This test contains 5 parts, worth 150 points in total. As always, you’ll have 50 minutes to complete the test. You may separate the pages; be sure to put your team number at the top of every page. You may use two letter-sized notes sheets. Good Luck, Have Fun! And always remember: The Eyes of Texas Are Upon You!
1. **Matching**

3 points each. Each choice might be used 0, 1, or more times. This section will be used for tiebreakers.

<table>
<thead>
<tr>
<th>A</th>
<th>Nitrogen</th>
<th>B</th>
<th>Mercury</th>
<th>C</th>
<th>MESSENGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>Protoplanets</td>
<td>E</td>
<td>Phobos</td>
<td>F</td>
<td>Ethane</td>
</tr>
<tr>
<td>G</td>
<td>Titan</td>
<td>H</td>
<td>Saturn</td>
<td>I</td>
<td>Carbon Dioxide</td>
</tr>
<tr>
<td>J</td>
<td>Venus</td>
<td>K</td>
<td>Deimos</td>
<td>L</td>
<td>Callisto</td>
</tr>
<tr>
<td>M</td>
<td>Cassini</td>
<td>N</td>
<td>Planetesimals</td>
<td>O</td>
<td>Voyager 2</td>
</tr>
<tr>
<td>P</td>
<td>Mars</td>
<td>Q</td>
<td>Pluto</td>
<td>R</td>
<td>Planets</td>
</tr>
<tr>
<td>S</td>
<td>Planetoids</td>
<td>T</td>
<td>Miranda</td>
<td>U</td>
<td>Oxygen</td>
</tr>
<tr>
<td>V</td>
<td>Potassium</td>
<td>W</td>
<td>Ceres</td>
<td>X</td>
<td>The moon</td>
</tr>
</tbody>
</table>

1. _____ Planets are thought to form when these coalesce.
2. _____ The main chemical component of the Martian atmosphere.
3. _____ This moon is a Galilean moon.
4. _____ This body is located in the asteroid belt.
5. _____ The planet most similar in size to the Earth.
6. _____ This body features a plateau called Lakshmi Planum.
7. _____ This spacecraft is the only one to have orbited Mercury for observation.
8. _____ A component of lunar KREEP.
9. _____ This body has the most cratered surface in the solar system.
10. _____ This body’s features are named after people and places from *Gulliver’s Travels*.
11. _____ The precession of this planet’s orbit was explained by general relativity.
12. _____ Planetary embryos which are large enough to have undergone internal melting.
13. _____ This planet has a surface atmospheric density nearly 100 times that of Earth.
14. _____ This planet has an axial tilt of 25.2 degrees (the most similar to Earth’s).
15. _____ This body features craters named *Swift* and *Voltaire*. 
2 Multiple Choice

General solar system astronomy, 3 points each.

16. Which of these is NOT valid evidence for the Giant Impact Hypothesis?
   A. The isotope ratios of lunar and terrestrial rock are identical.
   B. The Moon is approximately the same size as the Great Atlantic Basin.
   C. The spin of the Earth is aligned with the revolution of the Moon.
   D. The Moon has lower density than the Earth.

17. The Earth reaches perihelion
   A. Monthly
   B. Twice a year
   C. Annually
   D. Once every 138 years

18. The shape of a planetary orbit can always be mathematically defined by a/an
   A. Sphere
   B. Circle
   C. Oval
   D. Ellipse

19. Which of these is NOT a moon of Jupiter?
   A. Miranda
   B. Callisto
   C. Ganymede
   D. Europa

20. Ceres is considered a dwarf planet because
   A. It has not undergone planetary differentiation.
   B. It has not cleared its orbital neighborhood.
   C. It has not been rounded by its own gravity.
   D. It undergoes thermonuclear fusion.
21. Which of these is true about the formation of the Solar System?
   A. The sun formed about 4.6 million years ago.
   B. The terrestrial planets were much larger than they are now.
   C. The sun was one of the first stars in the universe.
   D. The Earth formed about 4.6 billion years ago.

22. Venus is unique among terrestrial planets for its
   A. Retrograde revolution
   B. Retrograde rotation
   C. Prograde revolution
   D. Prograde rotation

23. Jupiter’s Great Red Spot is best described as a giant
   A. Crater
   B. Moon
   C. Aurora
   D. Hurricane

24. A comet’s tail always points
   A. Opposite the direction of the comet’s motion
   B. In the same direction of the comet’s motion
   C. Away from the sun
   D. Towards the sun

25. Which of the following protects us from the solar wind?
   A. The ozone layer
   B. Clouds and other dense atmospheric structures
   C. The magnetosphere
   D. The greenhouse effect
3 Short Answer

26. (25 points) Planetary differentiation is an important process in the geologic lifespan of planets.
   (a) (5 points) What is planetary differentiation?

   (b) (5 points) Give an example of a planet (other than Earth) that has undergone differentiation, and a moon that has undergone differentiation.

   (c) (5 points) Explain why many terrestrial planets have iron-nickel cores.

   (d) (5 points) Explain why asteroids and other such objects typically are not differentiated.

   (e) (5 points) When did Earth begin to differentiate? When did it stop differentiating?
27. (25 points) “That’s no moon... it’s a space station!” – Obi-wan Kenobi

(a) (5 points) The Death Star was a giant, spherical, planet-destroying space station built by the evil Empire. Its center was a hollow chamber which housed the main reactor. Which moon in our solar system was once hypothesized by scientists to be hollow?

(b) (5 points) Suppose that the Death Star had half the surface area of Pluto, and one-tenth the mass. What is the density of the Death Star in terms of Pluto’s density? You are not required to compute the decimal answer; an expression is fine. Show work for full credit.
(c) (10 points) In *A New Hope*, the Empire planned to use the Death Star to destroy Yavin 4. The weapon orbited the helpless planet while it made preparations to obliterate it.

i. (5 points) Suppose the Death Star orbited at an altitude of 1000 km, and Yavin 4 had a diameter of 9500 km. If the Death Star is orbiting at 1.5 km/s, what is the orbital period in hours? Show work.

ii. (5 points) Suppose that Yavin had a mass of $4 \times 10^{24}$ kg and the Death Star has mass $1 \times 10^{21}$ kg. What is the gravitational force between the two, in Newtons? Show work.

(d) (5 points) After the rebels blew up the first Death Star, the Empire decided to build a second Death Star, this time over the forest moon of Endor. This forest moon had a substantial, breathable atmosphere. What is the only moon in the solar system with a substantial atmosphere?
4 Interpretive Task

The image below is an elevation map of the Martian terrain.

![Elevation map of Martian terrain](image)

28. (12 points) Label the following features using their numbers:

1. Olympus Mons
2. South Pole
3. Valles Marineris
4. Hellas Planitia
5. Tharsis Montes
6. Huygens crater
7. Argyre Planitia
8. Elysium Mons
9. Schiaparelli crater
10. Pathfinder site
11. Opportunity site
12. Curiosity site

29. (13 points) In this image, one hemisphere is mostly orange, while the other is mostly blue. What does this say about the geology of Mars? Explain the two most likely hypotheses for this geologic anomaly.