

Chapters 7-10: Life in the Solar System

1. If life does indeed exist elsewhere in our solar system it will most likely take the form of
 - A) human beings
 - B) plants
 - C) birds
 - D) robots
 - E) microbes or other simple life

2. Habitability generally refers to an environment capable of sustaining
 - A) human life
 - B) plant life
 - C) microbial life only
 - D) any kind of life
 - E) oxygen

3. The necessary elements of life (carbon, oxygen, etc) are
 - A) only found on the Earth and Mars
 - B) widespread in the solar system but rare in our Milky Way galaxy
 - C) widespread throughout the universe
 - D) widespread in our Milky Way galaxy but are not in other galaxies
 - E) are only found in comets and asteroids

4. The planet Saturn is approximately 10 times farther away from the Sun than the Earth is. Given this, how strong is the sunlight compared to the sunlight striking the Earth?
 - A) 1/10th
 - B) 1/100th
 - C) 1/1,000th
 - D) 1/10,000th
 - E) the same

5. Photosynthetic life existing on a planet much farther from the Sun than the Earth would most likely
 - A) be larger than photosynthetic life on Earth but less efficient at collecting solar radiation
 - B) be identical to photosynthetic life on Earth
 - C) be smaller than photosynthetic life on Earth or less efficient at collecting solar radiation
 - D) be larger than photosynthetic life on Earth or more efficient at collecting solar radiation
 - E) live deep in the rocks

6. Of the liquids we have discussed in class, which one of the following properties is unique to water?
- A) it has a high heat capacity
 - B) it expands on freezing
 - C) it is a good solvent
 - D) it is a liquid over a wide temperature range
 - E) it is only found on the Earth
7. Even though ethane (C_2H_6) has a liquid temperature range almost as wide as water, it is not as good a biological solvent as water because it is a liquid at
- A) much higher temperatures which would result in the breakdown of fragile biological molecules
 - B) very high pressures that are unlikely to be found elsewhere
 - C) very low pressures that are unlikely to be found elsewhere
 - D) much lower temperatures which would result in extremely slow metabolic reactions
 - E) the centers of planets
8. What happens to the rate of most chemical reactions as the temperature decreases?
- A) the rate of reaction drops only slightly
 - B) the rate of reaction drops rapidly
 - C) the rate of reaction increases rapidly
 - D) the rate of reaction stays the same
 - E) the rate of reaction increases rapidly
9. If we place living cells in a nonpolar solvent like methane or ethane,
- A) their membranes will thicken, preventing molecular transport across the membrane
 - B) they will rapidly explode due to pressure caused by the solvent building up inside the cell
 - C) they will function in much the same way as they do in water
 - D) their membranes will most likely dissolve as cell membranes are also nonpolar
 - E) they reproduce rapidly, and mutate into more advanced life forms
10. Which of the following is NOT a basic requirement for life as we know it?
- A) a liquid medium to transport valuable biological molecules to the cell
 - B) a liquid medium to transport waste molecules from the cell
 - C) a source of molecules from which to build living cells
 - D) oxygen from photosynthesis
 - E) a source of energy to fuel metabolism
11. In searching for life in the solar system, which basic requirement of life is the most fundamental and the one we always look for?
- A) the presence of liquid water
 - B) the presence of organic matter
 - C) the presence of an energy source
 - D) the presence of oxygen
 - E) the presence of blood

12. The search for life in the solar system is essentially a search for
- A) organic molecules
 - B) molecular oxygen
 - C) energy sources
 - D) liquid water
 - E) alien spaceships
13. Mercury and the Moon are probably the least-habitable bodies in the solar system because they
- A) have never had carbon compounds on their surfaces
 - B) do not have atmospheres containing oxygen
 - C) do not receive any sunlight
 - D) are unlikely to have liquids anywhere
 - E) are embedded in dense clouds of radiation
14. Water is present on the Moon in the form of
- A) liquid water present just beneath the surface
 - B) vapor in the atmosphere
 - C) oceans of liquid water on the surface
 - D) ice in polar craters
 - E) giant geysers, jetting far into space
15. The planet Venus is often referred to as the Earth's "sister planet" because
- A) it is almost the same size and density
 - B) it looks like the Earth through a telescope
 - C) its atmosphere has the same composition
 - D) its surface is very similar
 - E) it is populated by women
16. The distance of Venus from the sun is approximately
- A) 0.4 au
 - B) 0.7 au
 - C) 1 au
 - D) 1.5
 - E) as yet unknown
17. The surface of Venus is much hotter than the Earth because it
- A) has no magnetic field
 - B) has a much higher rate of volcanic activity
 - C) is closer to the Sun
 - D) has a very thick atmosphere of carbon dioxide
 - E) nuclear reactions inside the planet keep it warm

18. How does the surface temperature and atmospheric pressure on Venus compare with the Earth?
- A) lower temperatures but higher pressures
 - B) higher temperatures and pressures
 - C) lower temperatures and pressures
 - D) higher temperatures but lower pressures
 - E) same temperatures and pressures
19. We confidently rule out the possibility of life on Mercury because
- A) it is too far from the Sun to be considered within its habitable zone
 - B) it lacks an atmosphere, so liquid water is not stable on its surface
 - C) it has cooled off so much, all the water is frozen in the permafrost layer
 - D) its enormous greenhouse effect makes it too hot on the surface
 - E) impacts from asteroids would kill any life that tried to evolve
20. We confidently rule out the possibility of life on the Moon because
- A) it is too far from the Sun to be considered within its habitable zone
 - B) it lacks an atmosphere, so liquid water is not stable on its surface
 - C) it has cooled off so much, all the water is frozen in the permafrost layer
 - D) its enormous greenhouse effect makes it too hot on the surface
 - E) impacts from asteroids would kill any life that tried to evolve
21. Approximately how far is the Moon from the Sun?
- A) 0.4 au
 - B) 0.7 au
 - C) 1 au
 - D) 1.5
 - E) as yet unknown
22. If life exists on Mars today, it will most likely be found
- A) on the surface
 - B) beneath the surface, especially near thermally active areas
 - C) at the center of the planet
 - D) floating high in the atmosphere
 - E) in its satellites, Phobos and Deimos
23. Mars may have been more Earth-like in the past because
- A) its magnetic field used to be weaker
 - B) it was rotating more rapidly
 - C) the Sun was dimmer, putting out less solar radiation
 - D) it was not as close to the Sun
 - E) its atmosphere was thicker

24. The biggest obstacle to life being present in the atmospheres of Jupiter and Saturn is the
- A) absence of liquid water in their atmospheres
 - B) high levels of solar radiation that would destroy any biological molecules
 - C) very low temperatures at the tops of the clouds where water would not be liquid
 - D) strong vertical wind speeds that would rapidly carry organisms into the hot interior where they would be destroyed
 - E) presence of deadly Uranium in the clouds of Jupiter and Saturn.
25. Some Jovian moons may have liquid water
- A) beneath their surfaces
 - B) at their centers
 - C) on their surfaces
 - D) in their atmospheres
 - E) in smaller satellites that orbit them
26. Europa may have a subsurface ocean of liquid water due to
- A) the insulating properties of its icy surface
 - B) internal heat left over from its formation
 - C) tidal heating from the Sun
 - D) impacts from meteors
 - E) tidal heating from Jupiter and the other Galilean moons
27. Most of the detailed information about the planets in our solar system comes from
- A) telescopic observations from Earth
 - B) robotic spacecraft
 - C) human visits
 - D) meteorites
 - E) ancient scrolls discovered in the desert
28. Which kind of robotic space mission enables us to take a quick look at a planet?
- A) sample return
 - B) flyby
 - C) orbiter
 - D) lander/probe
 - E) astronaut missions
29. Which kind of robotic space mission enables us to study the majority of a planet's surface for an extended period of time?
- A) lander/probe
 - B) sample return
 - C) flyby
 - D) astronaut missions
 - E) orbiter

30. Which kind of robotic space mission enables us to determine the chemical composition of a planet's surface and atmosphere by testing it directly?
- A) Geocentric
 - B) lander/probe
 - C) orbiter
 - D) flyby
 - E) the international space station
31. Which kind of robotic space mission enables us to determine the chemical composition of a solar system body using laboratory equipment on Earth?
- A) flyby
 - B) sample return
 - C) lander/probe
 - D) orbiter
 - E) the international space station
32. A common way a robotic spacecraft can be accelerated and have its trajectory changed without the use of any fuel is via
- A) a gravitational assist from another spacecraft
 - B) radiation pressure from the Sun
 - C) a gravitational assist from another planet
 - D) the ejection of mass from the probe
 - E) antimatter drive
33. *Voyagers 1 and 2* were examples of which kind of space mission?
- A) antimatter engines
 - B) orbiter
 - C) sample return
 - D) lander/probe
 - E) flyby
34. Which of the following planets has not yet been studied with an orbiter
- A) Saturn
 - B) Mars
 - C) Venus
 - D) Earth
 - E) Uranus
35. The *Huygens* probe is an example of which kind of spacecraft?
- A) orbiter
 - B) sample return
 - C) flyby
 - D) lander
 - E) the international space station

36. The Mars rovers (*Sojourner*, *Spirit*, *Opportunity*, *Curiosity*) are examples of which kind of spacecraft?
- A) flybys
 - B) sample return
 - C) landers
 - D) orbiters
 - E) antimatter engines
37. Stardust is an example of which kind of mission?
- A) lander
 - B) flyby
 - C) sample return
 - D) orbiter
 - E) antimatter engines
38. The Mars Exploration Rovers, *Spirit* and *Opportunity*, landed on the surface of Mars using
- A) airbags
 - B) balloons
 - C) rockets
 - D) teleportation beams
 - E) antimatter engines
39. The Mars Science Laboratory, *Curiosity*, landed on the surface of Mars using
- A) balloons
 - B) rockets
 - C) teleportation beams
 - D) antimatter engines
 - E) sky crane
40. The first person to claim to see linear features on the surface of Mars was
- A) Angelo Secchi
 - B) Percival Lowell
 - C) William Herschel
 - D) Kepler
 - E) Giovanni Schiaparelli
41. Other astronomers were skeptical about Percival Lowell's claims of Martian canals because
- A) it did not seem possible for his telescope to see the surface through its thick atmosphere
 - B) when they pointed their own telescopes toward Mars they couldn't see them
 - C) they discovered that Lowell suffered from poor vision
 - D) they were able to prove that Lowell's telescope was faulty
 - E) they didn't like him

42. When Percival Lowell insisted on the existence of Martian canals, even though his observations were discredited by other scientists, he exhibited
- A) objectivity
 - B) stupidity
 - C) madness
 - D) personal bias
 - E) religious beliefs
43. What did the Martian surface look like from the *Viking* lander sites?
- A) very mountainous with huge volcanoes in the distance
 - B) a huge canyon stretching out to the horizon
 - C) flat, dark volcanic rocks out to the horizon
 - D) a dry, dusty, boulder-strewn desert
 - E) a vast ocean
44. How easy would it be for future astronauts to adapt to a daily schedule on Mars?
- A) easy because the Martian day is only about 40 minutes longer than the terrestrial day
 - B) easy because the surface of Mars experiences perpetual daytime
 - C) easy because the surface of Mars experiences perpetual nighttime
 - D) very difficult because the Martian day is much longer than the terrestrial day
 - E) very difficult because the Martian day is much shorter than the terrestrial day
45. Liquid water cannot exist for very long on the surface of Mars today because
- A) its atmosphere is too thin
 - B) it gets rapidly destroyed by intense solar radiation
 - C) its surface temperature is too high
 - D) it rapidly reacts with the Martian surface to form peroxides
 - E) the gravity is so weak, water would float away
46. In the mid-1970s, the *Viking 1* orbiter discovered a feature in the Cydonia region of Mars which resembled a human face. What is the currently accepted scientific explanation for this feature?
- A) it was an illusion resulting from a calibration error of the Viking camera
 - B) the feature was added by NASA scientists to the *Viking* image as a joke
 - C) it is a natural hill feature that simply looked like a face using the low-resolution cameras installed on *Viking*
 - D) it is a monolith left by an ancient Martian civilization
 - E) it is a piece of equipment left behind by a prior mission
47. Seasonal variations on Mars are due
- A) only to its changing distance from the Sun
 - B) only to its axis tilt
 - C) both to its axis tilt and its changing distance from the Sun
 - D) to changes in the amounts of energy emitted by the Sun
 - E) to water vaporizing off the Martian oceans

48. Due to its elliptical orbit, Mars is closer to the Sun on average during winter in the Northern Hemisphere. This means Northern Winter on Mars will be
- A) short and hot
 - B) long and mild
 - C) short and mild
 - D) long and cold
 - E) variable in length, depending upon the position of the Earth
49. Due to its elliptical orbit, Mars is farther from the Sun on average during winter in the Southern Hemisphere. This means Southern Winter on Mars will be
- A) long and mild
 - B) long and cold
 - C) short and hot
 - D) short and mild
 - E) variable in length, depending upon the position of the Earth
50. During winter, the northern polar cap of Mars is made of
- A) a layer of carbon dioxide ice
 - B) a layer of water ice
 - C) water ice overlaying carbon dioxide ice
 - D) carbon dioxide ice overlaying water ice
 - E) solid rock
51. During summer, the northern polar cap of Mars is made of
- A) a layer of water ice
 - B) carbon dioxide ice overlaying water ice
 - C) a layer of carbon dioxide ice
 - D) water ice overlaying carbon dioxide ice
 - E) solid rock
52. An image of Mars taken with the Hubble Space Telescope shows a small Northern polar cap and a large Southern Polar cap. What season is it in the Northern hemisphere?
- A) spring
 - B) fall
 - C) summer
 - D) winter
 - E) all of the above
53. During summer in the Southern hemisphere of Mars, winds travel
- A) around the equator
 - B) around the South Pole
 - C) from the North Pole to the South Pole
 - D) from the South Pole to the North Pole
 - E) hardly at all, since the atmosphere is still

54. What are the relative ages of the heavily cratered Southern highlands and the smooth Northern plains of Mars?
- A) the highlands and the plains are the same age
 - B) the highlands are older than the plains
 - C) it is impossible to tell unless we know the specific geological processes that occurred in each hemisphere
 - D) the plains are older than the highlands
 - E) we have no way of knowing
55. The Tharsis region of Mars was most likely formed
- A) from sediment that piled up due to past water erosion
 - B) by plate tectonics
 - C) from compressions in the Martian crust as the planet cooled and contracted
 - D) from water eroding the surface
 - E) by a plume of molten mantle material rising to the surface forming a bulge
56. In the Tharsis region of Mars we find
- A) a huge impact basin
 - B) heavily cratered highlands
 - C) smooth rolling plains
 - D) huge shield volcanoes like Olympus Mons
 - E) signs of an ancient Martian civilization
57. What is the most likely origin of the Valles Marineris on Mars?
- A) it is a fissure in the surface carved out by a giant impact
 - B) it is a huge canyon system formed by water erosion
 - C) it was formed from the separation of two tectonic plates
 - D) it is a tectonic fracture associated with the formation of the adjacent Tharsis bulge
 - E) it is a huge ancient volcano
58. Indications of what kind of surface processing do we not see on Mars?
- A) Volcanism
 - B) Water erosion
 - C) Wind erosion
 - D) Biological decay via lichen and plant roots
 - E) Giant tectonic cracks
59. What method has been used to determine the most recent time the Tharsis volcanoes on Mars have erupted?
- A) measuring the thickness of lava flows on their sides
 - B) measuring the intensity of infrared radiation emitted by them
 - C) counting the craters on their slopes
 - D) measuring the changes in sulfur compound concentrations in the planet's atmosphere
 - E) watching the rate that lava pours out of the volcanoes

60. The ancient water erosion features on the surface of Mars suggest that the planet must have had a much
- A) warmer, thinner atmosphere in the past
 - B) cooler, thicker atmosphere in the past
 - C) cooler, thinner atmosphere in the past
 - D) cooler, thicker helium atmosphere in the past
 - E) warmer, thicker atmosphere in the past
61. At the Mars *Pathfinder* landing site, the surrounding rocks are scattered and stacked against each other. This suggests that the spacecraft landed in
- A) an area of explosive volcanic activity
 - B) an area subjected to wind erosion
 - C) the debris from a giant impact
 - D) an area subjected to a giant landslide
 - E) an ancient floodplain
62. The landing site for the Mars Exploration Rovers were chosen because
- A) of their proximity to the Tharsis region
 - B) we can see ice patches there
 - C) they were selected at random
 - D) they occur in one of the canals seen by Percival Lowell
 - E) we believe these regions were once associated with liquid water
63. Which of the following is not a Martian rover?
- A) Curiosity
 - B) Sojourner
 - C) Spirit
 - D) Enterprise
 - E) Opportunity
64. Results from the Mars Exploration Rovers *Spirit* and *Opportunity* suggest that liquid water
- A) has never existed in significant quantities on the surface of Mars
 - B) was once plentiful on the surface of Mars
 - C) is only present in the Tharsis region of Mars
 - D) is present in large quantities beneath the Martian surface today
 - E) only occurs in the Martian atmosphere
65. The minerals jarosite and hematite (the blueberries) that Opportunity found indicate
- A) water once flowed on the surface of Mars
 - B) liquid water was once stable on the surface of Mars
 - C) water once flowed on the surface of Venus
 - D) carbon dioxide is a clear component of the Martian atmosphere
 - E) water only occurs in the Martian atmosphere

66. Recurring slope lineae on Mars seem to be
- A) geysers erupting on the surface of Mars
 - B) salty, chemical-rich water leaking out of the crater walls of Mars
 - C) a trick of light that was later disproved by modern orbiters
 - D) rock layers indicating water was once stable on Mars
 - E) proof that Percival Lowell's canals actually exist
67. The presence of channels carved out on the slopes of large Martian volcanoes is consistent with
- A) recent wind erosion
 - B) the existence of past underground pockets of water
 - C) the action of plate tectonics
 - D) recent impacts
 - E) Percival Lowell's canals
68. Recent observations by the Mars *Odyssey* orbiter show that most of the water on Mars today is
- A) flowing in rivers on the surface
 - B) frozen beneath the surface
 - C) present in the atmosphere
 - D) present in the polar caps
 - E) deep inside the Martian core
69. Within a few months of its arrival, the Curiosity rover discovered
- A) alien artifacts
 - B) microscopic life forms
 - C) caves on Mars
 - D) tumbled rocks indicative of former, rapid water flows
 - E) craters with frozen water inside them
70. Which of the following did NOT contribute to the thinning of the Martian atmosphere during its early history?
- A) the photodissociation of water molecules by ultraviolet light in the atmosphere
 - B) the consumption of carbon dioxide by photosynthetic bacteria
 - C) the stripping of the atmosphere by solar wind particles from the Sun
 - D) atmospheric gases being blasted into space by large impacts
 - E) the escape of the fastest moving molecules into space
71. The Earth's axis tilt has changed little over its history due to
- A) the stabilizing effects of Jupiter's gravity
 - B) the stabilizing effects of the Sun's gravity
 - C) its rapid rotation
 - D) the effects of the Sun
 - E) the stabilizing effects of the Moon's gravity

72. Compared to the Earth, Mars has experienced wild swings in its axis tilt over relatively short time periods. This is because of its
- A) proximity to Jupiter and its lack of a large moon
 - B) greater distance from the Sun
 - C) slower rotation rate
 - D) small size
 - E) greater distance from the Earth's stabilizing moon
73. What discovery suggests that life might have had the opportunity to develop on Mars?
- A) The discovery that water might have sloshed around on its surface for short periods of time
 - B) Observations of Martian bigfoots and mermaids
 - C) The discovery of two Martian moons
 - D) The discovery of Martian polar caps
 - E) The discovery (from jarosite/hematite) that water was stable on Mars for long periods of time
74. Which of the following statements best describes the idea behind the Gas Chromatograph/Mass Spectrometer Experiment on board the *Viking* landers?
- A) radioactive gases should be produced when radioactive nutrients are added to a soil sample
 - B) living organisms in the soil should incorporate carbon from atmospheric gases
 - C) living organisms in the soil should give off gases when they metabolize nutrients
 - D) soil with living organisms in it should contain organic molecules
 - E) living organisms should grow and be visible via the onboard Viking camera
75. Which was the only biology experiment on the *Viking* landers which gave a positive result?
- A) Gas Chromatograph/Mass Spectrometer
 - B) Carbon Assimilation
 - C) Gas Exchange
 - D) Labeled Release
 - E) Long range scanners
76. The positive result from the Labeled Release experiment was inconsistent with the results from which other biology experiment or experiments?
- A) Carbon Assimilation
 - B) Gas Chromatograph/Mass Spectrometer
 - C) Gas Exchange
 - D) Tricorder readings
 - E) Long range scans

77. Which of the following statements is an overall summary of the findings from the *Viking* biology experiments?
- A) the Martian soil showed no signs of chemical or biological activity
 - B) the Martian soil showed clear signs of biological activity
 - C) the Martian soil contained organic molecules but showed no signs of biological activity
 - D) the Martian soil is chemically reactive but shows no clear signs of biological activity
 - E) life is common on Mars
78. What are the most likely sources of the methane gas detected in the Martian atmosphere by the *Mars Express* orbiter and Curiosity?
- A) biological and/or volcanic activity
 - B) biological activity only
 - C) comet impacts only
 - D) volcanic activity only
 - E) the polar caps
79. Why must lander probes on Mars be sterilized before launch?
- A) to prevent terrestrial microbes destroying the electronics in the probe during its passage to Mars
 - B) to prevent Martian dust from building up on the probe on the surface
 - C) to prevent Martian microbes from contaminating the lander probe
 - D) to prevent terrestrial microbes hitching a ride on the probe and contaminating the Martian surface
 - E) to protect the scientists building the probes
80. Why is the possible contamination of the Earth by Martian microbes in a future sample return mission not considered to be a significant problem?
- A) Martian microbes will certainly be destroyed by terrestrial microbes
 - B) any Martian microbes will be destroyed by high-energy particles and radiation on their trip back to Earth
 - C) Martian microbes will be rapidly destroyed by oxygen in the Earth's atmosphere
 - D) the Martian probes are too large
 - E) Martian microbes are likely to be quite different than terrestrial microbes and, hence, will probably not be able to affect life on Earth
81. What is the most significant drawback of possibly sending humans to Mars?
- A) the fact that there would be no possible source of water on the surface
 - B) the high probability that Martian microbes would infect the crew
 - C) the high probability of contamination of the Martian surface by microbes associated with human beings
 - D) the fact that astronauts could not breathe in the Martian atmosphere
 - E) the fact that there would be no sunlight on Mars

82. The process of making an uninhabitable planet like Mars habitable and suitable for humans is referred to as
- A) bioforming
 - B) terraforming
 - C) bioadaptation
 - D) terra-restructuring
 - E) genetic modifications
83. What is the origin of Martian meteorites?
- A) they are rocks blasted from the surface of Mars by impacts
 - B) they are rocks brought to Earth by Martians
 - C) they are rocks brought back to Earth by sample return missions
 - D) they are rocks blasted from the surface of Mars by volcanoes
 - E) they were fakes made in Thailand
84. What is the most convincing piece of evidence to suggest that Martian meteorites actually came from Mars?
- A) they are igneous rocks
 - B) they are red in color
 - C) they show evidence for having been in contact with water
 - D) they contain trapped gases with a similar composition to the Martian atmosphere
 - E) they were seen flying directly from Mars
85. Why was the Martian meteorite ALH84001 singled out for intense study?
- A) it is the only Martian meteorite that has even been discovered
 - B) the meteorite appeared to be giving off methane gas
 - C) it is a very old rock, dating back from the time when Mars probably had liquid water on its surface
 - D) it is a very young rock originating from the Tharsis region
 - E) it was seen flying directly from Mars
86. What is the most intriguing piece of evidence that suggests that the Martian meteorite ALH84001 may have once contained life?
- A) molecules of DNA were found inside
 - B) oxygen gas was found trapped inside the meteorite
 - C) amino acids were found inside
 - D) highly magnified images of carbonate grains found inside reveal rod-shaped structures that look much like terrestrial nanobacteria
 - E) it ate the first research team working on it

87. Why is the claim of fossilized life in the Martian meteorite ALH84001 controversial?
- A) it is doubtful that the rock actually came from Mars
 - B) the proposed fossilized organisms in no way resemble any kind of life found on Earth
 - C) there are reasonable nonbiological explanations for the observed evidence
 - D) the rock is too young to have fossilized life within it
 - E) the scientists working on the project were found to be faking their data
88. The first discovery of Jovian moons was made by
- A) Tycho
 - B) Huygens
 - C) Galileo
 - D) Cassini
 - E) Newton
89. The largest Jovian moons (Ganymede and Titan) are
- A) larger than the Earth
 - B) larger than Mercury but smaller than the Earth
 - C) larger than the Moon but smaller than Mercury
 - D) about the same size as Mars
 - E) larger than Jupiter itself!
90. The fact that many of the larger Jovian moons orbit nearly in the equatorial plane of their host world, moving in the same direction as their planet's spin, suggest that they
- A) were spun out from the rapidly spinning host world as it formed
 - B) formed elsewhere in the solar system and were later captured
 - C) were formed from a giant impact between the host world and another body
 - D) were ejected from the Sun via a coronal mass ejection
 - E) formed from a rotating disk of gas and dust like a miniature solar system
91. Most of the smallest Jovian moons are most likely
- A) captured asteroids and comets
 - B) captured objects from outside the solar system
 - C) small clumps of gas left over from the formation of the host planet
 - D) fragments of other moons
 - E) material ejected from the Sun via a coronal mass ejection
92. The largest Jovian moon that appears to have been captured by its planet is
- A) Triton, the moon of Neptune
 - B) Titania, the moon of Uranus
 - C) Io, the moon of Jupiter
 - D) Titan, the moon of Saturn
 - E) our moon

93. Jovian moons are typically made of
- A) solid ice
 - B) rock and iron
 - C) solid rock
 - D) hydrogen and helium
 - E) ice and rock
94. Like our own moon, many Jovian moons exhibit what is called synchronous rotation. This means that they rotate at the same rate
- A) that their host planet rotates
 - B) as all other moons around the host planet
 - C) that the host planet orbits about the Sun
 - D) as the Sun
 - E) that they orbit their host planet
95. The fact that the strength of gravity decreases with distance means the force of gravity exerted by one object on another (e.g., the Earth and Moon) is greater on the near side than the far side. This effect is commonly referred to as a
- A) differential energy
 - B) distortive force
 - C) tidal force
 - D) tractive force
 - E) centrifugal force
96. Io experiences strong internal tidal heating because of
- A) large amounts of radioactive decay occurring inside the moon
 - B) the large amount of internal heat left over from its formation
 - C) the strong tidal forces exerted by the outer Galilean moons, Europa, Ganymede, and Callisto
 - D) the strong tidal force from the massive Jupiter combined with its elliptical orbit which causes the strength of the force to constantly change
 - E) tidal forces from the Sun, as the Jupiter system orbits the Sun on an elliptical orbit
97. Even though Jupiter's moon Io is similar in size to our geologically dead Moon, it is more geologically active than the Earth. How can this be?
- A) because Io orbits very close to Jupiter, it still has a lot of heat trapped inside from its formation
 - B) Io is tidally heated by tidal forces exerted by the outer Galilean moons, which flex and distort its interior
 - C) Io is tidally heated due to tidal forces exerted by Jupiter
 - D) Io has much more radioactive decay occurring inside it than does the Earth
 - E) Io has only recently been formed

98. Which of the following best describes the internal structure of Europa?
- A) thin icy crust, subsurface ocean of water, thick iron mantle, central rocky core
 - B) thin icy crust, subsurface ocean of water, thick rocky mantle, central iron core
 - C) thin icy crust, thick rocky mantle, central iron core
 - D) surface ocean of water, thick rocky mantle, central iron core
 - E) solid rock and iron core
99. The lack of large impact craters on the surface of Europa is consistent with
- A) active volcanism that is constantly resurfacing the crust
 - B) the surface being covered with an ocean of liquid water
 - C) the crust being so thick and hard that impacts leave no marks on the surface
 - D) the moon having been shielded from impacts by Jupiter
 - E) a subsurface ocean of water because large impacts will break the thin crust causing water and slushy ice below to flood out and resurface the crust
100. Much of Europa's surface appears chaotic and clogged with huge iceberg-like blocks. This is consistent with
- A) the surface thawing due to heat emitted by Jupiter
 - B) the breaking up of the surface due to plate tectonics
 - C) a giant impact that has recently shattered the crust into pieces
 - D) a thin icy crust that has been broken into pieces by tidal forces below which is a subsurface ocean or lakes of water
 - E) the loss of an atmosphere, allowing Europa to fracture
101. Life beneath the surface of Europa would most likely obtain energy from
- A) tidal heating
 - B) the Sun
 - C) Jupiter
 - D) radioactivity
 - E) nuclear fusion processes
102. In the subsurface ocean beneath Europa's icy crust, if life exists, it most likely originated
- A) on the surface and then migrated down into the ocean
 - B) close to volcanic vents on its ocean floor
 - C) just below the surface of its thin icy crust where sunlight is still able to penetrate
 - D) in the atmosphere of Jupiter
 - E) in the ancient atmosphere of Europa
103. Life in the subsurface ocean of Europa will most likely consist of
- A) creatures similar to seals and penguins which enter the ocean through holes in the icy crust
 - B) simple single-celled organisms
 - C) plants on the ocean floor
 - D) fish and other complex aquatic organisms
 - E) large predators that move rapidly so they stay warm

104. The complexity of any life present in Europa's subsurface ocean is mainly limited by the
- A) amount of water in the ocean
 - B) average temperature of the water
 - C) amount of organic material present
 - D) amount of oxygen available
 - E) amount of available energy to sustain it
105. Which of the following is the most convincing observation that suggests that like Europa, Ganymede may also have a subsurface ocean?
- A) the detection of salts on the surface that may have been brought up from below the crust
 - B) the presence of young grooved terrain that may be the result of cryovolcanism
 - C) in addition to its internal magnetic field, Ganymede has a magnetic field induced by Jupiter which is consistent with a salty ocean beneath its crust
 - D) the fact that it is the largest moon in the solar system and, hence, should have plenty of internal heat to maintain liquid water beneath its surface
 - E) the presence of an oxygen-rich atmosphere
106. Which Galilean moons of Jupiter show evidence for subsurface oceans of water beneath their icy crusts?
- A) all four show evidence for subsurface oceans
 - B) Europa, Ganymede, and Callisto
 - C) Europa and Ganymede
 - D) Europa
 - E) Io
107. Which of the four Galilean moons is *least* likely to harbor life on or beneath its surface?
- A) Europa
 - B) Callisto
 - C) Io
 - D) Ganymede
 - E) Titan
108. In addition to being the second-largest moon in the solar system, Saturn's moon Titan, is
- A) the only moon to have its own internal magnetic field
 - B) more geologically active than the Earth
 - C) the only moon to show evidence for a subsurface ocean of water
 - D) the only moon to have its own atmosphere thicker than the Earth's
 - E) the only moon with an oxygen-rich atmosphere
109. How is Titan, the moon of Saturn, similar to the Earth?
- A) Titan, like the Earth, has an internal magnetic field
 - B) like the Earth, Titan has oceans of liquid water on its surface
 - C) Titan is almost the same size as the Earth
 - D) like the Earth, Titan has an atmosphere made mostly of molecular nitrogen
 - E) Titan has an oxygen-rich atmosphere

110. In addition to nitrogen, the other main components of Titan's atmosphere are
- A) ammonia and water vapor
 - B) hydrogen and helium
 - C) oxygen and carbon dioxide
 - D) silicon
 - E) hydrocarbons like methane and ethane
111. What is the origin of the nitrogen in Titan's atmosphere?
- A) breakdown of ammonia (NH₃) by ultraviolet light from the Sun
 - B) gas captured from the solar nebula
 - C) outgassing from Titan's interior
 - D) impacts from comets
 - E) Saturn's rings
112. Titan is roughly the same size as Mercury, yet Titan has an atmosphere while Mercury does not. How can this be?
- A) Although Titan is roughly the same size as Mercury, it is much denser, making its gravitational field stronger
 - B) Unlike Mercury, Titan is constantly being bombarded by icy comets that evaporate and maintain its atmosphere
 - C) On its surface, Titan has volcanism that is constantly replenishing its atmosphere while Mercury does not
 - D) Titan is much colder, allowing its weak gravity to trap molecules
 - E) Titan gathered its atmosphere from the rings of Saturn
113. When the *Huygens* probe touched down on Titan, it landed
- A) in a vast ocean of liquid methane
 - B) in a shallow pool of liquid methane
 - C) on the slopes of an icy volcano covered with water and methane ice
 - D) on a solid surface of frozen water and methane ices that resembled a streambed
 - E) on the peak of an ancient, dormant volcano
114. Even though Titan has liquid methane on its surface, some internal heat, and plenty of carbon-containing compounds, it is not a suitable place for life because
- A) Titan orbits within Saturn's radiation belt so its surface is completely sterilized by high-energy particles
 - B) there is too much volcanic activity on the surface
 - C) it has no ozone layer to protect the surface from harmful UV rays from the Sun
 - D) it is far too cold, and methane is not a very good biological solvent
 - E) it is covered with liquid water

115. Saturn's icy moon Enceladus
- A) has an ancient, heavily cratered surface reminiscent of the Moon
 - B) is small and irregular in shape like an asteroid
 - C) has fountains of ice particles and water vapor spraying out from its surface
 - D) has a smooth, icy surface criss-crossed with dark cracks
 - E) has an oxygen-rich atmosphere
116. Triton's retrograde orbit is consistent with it having
- A) been spun out from a rapidly rotating Neptune
 - B) undergone a massive impact
 - C) been captured by Neptune's gravity
 - D) formed from a rotating disk of gas and dust around Neptune
 - E) an iron core
117. From a chemical energy standpoint, the basic requirement for life is a situation in which chemicals naturally exist in a state of
- A) disequilibrium
 - B) instability
 - C) equilibrium
 - D) stability
 - E) explosive reactivity
118. Most of the key energy-generating chemical reactions used by life on Earth are
- A) redox reactions
 - B) rearrangement reactions
 - C) decomposition reactions
 - D) combination reactions
 - E) nuclear reactions
119. What is the definition of a star's habitable zone?
- A) the range of distances from the star where planets with life have been detected
 - B) the range of distances from the star where liquid water can be stable on the surface of a suitable planet
 - C) the range of distances from the star where rocky planets can form
 - D) the range of distances from the star where organic molecules can be stable on the surface of a suitable planet
 - E) the distance of the star from the Earth
120. Over time the Sun's habitable zone has
- A) narrowed and moved farther from the Sun
 - B) narrowed and moved closer to the Sun
 - C) widened and moved closer to the Sun
 - D) widened and moved farther from the Sun
 - E) slowly gotten smaller

121. Europa is exterior to the Sun's habitable zone and yet may be habitable. How can this be?
- A) Europa's subsurface ocean contains lots of minerals that allow water to remain liquid at much lower temperatures
 - B) Europa is continually being hit by comets and asteroids which keeps water beneath its surface liquid
 - C) Europa is large enough to have appreciable heat trapped inside it to keep water beneath the surface liquid
 - D) Europa is tidally heated, allowing liquid water to exist beneath its icy surface
 - E) Europa is being heated by the solar wind
122. The Moon is within the habitable zone of the Sun, at the same distance as the Earth, but is not habitable. How can this be?
- A) the Moon did have water on its surface in the past, but it was destroyed by high-energy particles from the Sun
 - B) the Moon has never had water on its surface at any time
 - C) the Moon did have water on its surface in the past, but it was blasted off the surface by impacts
 - D) the Moon is too small to retain an atmosphere necessary for liquid water to be stable
 - E) the Moon is being heated by the solar wind
123. Apart from its distance from its parent star, what is the next most important factor that determines a planet's habitability?
- A) whether it has a large moon
 - B) the chemical composition of its atmosphere
 - C) the size of the planet
 - D) the chemical composition of its surface
 - E) whether it has a ring system, which shields it from the Sun
124. Based only on its distance from the Sun, we would expect the surface of Venus to be
- A) slightly colder than the Earth
 - B) roughly the same temperature as the Earth
 - C) slightly warmer than the Earth
 - D) very much warmer than the Earth
 - E) very much colder than the Earth
125. Most of the carbon dioxide on Venus
- A) is present in its atmosphere
 - B) is trapped beneath the surface of the planet in gaseous form
 - C) has escaped into space
 - D) is locked up in carbonate rocks in its crust
 - E) was blown away by the Sun

126. Most of the carbon dioxide on the Earth
- A) is trapped beneath the surface of the planet in gaseous form
 - B) has escaped into space
 - C) is located in its atmosphere
 - D) was blown away by the Sun
 - E) is locked up in carbonate rocks in its crust or is dissolved in the oceans
127. Most of the water that used to be present in the Venusian atmosphere
- A) became chemically incorporated into rocks in the crust
 - B) was destroyed in the atmosphere by ultraviolet light from the Sun
 - C) was blasted into space by impacts
 - D) escaped into space
 - E) was blown away by the Sun
128. Evidence for the loss of water from the atmosphere of Venus via the action of ultraviolet light comes from the
- A) observation of auroras high in the Venusian atmosphere caused by the action of ultraviolet light on water molecules
 - B) fact that today, water is found only in the upper atmosphere of Venus
 - C) observation of an excess of heavy hydrogen (deuterium) atoms in the atmosphere which are less easily able to escape once the water is broken apart
 - D) observation of an ozone layer in the atmosphere which is formed from the breakup of water molecules by ultraviolet radiation
 - E) detection of subsurface Venusian lakes
129. If the Earth were to be moved to where Venus is today,
- A) the oceans would evaporate, blocking light from the Sun and causing global temperatures to fall
 - B) carbon dioxide would be released from the oceans leading to higher temperatures but liquid water could still exist on the surface
 - C) the oceans would evaporate slightly producing a slightly warmer, more humid planet
 - D) gravitational forces would return the Earth to its original position
 - E) the oceans would evaporate and carbonate rocks would decompose producing a runaway greenhouse effect comparable or even more severe than the one that exists on Venus today
130. Venus is located
- A) near the outer border of the Sun's habitable zone
 - B) within the Sun's habitable zone
 - C) between the Earth and Mars
 - D) possibly within the Sun's habitable zone, but we can't be sure
 - E) interior to the Sun's habitable zone

131. Around 4 billion years ago Venus could have been more Earth-like with liquid water on its surface because
- A) Venus has a protective magnetic field
 - B) its atmosphere was thinner
 - C) Venus was farther from the Sun
 - D) it had a much thicker atmosphere
 - E) the Sun was dimmer so Venus would have received less radiation
132. If life is present on Venus today, it will most likely be
- A) inside large rocks that are protected from the heat
 - B) found in the atmosphere where highly acidic droplets of water can be found
 - C) organisms living beneath the crust where liquid water may still be present
 - D) heat-loving extremophiles found on the surface
 - E) slow-moving desert animals, like tortoises
133. A star more luminous than our Sun will have a habitable zone that is
- A) narrower and farther from the star than the habitable zone of the Sun
 - B) narrower and closer to the star than the habitable zone of the Sun
 - C) wider and closer to the star than the habitable zone of the Sun
 - D) non-existent
 - E) wider and farther from the star than the habitable zone of the Sun
134. A star less luminous than our Sun will have a habitable zone that is
- A) wider and closer to the star than the habitable zone of the Sun
 - B) narrower and farther from the star than the habitable zone of the Sun
 - C) narrower and closer to the star than the habitable zone of the Sun
 - D) wider and farther from the star than the habitable zone of the Sun
 - E) non-existent
135. Stars much more luminous than the Sun have
- A) narrow habitable zones, and lifetimes too short for advanced life to develop
 - B) wide habitable zones, and lifetimes too short for advanced life to develop
 - C) narrow habitable zones, and lifetimes longer than our Sun's
 - D) wide habitable zones, and lifetimes longer than our Sun's
 - E) non-existent habitable zones
136. Stars much less luminous than the Sun have
- A) narrow habitable zones, and lifetimes too short for advanced life to develop
 - B) wide habitable zones, and lifetimes too short for advanced life to develop
 - C) narrow habitable zones, and lifetimes longer than our Sun's
 - D) wide habitable zones, and lifetimes longer than our Sun's
 - E) non-existent habitable zones

A series of questions that follow refer to Figure 1 at the end of the test bank.

137. Referring to Figure 1, what is the location of Mercury?
A) Region A
B) Region B
C) Boundary C
D) Boundary D
E) Region E
138. Referring to Figure 1, what is the location of Venus?
A) Region A
B) Region B
C) Boundary C
D) Boundary D
E) Region E
139. Referring to Figure 1, what is the location of Earth?
A) Region A
B) Region B
C) Boundary C
D) Boundary D
E) Region E
140. Referring to Figure 1, what is the location of the Moon?
A) Region A
B) Region B
C) Boundary C
D) Boundary D
E) Region E
141. Referring to Figure 1, what is the location of Europa?
A) Region A
B) Region B
C) Boundary C
D) Boundary D
E) Region E
142. Referring to Figure 1, what is the location of Titan?
A) Region A
B) Region B
C) Boundary C
D) Boundary D
E) Region E

143. Referring to Figure 1, the moist greenhouse effect is most related to adjusting the precise placement of which boundary or region?
- A) The star at the middle of the diagram
 - B) Region B
 - C) Boundary C
 - D) Boundary D
 - E) The moist greenhouse effect does not relate to this diagram
144. Referring to Figure 1, the issue that a planet may lose its CO₂ atmosphere because it may freeze out as CO₂ snow, is most related to the precise placement of which boundary or region?
- A) Region A
 - B) The star at the middle of the diagram
 - C) Boundary C
 - D) Boundary D
 - E) The issue described does not relate to this diagram
145. Referring to Figure 1, what is the region or boundary where you are most likely to find a planet with a runaway greenhouse effect?
- A) Region A
 - B) Region B
 - C) Boundary C
 - D) Boundary D
 - E) Region E
146. Referring to Figure 1, what is the region or boundary where you would most likely require an energy source other than the Sun—such as tidal heating—to make a planet habitable?
- A) Region A
 - B) Region B
 - C) Boundary C
 - D) Boundary D
 - E) Region E
147. Referring to Figure 1, what is the region or boundary where you would most likely find a planet with surface oceans of liquid methane or ethane?
- A) Region A
 - B) Region B
 - C) Boundary C
 - D) Boundary D
 - E) Region E

148. Referring to Figure 1, in several billion years, when the Sun becomes a red giant, in what region or boundary would the Earth be located?
- A) Region A
 - B) Region B
 - C) Boundary C
 - D) Boundary D
 - E) Region E
149. Referring to Figure 1, four billion years ago when the Sun was not as bright, Venus may have had large surface oceans of water—if that is the case, at that time, in what region or boundary would Venus have been located?
- A) Region A
 - B) Region B
 - C) Boundary C
 - D) Boundary D
 - E) Region E
150. Referring to Figure 1, consider a point located in the continuously habitable zone. Where was that point shortly after the end of the Late Heavy Bombardment?
- A) Region A
 - B) Region B
 - C) Boundary C
 - D) Boundary D
 - E) Region E
151. Which is not a critical factor that determines the habitability of a planet?
- A) presence of a solid surface
 - B) size
 - C) distance from parent star
 - D) presence of an atmosphere
 - E) all the above factors are critical in determining the habitability of a planet
152. The moist greenhouse effect refers to
- A) the point at which water is evaporating from the surface at a faster rate than it is condensing
 - B) the natural greenhouse effect due to clouds of water vapor in the lower atmosphere
 - C) an enhanced greenhouse effect above tropical regions of the Earth's surface
 - D) the process by which water vapor rises into the upper atmosphere above the ozone layer where it is then broken apart by ultraviolet radiation, and lost
 - E) the moisture that occurs on the outside of a glass on a warm day

153. If we allow for moisture loss due to a moist greenhouse effect, the inner boundary of the Sun's habitable zone would be
- A) roughly halfway between the orbits of Venus and Mercury
 - B) just inside the orbit of the Earth
 - C) roughly halfway between the orbits of the Earth and Venus
 - D) just outside the orbit of the planet Mercury
 - E) non-existent
154. If Mars had a thicker atmosphere with a strong greenhouse effect, the outer boundary of the Sun's habitable zone would lie
- A) roughly halfway between the orbit of the Earth and Mars
 - B) just within the orbit of Mars
 - C) just beyond the orbit of Mars
 - D) roughly halfway between the orbit of Mars and Jupiter
 - E) just within the orbit of Mercury!
155. When the Sun was younger, how did its habitable zone compare with its habitable zone today?
- A) narrower and farther from the Sun
 - B) wider and closer to the Sun
 - C) wider and farther from the Sun
 - D) narrower and closer to the Sun
 - E) non-existent
156. Compared to today, in the future, the Sun's habitable zone will be
- A) wider and farther from the Sun
 - B) wider and closer to the Sun
 - C) narrower and closer to the Sun
 - D) narrower and farther from the Sun
 - E) non-existent
157. The range of distances that has remained habitable for the entire duration of the Sun's lifetime is referred to as the
- A) habitable zone of consistency
 - B) continuously habitable zone
 - C) zone of water stability
 - D) permanently habitable zone
 - E) life zone
158. According to pessimistic estimates, the end of habitability of Earth will come about
- A) 25 years
 - B) a few hundred thousand years from now
 - C) 10 million years from now
 - D) one half to one billion years from now
 - E) 3 to 4 billion years from now

159. According to optimistic estimates, the end of habitability of Earth will come about
- A) 25 years
 - B) a few hundred thousand years from now
 - C) 10 million years from now
 - D) one half to one billion years from now
 - E) 3 to 4 billion years from now
160. When the Sun runs out of nuclear fuel and expands to become a red giant,
- A) the Earth's oceans will freeze solid
 - B) the Earth will experience a runaway greenhouse effect followed by the total loss of its atmosphere
 - C) the Earth will be ejected from the solar system
 - D) the Earth will be turned into neutrinos
 - E) the Earth will be unaffected
161. When the Sun ejects its outer layer into space to become a planetary nebula, the probable result will be that
- A) the Earth will be ejected from the solar system
 - B) the Earth's oceans will freeze solid
 - C) the Earth will experience a runaway greenhouse effect followed by the total loss of its atmosphere
 - D) the Earth will be destroyed
 - E) the Earth will be unaffected
162. The recent rise in the Earth's average surface temperature is commonly referred to as
- A) global warming
 - B) the greenhouse effect
 - C) ozone depletion
 - D) global heating
 - E) summer
163. As the average surface temperature of the Earth rises, the Northern hemisphere of the Earth is warming more rapidly than the Southern hemisphere because
- A) during summer in the Northern hemisphere, the Earth is closer to the Sun
 - B) there is less ice in Arctic regions compared to the Antarctic regions so less radiation is reflected out into space
 - C) the Northern hemisphere contains more landmass which more readily absorbs solar radiation
 - D) there are more clouds in the Southern hemisphere to reflect solar radiation out into space
 - E) the Sun is hotter on its northern surface

164. Measurements of carbon dioxide concentrations in our atmosphere over the past 650,000 years show
- A) an indirect correlation with global surface temperatures
 - B) a direct correlation with global surface temperatures, only over the past century
 - C) no correlation with global surface temperatures
 - D) the carbon dioxide levels are dropping
 - E) a direct correlation with global surface temperatures
165. The atmospheric carbon dioxide concentration
- A) is higher than it has been at any time during the last 650,000 years
 - B) is higher than it has been at any time during the Earth's history
 - C) has remained roughly constant during the last 650,000 years
 - D) is lower than it has been at any time during the last 650,000 years
 - E) is slowly but surely dropping
166. While there is no doubt that global temperatures are increasing, it is
- A) now becoming clear that this effect is due to the slow brightening of the Sun
 - B) now certain that human activity has no effect on the Earth's climate
 - C) now becoming clear that human activity is indeed causing global warming
 - D) still not clear whether human activity is affecting the climate at all
 - E) clear that this is all due to the gravity of the Moon
167. As global climate change continues, weather patterns will change causing
- A) only the oceans to become warmer while the landmasses will become colder
 - B) only the landmasses to become warmer while the oceans will become colder
 - C) all parts of the Earth's surface will become warmer
 - D) some parts of the Earth's landmass to become warmer while other parts will actually get colder. The ocean temperatures will continue to rise
 - E) the oceans to dry up
168. As global warming raises the moisture content in our atmosphere, storms will
- A) become more numerous and severe
 - B) become less numerous and less severe
 - C) disappear all together
 - D) become less numerous but more severe
 - E) stay more or less as they are now
169. Climate models predict that as the polar ice caps melt within the next century, sea levels
- A) will remain stable due to increased evaporation into the Earth's atmosphere
 - B) may rise by more than tens of meters
 - C) will actually fall by a meter due to increased evaporation into the Earth's atmosphere
 - D) may rise anywhere from several cm to several meters
 - E) could do just about anything—scientists simply do not know

170. Climate models predict if the polar ice caps were to completely melt over centuries to thousands of years, sea levels
- A) will remain stable due to increased evaporation into the Earth's atmosphere
 - B) may rise by more than tens of meters
 - C) will actually fall by a meter due to increased evaporation into the Earth's atmosphere
 - D) may rise anywhere from several cm to a meter
 - E) could do just about anything—scientists simply do not know
171. Which is not a greenhouse gas?
- A) O₂ (oxygen)
 - B) CO₂ (carbon dioxide)
 - C) H₂O (water vapor)
 - D) CFCs (chlorofluorocarbons)
 - E) CH₄ (methane)
172. While the Sun is getting brighter with time, this cannot explain current global climate change, because
- A) solar brightening is a process that has been happening for billions of years, while global climate change only dates back to the industrial revolution.
 - B) the axial tilt of the Earth is something that takes place over millions of years, while global climate change only dates back to the industrial revolution.
 - C) crooked scientists are all just trying to make a buck, living off taxpayers' hard-earned money
 - D) crooked politicians are all just trying to make a buck, living off taxpayers' hard-earned money
 - E) the science just isn't in yet—we don't know if climate change is real!
173. While the Earth's axis wobbles with time, this cannot explain current global climate change, because
- A) solar brightening is a process that has been happening for billions of years, while global climate change only dates back to the industrial revolution.
 - B) the axial tilt of the Earth is something that takes place over millions of years, while global climate change only dates back to the industrial revolution.
 - C) crooked scientists are all just trying to make a buck, living off taxpayers' hard-earned money
 - D) crooked politicians are all just trying to make a buck, living off taxpayers' hard-earned money
 - E) the science just isn't in yet—we don't know if climate change is real!

See Figure 1 on next page

FIGURE 1

A = This zone is “interior” to the habitable zone.

B = This zone is “exterior” to the habitable zone.

Note: Together, zones A+B indicate the region “outside” the habitable zone.

C = The inner boundary of the habitable zone.

D = The outer boundary of the habitable zone

E = The habitable zone for the star. Points here are “within” or “inside” the habitable zone.

