

SECTION 1: MULTIPLE CHOICE

Choose the best possible answer.

50 points possible

- 1) Ice can be found in which of the following places on Mars?
 - a) The North Pole
 - b) The South Pole
 - c) Equatorial regions
 - d) a & b only
 - e) All of the above

- 2) In 2007 the Mars Express spacecraft determined that the frozen water in Mars' south polar region is enough to cover the entire planet in a liquid layer approximately how deep?
 - a) 10-50 centimeters
 - b) 1-5 meters
 - c) 5-10 meters
 - d) 10-15 meters
 - e) There is no frozen water in Mars' south polar region

- 3) RADAR measurements have determined the volume of frozen water in Mars' north polar region to be approximately what amount?
 - a) 1,000 - 10,000 km³
 - b) 10,000 - 100,000 km³
 - c) 100,000 - 1,000,000 km³
 - d) 1,000,000 - 10,000,000 km³
 - e) There is no frozen water in Mars' north polar region

- 4) Which of the following is not the name of a Martian rover?
 - a) Curiosity
 - b) Opportunity
 - c) Sojourner
 - d) Spirit
 - e) These are all Martian rovers

- 5) In late 2013, a Martian rover discovered key geological evidence in Gale Crater that Mars may have been hospitable to life billions of years ago. What did it discover?
 - a) Evidence of an ancient freshwater lake
 - b) Evidence of an ancient river
 - c) Groundwater
 - d) Microbial organisms
 - e) A tripod-shaped machine from H.G. Wells' *War of the Worlds*

- 6) What planet does Europa orbit?
 - a) Mars
 - b) Jupiter
 - c) Saturn
 - d) Uranus
 - e) Neptune

- 7) Which probe first determined the existence of subsurface saltwater on Europa?
 - a) Cassini-Huygens
 - b) Galileo
 - c) Voyager 1
 - d) Voyager 2
 - e) The existence of subsurface saltwater on Europa is not proven

- 8) Describe Europa in relation to the four Galilean satellites.
- Europa is the largest and closest to the planet which they orbit
 - Europa is the largest and furthest from the planet which they orbit
 - Europa is the smallest and closest to the planet which they orbit
 - Europa is the smallest and furthest from the planet which they orbit
 - Europa is not one of the four Galilean satellites
- 9) Where would life most likely have developed on Europa?
- On top of a layer of ice
 - On land on the surface
 - In a surface ocean
 - In an ocean below the surface
 - In the core
- 10) Which of these could be used to indicate the existence of an ocean on Europa?
- Constant fracturing of the surface ice
 - Exceptionally high albedo
 - Microbial organisms
 - Significantly higher surface temperature
 - Significantly lower surface temperature
- 11) What planet does Enceladus orbit?
- Mars
 - Jupiter
 - Saturn
 - Uranus
 - Neptune
- 12) What unique feature is found in bands at the south pole of Enceladus?
- Microbial organisms
 - An ocean of liquid water
 - An ocean of liquid carbon dioxide
 - Glacial rivers cutting through the ice cap
 - Tiger stripes
- 13) What is significant about the feature in the previous question?
- It is significantly hotter than the rest of Enceladus
 - It is significantly colder than the rest of Enceladus
 - It is significantly more reflective than the rest of Enceladus
 - It is significantly less reflective than the rest of Enceladus
 - None of the above
- 14) A cryovolcano can also be found on the south pole of Enceladus. What does this cryovolcano do?
- Releases lava and ash into the air around the south pole
 - Releases geysers of water vapor and ice particles into space
 - Releases chunks of solid ice into the air around the south pole
 - Releases CO₂ and trace amounts of other gases into space
 - This cryovolcano is dormant
- 15) The cryovolcano at the south pole of Enceladus was discovered by what spacecraft?
- Cassini-Huygens
 - Galileo
 - Icarus
 - Voyager 1
 - Voyager 2

- 16) Which of the following pairs of moons orbits Saturn?
- Iapetus and Triton
 - Triton and Europa
 - Europa and Titan
 - Titan and Iapetus
 - None of the above
- 17) Which of the following is a dwarf planet, not a moon?
- Ceres
 - Iapetus
 - Titan
 - Triton
 - These are all moons
- 18) Iapetus' low density suggests that it is mainly composed of what?
- Carbon
 - Ice
 - Metal
 - Rock
 - Water
- 19) Like Enceladus, Triton has cryovolcanic eruptions. What is released in the eruptions on Triton?
- Carbon dioxide
 - Ice
 - Nitrogen
 - Oxygen
 - Water vapor
- 20) The Cassini-Huygens space probe detected lakes of what liquid on Titan?
- Ice
 - Mercury
 - Methane
 - Nitrogen
 - Water
- 21) Long-period comets are thought to originate from where in our solar system?
- Chunks of material from the inner planets
 - The Kuiper belt
 - The main asteroid belt
 - The Oort cloud
 - Comets do not originate in our solar system
- 22) Objects in the Oort cloud are composed of what material?
- Carbon
 - Ice
 - Metal
 - Rock
 - The Oort cloud is the absence of objects found throughout the solar system
- 23) Where can the Kuiper belt be found?
- Between Mars and Jupiter, about 3 AU
 - Between Mars and Jupiter, about 50 AU
 - Beyond the orbit of Neptune, about 3 AU
 - Beyond the orbit of Neptune, about 50 AU
 - The Kuiper belt is not located in our solar system

- 24) What size are most known Kuiper belt objects?
- a) 1 – 5 m in diameter
 - b) 5 – 10 m in diameter
 - c) 10 – 50 m in diameter
 - d) 50 – 100 m in diameter
 - e) 100 – 500 m in diameter
- 25) How large are the diameters of Kuiper belt objects in comparison to the dwarf planet Pluto?
- a) 0.01% the diameter of Pluto
 - b) 0.1% the diameter of Pluto
 - c) 1% the diameter of Pluto
 - d) 10% the diameter of Pluto
 - e) The same as Pluto

SECTION 2: TRUE/FALSE

Indicate whether the given statement is true or false

20 points possible

- 26) On Mars, the north polar ice cap is larger than the south polar ice cap.
- 27) On Mars, the south polar ice cap is about 85% water ice and 15% carbon dioxide ice.
- 28) Europa likely has significant amounts of nickel in its core, similar to Earth.
- 29) It is unlikely that life exists below the ice surface of Europa because it is too far away from the sunlight.
- 30) The emissions from Enceladus' cryovolcano could fill several Olympic-sized swimming pools each day.
- 31) Snow accumulation rates suggest that Enceladus' cryovolcano has been active for about one million years.
- 32) Ceres was originally classified as a planet before being reclassified as an asteroid.
- 33) Iapetus' mass is approximately one-quarter of the mass of Earth's moon.
- 34) Triton's surface is mostly water ice.
- 35) Every comet that passes through the solar system is in orbit around the Sun.

SECTION 3: SHORT ANSWER

4 parts, 80 points possible

PART A

36) Place the following solar system objects in order based on their distance from the Sun. Assign the number 1 to the *closest* object and the number 7 to the *farthest* object.

- a) Ceres
- b) Europa
- c) Iapetus
- d) Kuiper Belt
- e) Mars
- f) Oort Cloud
- g) Triton

37) Place the following solar system objects in order based on their mass. Assign the number 1 to the *lightest* object and the number 6 to the *heaviest* object.

- a) Ceres
- b) Enceladus
- c) Europa
- d) Mars
- e) Titan
- f) Triton

PART B

38) What is the Oort cloud thought to be a remnant of?

39) Is the Oort cloud believed to be capable of supporting life?

40) What is the name of NASA's first mission to the Kuiper belt?

41) At what distances do the Kuiper belt and Oort cloud orbit the sun? Give your answer in astronomical units.

42) Who are the Kuiper Belt and Oort cloud named for?

43) What discovery eventually led to the demotion of Pluto to "dwarf planet" status?

PART C

44) To which planet is the Cassini Solstice mission targeted?

45) To which planet is the Galileo mission targeted?

46) What is the significant relationship between the name Galileo and the answer to question 45?

47) Which two spacecraft were the first to make a successful landing on Mars?

48) What significant discovery was made on Ceres in January of 2014?

49) What spacecraft will arrive at Ceres in 2015?

PART D

Refer to the provided image sheets for Part D

- 50) What moon is portrayed in **Image 1**?
- 51) What feature is portrayed in **Image 1**?
- 52) What is significant about the feature portrayed in **Image 1** and how does it relate to the possibility of life on this moon?
- 53) What moon is portrayed in **Image 2**?
- 54) **Image 2** uses false-color imaging to create a composite image. The color blue, for example, represents relatively old icy plains. The region in the image is interesting because the terrain is disrupted, creating various surface features like domes and ridges. Based on this information, what might the red areas of the image represent?
- 55) What moon is portrayed in **Image 3**?
- 56) What significant features are seen in **Image 3** (the dark, reddish regions)?
- 57) How might the features in **Image 3** have formed?
- 58) Which spacecraft most likely obtained **Image 3**?