CORRECT/INCORRECT: Bubble in A for Correct or B for Incorrect. (2 points each).

1) The inner rocky planets are thought to be leftovers from the formation of the solar system. B

2) According to current theory, a planet must have a convecting molten metal core in order to have a magnetic field. A

3) The bigger the planet, the slower it cools. A

4) According to radiometric age dating, the lunar highlands are about a billion years older than the maria. A

5) The Caloris Basin is the largest impact crater on Venus. B

6) The plane of the ecliptic is at a 45° angle to the Sun’s equator. B

7) A lander mission is the most complex and potentially dangerous type of robotic mission. B

8) Almost all of the mass in the solar system is in the form of Hydrogen, Helium, and Hydrogen compounds. A

9) Radiometric dating of meteorites indicates that the solar system is about 4.6 billion years old. A

10) Differentiation is the most common geologic force in the solar system. B

MULTIPLE CHOICE: Choose the most accurate answer to complete the statement or questions. (2 points each)

11) The most common example of radioactive decay is when unstable uranium isotopes spontaneously emit radiation and eventually turn into lead. The heat from this decay process is thought to be responsible for what?
   A) impact cratering  B) phase transitions  C) keeping the interior of Earth molten.
   D) sunlight  E) none of these

12) A half-life is the time it takes for half of a radioactive parent material to decay into a daughter product. Over a period of billions of years, the ratio of parent to daughter product can be used for what?
   A) core mantling  B) fusion coefficient  C) quartile doubling
   D) fissioning studies  E) radiometric dating

13) Rank the following components of the solar nebula from most common to least common.
   A) H & He gas, H compounds, Minerals, Metals  B) H & He gas, Metals, H compounds, Minerals
   C) H compounds, H & He gas, Metals, Minerals  D) Metals, Minerals, H compounds, H & He gas

14) What characteristic is the single most obvious piece of evidence that all of the planets formed at the same time?
   A) all planets have roughly the same composition  B) all planets experienced the same impact history
   C) all planets orbit in the same plane in the same direction  D) all planets formed at the same time

15) The simplest and most common type of robotic mission for visiting a planet is what?
   A) orbiter  B) sample return  C) lander  D) flyby

16) When we observe two regions of a planet with dramatically different cratering rates such as the heavily-cratered southern hemisphere of Mars versus the relatively smooth and pristine northern plains, what do we conclude?
   A) that the plains were created by a massive impact sometime after the southern hemisphere was cratered.
   B) that the heavily-cratered southern hemisphere is older than the less-heavily-cratered northern plains.
   C) that the smooth northern plains are younger than the more heavily-cratered southern hemisphere.
   D) that the two areas did not form at the same time.
   E) all are correct.

17) Why is the surface of Venus, at 800° F, so hot?
   A) because its dense CO₂ atmosphere traps heat  B) because it is closer to the Sun
   C) because it is covered with a deep boiling sea  D) because it turns so slowly on its axis
18) Despite its cold temperatures and extremely thin atmosphere, Mars has long been thought to be similar to earth. Why?
   A) because the length of its day, called a sol is similar to earth (24 hours, 39 minutes).
   B) because its axial tilt of 25° is similar to Earth.
   C) because it has seasons
   D) because it has canals
   E) all except “D”

19) Which terrestrial planet has the simplest or least geologically-evolved surface?
   A) Mars
   B) Mercury
   C) Venus
   E) Earth

20) Layered sedimentary rocks have only been found on two planets. Which two?
   A) Earth and Venus
   B) Earth and The Moon
   C) Mars and Earth
   D) Venus and Mercury

21) Some of the most respected astronomers of the day claimed to have observed the canali on Mars. What were they?
   A) a fantasy
   B) an optical illusion
   C) a bad Italian translation
   D) all of the preceding

22) What is the Giant Impact Hypothesis?
   A) a fantasy
   B) an optical illusion
   C) a theory of lunar formation
   D) all of the preceding

23) Mars used to be very wet with rivers and likely oceans. Where did all the water go?
   A) it was burned off by the T-Tauri stage.
   B) it is still there in the form of permafrost just below the surface.
   C) it sublimated into a very dense atmosphere.
   D) it was destroyed by Late Heavy Bombardment.

24) A phase diagram for H2O shows something called a Triple Point. This is the combined temperature and pressure where all three phases of water (gas, liquid, and solid) can co-exist simultaneously. The Triple Point of water actually exists on the surface of Mars. What are the correct values for this Triple Point on Mars?
   A) 32° C and 0.7 atmospheres
   B) 0° C and 1.5 atmospheres
   C) 0° C and 0.006 atmospheres
   D) 100° C and 1.0 atmospheres

25) All of the inner terrestrial planets…
   A) show evidence of impact cratering
   B) are differentiated into silicates on iron cores.
   C) have molten iron cores
   D) “A” or “B” are correct.

26) Why are all but one of the lunar maria on the Earth-facing side of the Moon?
   A) because the maria came from recent impacts which only happen on the Earth-facing side.
   B) because the highlands areas on the far-side formed after the Late Heavy Bombardment.
   C) because they have not been impacted much.
   D) because Earth’s gravity pulled the lunar interior over to the Earth-facing side when it was still molten.
   E) because the lunar atmosphere has covered the maria on the far aside.

27) Which of the following is the accurate description of the evolution of Mercury?
   A) a massive aluminum core melted and ran out onto the surface.
   B) the mantle of Venus was ripped away by an impact and spun into a new orbit closer to the Sun.
   C) a mostly-iron planet with a thin crust cooled and shrank quickly and then was hit by the Caloris impact...
   D) answers “B” and “C”
   E) answers “A” and “C”

28) What is the name of the feature that contains the 4 largest volcanoes in the solar system?
   A) the Tharsis Bulge
   B) the crustal dichotomy
   C) the Tibetan Plateau
   D) the Caloris impact

29) How do we know the ages of planetary surfaces in the inner solar system?
   A) differentiation curves for sporadic mentoring centers are placed beneath the youngest craters.
   B) absolute radiometric age dates from lunar samples are plotted against cratering density curves.
   C) the thermal cooling index of each planetary interior has been calculated from P-waves and S-waves.
D) we have no idea about anything other than the age of the lunar surface.

30) What do blueberries indicate?
   A) standing water        B) Pop-Tarts on the Moon
   C) magnetism              D) mineral destruction by radioactive decay

31) Where do atmospheres come from on the terrestrial planets?
   A) volcanic outgassing    B) differentiation     C) sublimation     D) crustal dichroism.

32) Which of the following IS NOT an example of erosion?
   A) viscous relaxation     B) running water.
   C) glaciers                D) micrometeorite gardening.
   E) volcanism

33) Which of the following processes is not part of the “normal” sequence of solar system formation?
   A) accretion of planetesimals  B) T-Tauri stage
   C) plate tectonics            D) creation of a frostline
   E) contraction of solar nebula

34) Which of the following processes are common to all terrestrial planets?
   A) resurfacing        B) volcanism        C) impact cratering
   D) rotation rate      E) all except “D”

35) How do we know about the interior size and composition of the terrestrial planets?
   A) from studying seismic waves.
   B) from studying their gravitational fields.
   C) by measuring magnetic fields (or the lack thereof).
   D) by measuring tiny changes in the trajectory of spacecraft as they fly past or go into orbit around a planet.
   E) all of these.

ESSAY/SHORT ANSWER/SKETCH: Select three (3) of the five (5) essay/short answer questions below and answer them in the space provided on the back of your Scantron sheet. If you answer more than three (3), only the first three (3) you answer will be graded. To make sure you have answered the question completely, each question is labeled with the number of parts to be graded. {10 points each}.

36) The Early Heavy Bombardment and the Late Heavy Bombardment were two key events in the development of our solar system. But we see almost no evidence of these events on Earth. Give two reasons why? { 2 parts}
   First: Erosion has wiped all traces of the earliest craters. Plus, plate tectonics has recycled the crust.

37) At several points in the last few weeks we have talked about the term differentiation. The driving force behind differentiation is gravity and it functions in the segregation of the solar nebula as well the planets. If differentiation is so ubiquitous, why do we say that something else, impact cratering, is the most common geologic process in the solar system? Give an example where differentiation would not work. {2 parts}
   Impact cratering exists everywhere there is a solid surface. Since differentiation is driven by gravity, it would not work on low mass objects such as comets and small asteroids.

38) If two planets were exactly the same size but one was twice as massive, what would you conclude? {1 broad part}
   Two obvious possibilities: (1) That one planet (the more massive one) was much more dense. (2) That the denser planet would take much longer to cool off inside.

39) Why do we say it would be impossible for our solar system to be too much older than it actually is? {1 broad part}
   Because there were no heavy elements until the second generation stars formed. Some comments about either first generation and second generation stars or “recycled” material.

40) Describe the formation of a Jovian planet {1 broad part}
   Ice crystals for small particles outside the frost line. An area already depleted in heavy particles.
   Planetesimals sweep up debris from a large area.
   Metal particles differentiation into cores
   Additional gravity from additional; mass sweeps up even more H and He.
Bonus Question: Worth up to 10 points extra. A wrong answer WILL NOT count against you. If you chose to answer this bonus question, you must fit it on the essay area on the back of your Scantron sheet. This item will be graded for points ONLY if you complete all other required questions on the exam so don’t spend any time on this one until you have completed everything else.

41) In chronological order, list 4 famous spacecraft which were important in the preliminary reconnaissance of our solar system during the last 40 years {4 broad parts}

Lots of possibilities on this one. Here are some (all in rough chronological order): Luna, Ranger, Surveyor, Lunar Orbiter, Mars 1-7, any of the Mariner missions, Apollo, Lunakod, any of the Pioneer missions, Viking, Voyager, Galileo, Magellan, Mars Pathfinder, Cassini, etc..