It is less than the energy released when the hydrogen is burned, so we get a net gain of energy.

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

20 As seen from far above the Earth’s South Pole,
   a. only Uranus orbits the Sun clockwise.
   b. no planet orbits the Sun counterclockwise.
   c. only Uranus orbits the Sun counterclockwise.
   d. no planet orbits the Sun clockwise.

21 A disadvantage of the gravitational tractor approach to deflecting an asteroid is that
   a. the asteroid might consist of loose gravel.
   b. the asteroid might be rotating.
   c. a massive spacecraft is needed.
   d. it depends on the mass of the asteroid.
22 The Outer Oort Cloud is
   a. distributed in all directions.
   b. a belt of objects mostly in the plane of the solar system.
   c. distributed along the rotation axis of the solar system.
   d. a doughnut-shaped region with objects above and below the plane of the solar system.

23 Light that has been spread out to show the frequencies or colors that are present is called
   a. a spectrum.
   b. an absorption diagram.
   c. a speculum.
   d. a frequency diagram.
   e. an energy level diagram.

24 The Kuiper Belt is mostly located
   a. between the orbits of Uranus and Neptune.
   b. between the orbits of Mars and Jupiter.
   c. beyond the orbit of Neptune.
   d. between the orbits of Jupiter and Uranus.

25 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. is divided by 3.
   c. does not change.
   d. is multiplied by 3.
   e. is multiplied by 2.

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

27 A large asteroid impact causes the extinction of whole species mainly by the effects of the
   a. light and heat: It incinerates them.
   b. noise: It scares them to death.
   c. smoke and dust: It blocks the sunlight.
   d. blast and shock wave: It blows them away.

28 Asteroids a few meters in diameter hit the Earth’s atmosphere
   a. once every few years and cause air bursts similar to small nuclear weapons.
   b. once in a thousand years, and create widespread devastation.
   c. once in a hundred years and cause local devastation.
   d. once every few years and cause only meteor trails.
29 From our discussion of how water and carbon dioxide interact on Mars, what would happen if a large body of liquid water (a big lake perhaps) were to appear on Mars?
   a. The water would release dissolved carbon dioxide, which would raise the atmospheric pressure and cause the water to evaporate or freeze.
   b. The water would release dissolved carbon dioxide, which would raise the atmospheric pressure and make it easier for water to stay in liquid form.
   c. The water would absorb carbon dioxide, which would reduce the atmospheric pressure and cause the water to evaporate or freeze.
   d. The water would absorb carbon dioxide, which would reduce the atmospheric pressure and make it easier for water to stay in liquid form.

30 Shear waves normally propagate
   a. at the same speed as pressure waves.
   b. faster than pressure waves.
   c. slower than pressure waves.

31 The asteroid 2008 AF4 has one chance in 21,000 of hitting the Earth between the years 2078 and 2100. The asteroid is 390 meters in diameter compared to 250 meters in diameter for Apophis. Assuming that an impact could cause the death of 30,000,000 people the average death rate for this type of event is approximately
   a. 3000 people per event.
   b. 500 people per event.
   c. 2000 people per event.
   d. 1500 people per event.
   e. 2500 people per event.

32 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.

33 The edges of the moving plates on the Earth’s surface are often where
   a. earthquakes occur.
   b. floods occur.
   c. hurricanes occur.
   d. large lakes occur.
   e. glaciers occur.

34 An encounter between Earth and an iron asteroid fifty meters in diameter would most likely cause
   a. a meteor that quietly burns up.
   b. the extinction of all life on earth.
   c. a large explosion on the ground.
   d. a large explosion in the air.
35 Short-period comets are thought to be
   a. Kuiper belt objects 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. long period comets deflected by Neptune.

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

37 The thickness of the Earth’s crust is about
   a. one fifth the radius of the Earth.
   b. half the radius of the Earth.
   c. 100 miles.
   d. 10 miles.

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

39 The absorption and re-radiation of infrared light by gases such as carbon dioxide is the key process in the
   b. creation of the ionosphere.
   c. creation of smog.
   d. Stark Effect.
   e. destruction of the ozone layer.

40 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 Outer Oort Cloud might be at a distance from the Sun of
   a. 40,000 astronomical units.
   b. 40 astronomical units.
   c. 15,000 astronomical units.
   d. 0.5 astronomical units.
   e. 3 astronomical units.

41 Which of the following types of radiation has the highest frequency on this list?
   a. Radio waves.
   b. heat radiation.
   c. green light.
   d. infrared light.
   e. red light.
42 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.

43 The role of the DNA molecule in current Earth life is to
   a. use photons to split water into oxygen, electrons, and hydrogen ions.
   b. provide the patterns for the enzymes that carry out the chemical processes of life.
   c. carry out all of the chemical processes of life.
   d. store and release oxygen as needed.
   e. store and release energy as needed.

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

45 Far from the Sun, a comet is basically a
   a. dirty lump of frozen gas and ice.
   b. cloud of individual dust particles.
   c. lump of iron or rock.
   d. ball of ionized gas.

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

47 The Kuiper Belt was named after Gerard Kuiper, who said that
   a. the belt formed early in the history of the solar system and should still be there, stabilized by orbital resonances with Neptune.
   b. the belt formed early in the history of the solar system but should not still be there because Pluto would have cleared its neighborhood of smaller objects.
   c. the belt formed early in the history of the solar system but should not still be there because Neptune would have cleared its neighborhood of smaller objects.
   d. no such belt ever formed because of the disruptive effects of Neptune’s gravity.

48 Compared to the frequency of photons absorbed during a transition from a from a -5ev state to a -4ev state, transitions from the -6ev state to a -1ev state would correspond to absorbing photons whose frequency is
   a. the same.
   b. 3 times as high.
   c. 2 times as high.
   d. 5 times as high.
   e. 4 times as high.
49 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.

50 Icy objects were ejected inward from the neighborhood of the Jovian planets to form
  a. the oceans and atmosphere of Earth.
  b. the Moons of the Jovian planets.
  c. the asteroid belt.
  d. the Oort Cloud.
  e. the Kuiper belt.
Answer Key: Exam 3, Preview Version 2

1. Choice b. (Atlantic Ocean.)
2. Choice b. (the Earth passes through comet debris.)
3. Choice b. (it was cold enough for gases and water to condense.)
4. Choice a. (the attraction between the hydrogen atoms on one water molecule and the oppositely charged oxygen atom on another.)
5. Choice d. (Earth is moving towards during the shower.)
6. Choice c. (dissolves in liquid water.)
7. Choice c. (more volume than the liquid water did.)
8. Choice a. (The Panspermia Model.)
9. Choice d. (infrared light.)
10. Choice b. (ultraviolet light heats the Ozone Layer.)
11. Choice a. (you expect no changes.)
12. Choice d. (15000 astronomical units.)
13. Choice c. (sunlight.)
14. Choice a. (a deep ocean trench where tectonic plates are pulled together.)
15. Choice d. (polysilylenes tend to explode in the presence of oxygen.)
16. Choice d. (Carbon)
17. Choice a. (meteor.)
18. Choice b. (It is the same as the energy released when the hydrogen is burned, so we get no net gain of energy.)
19. Choice a. (are kicked out of the asteroid belt by Jupiter's gravity.)
20. Choice b. (no planet orbits the Sun counterclockwise.)
21. Choice c. (a massive spacecraft is needed.)
22. Choice a. (distributed in all directions.)
23. Choice a. (a spectrum.)
24. Choice c. (beyond the orbit of Neptune.)
25. Choice e. (is multiplied by 2.)
26. Choice b. (at least a quarter of the way to the nearest star.)
27. Choice c. (smoke and dust: It blocks the sunlight.)
28. Choice a. (once every few years and cause air bursts similar to small nuclear weapons.)
29. Choice c. (The water would absorb carbon dioxide, which would reduce the atmospheric pressure and cause the water to evaporate or freeze.)
30. Choice c. (slower than pressure waves.)
31. Choice d. (1500 people per event.)
32. Choice d. (one sugar phosphate chain with single nitrogenous bases attached to the side of it.)
33. Choice a. (earthquakes occur.)
34. Choice c. (a large explosion on the ground.)
35 Choice a. (Kuiper belt objects deflected by Neptune.)
36 Choice d. (Nitrogen)
37 Choice d. (10 miles.)
38 Choice a. (flows like a liquid under gradual pressure but is stiff like a solid under sudden pressure.)
39 Choice a. (Greenhouse Effect.)
40 Choice a. (40,000 astronomical units.)
41 Choice c. (green light.)
42 Choice d. (are quite common.)
43 Choice b. (provide the patterns for the enzymes that carry out the chemical processes of life.)
44 Choice d. (large because they are much brighter than ordinary stars.)
45 Choice a. (dirty lump of frozen gas and ice.)
46 Choice b. (hydrogen.)
47 Choice b. (the belt formed early in the history of the solar system but should not still be there because Pluto would have cleared its neighborhood of smaller objects.)
48 Choice d. (5 times as high.)
49 Choice d. (the Earth is moving toward Lyra when it passes through the remains of the comet.)
50 Choice a. (the oceans and atmosphere of Earth.)
Where to find these questions in the notes

1 EModule 016.102 Earth’s Living Surface An Active Crust
2 Module 013.203 Comets and the Outer Solar System Meteor Showers
3 Module 014.302 Formation of the Solar System Condensation of the Planets
4 Module 018.305 Requirements for Life The Requirements for a Carbon Cycle
5 ***Module 013.206-g01 Comets and the Outer Solar System Meteor Showers(26%)
6 Module 018.310 Requirements for Life The Requirements for a Carbon Cycle
7 Module 018.307 Requirements for Life The Requirements for a Carbon Cycle
8 **Module 018.509 Requirements for Life Reproduction (31%)
9 Module 018.102-g02 Requirements for Life Light
10 Module 015.305-g01 Earth’s Atmosphere and Interior Temperature Layers
11 Module 015.203 Earth’s Atmosphere and Interior Convection
12 Module 013.402 Comets and the Outer Solar System The Transition from Kuiper Belt to Oort Cloud (46%)
13 Module 018.404 Requirements for Life The Energy Sources of Life
14 *Module 016.106-g01 Earth’s Living Surface An Active Crust (35%)
15 Module 018.204 Requirements for Life The Chemical Basis of Life
16 Module 016.301 Earth’s Living Surface The Carbon Cycle
17 Module 013.201-g01 Comets and the Outer Solar System Meteor Showers
18 Module 018.401 Requirements for Life The Energy Sources of Life
19 Module 017.101 Earth Impacts Near Earth Objects
20 EModule 014.104-g01 Formation of the Solar System The Solar Nebula (F20113:42%)
21 Module 017.502 Earth Impacts Asteroid Defense
22 *Module 013.303 Comets and the Outer Solar System The Origin of Comets (37%)
23 Module 018.115 Requirements for Life Light
24 Module 013.305 Comets and the Outer Solar System The Origin of Comets
25 Module 018.109 Requirements for Life Light
26 Module 013.501 Comets and the Outer Solar System Beyond the Oort Cloud
27 Module 017.303 Earth Impacts Large Object Impacts
28 *Module 017.202-g01 Earth Impacts Small Object Impacts (36%)
29 Module 016.503-g01 Earth’s Living Surface Comparing Earth to Other Planets
30 Module 015.510-g01 Earth’s Atmosphere and Interior The Earth’s Interior
31 Module 017.406 Earth Impacts Hunting Killer Asteroids
32 Module 018.501-g01 Requirements for Life Reproduction (47%)
33 Module 016.201 Earth’s Living Surface An Active Crust
34 Module 017.204 Earth Impacts Small Object Impacts
35 Module 013.308 Comets and the Outer Solar System The Origin of Comets (43%)
36 Module 015.103 Earth’s Atmosphere and Interior A Thin Layer of Air
37 Module 015.501 Earth’s Atmosphere and Interior The Earth’s Interior
38 Module 015.503-g01 Earth’s Atmosphere and Interior The Earth’s Interior
39 Module 015.402 Earth’s Atmosphere and Interior Greenhouse Effect
40 Module 013.302 Comets and the Outer Solar System The Origin of Comets
41 ***Module 018.101-g01 Requirements for Life Light (28%)
42 Module 014.403 Formation of the Solar System Jupiter Loses the Race
43 EModule 018.505 Requirements for Life Reproduction (F20113:89%)
44 Module 014.204 Formation of the Solar System The Protostar Stage
45 Module 013.102-g01 Comets and the Outer Solar System Comets in Detail
46 Module 018.201 Requirements for Life The Chemical Basis of Life
47 Module 014.508 Formation of the Solar System The Fates of Dirty Snowballs
48 Module 018.114 Requirements for Life Light
49 Module 013.205-g01 Comets and the Outer Solar System Meteor Showers
50 *Module 014.503 Formation of the Solar System The Fates of Dirty Snowballs (38%)