Astronomy 101 16 November, 2016
Introduction to Astronomy: The Solar System

Mid-term Exam 3

Practice Version

Name (written legibly): _____

Honor Pledge: ***On my honor, I have neither given nor received unauthorized aid on this examination.***

Signature: _____ Student PID: _____

Instructions:

On the scannable answer sheet:
- Fill in your name (last name, then first name) and ID number and sign in the blank above.
- Identify the form number in the *last column* of the sequence number block.
- Answer all 40 questions using a number 2 pencil.

In addition:
- Do not open your exam until instructed to do so.
- Be sure to also answer each question in the blanks provided on this exam form.
- The exam ends at 1:10.
- When done, raise your hand and we will collect both this form and your answer sheet.
- No one may leave between 12:55 and 1:10.

And of course:
- You may not use any notes, texts, calculators or communications devices.
- All work must be your own.

Score: _____ out of 40.

Useful equations:

$p^2 = (4\pi^2/GM)\, a^3$

$F = m\, a$

$F = G\, m_1\, m_2 / r^2$

$v = \lambda \upsilon$ (for light, $v=c$)

$E = h\upsilon$ (h = Planck's constant.)

$\theta_R \sim \lambda/D$ (The constant of proportionality depends on the units of λ and D.)

λ_{peak} (μm) = 2880 / T (K)

$L = 4\pi\, r^2\, \sigma T^4$ (σ = the Stefan-Boltzmann constant.)

$\Delta\lambda/\lambda = v/c$

$T = T_{ref} / R^{1/2}$ (If R is in AU, then T_{ref} = 300 K.)

Constants (which you probably won't need):

G = 6.674×10^{-11} N m^2 kg^{-2}

c = 2.998×10^8 m/s

h = 6.626×10^{-34} J/s

σ = 6.570×10^{-8} W m^{-2} K^{-4}

Pick the best answer to each question.

_____ 1. The bright white spots on Ceres in the Main Asteroid Belt, ...

a. are the result of eruptions from the surface.
b. are the result of crater exposing fresh ice underneath.
c. are glaciers in the mountains of Ceres.
d. are from the ice carried by comets which impacted it.
e. have not been explained.

_____ 2. If the Earth is impacted by an object hundreds of km across, it most likely came from ...

a. the Kuiper Belt.
b. the Oort Cloud.
c. the Main Asteroid Belt.
d. one of the two groups of Trojans associated with Jupiter.
e. one of the moon systems around the giant planets.

_____ 3. Jupiter's gravitational influence on the Main Asteroid Belt ...

a. perturbs the orbits of any asteroids in an orbital resonance with it.
b. prevented the objects in the belt from accumulating into a planet.
c. sends asteroids on collision trajectories with other worlds.
d. All of the above.
e. None of the above.

_____ 4. An asteroid identified as a rubble pile might have a density of ...

a. 1.9 g/cm^3.
b. 3.5 g/cm^3.
c. 5.5 g/cm^3.
d. 12 g/cm^3.
e. 100 g/cm^3.

_____ 5. Which of the giant planets has a density less than water (1.0 g/cm^3)?

a. Jupiter.
b. Pluto.
c. Saturn.
d. Uranus.
e. Neptune.

_____ 6. Which of the giant planets had the least cloud contrast (i.e. the most boring appearance) when a NASA probe flew by it?

a. Jupiter.
b. Neptune.
c. Saturn.
d. Uranus.
e. None of the above.

_____ 7. Which of the giant planets had a storm system described as the Great Dark Spot when a NASA probe flew by it?

a. Jupiter.
b. Neptune.
c. Saturn.
d. Uranus.
e. None of the above.

_____ 8. What was the first spacecraft to visit Jupiter?

a. Socrates.
b. Pioneer 11.
c. Pioneer 12.
d. Cassini.
e. Voyager 1.

_____ 9. The most abundant element in Jupiter is ...

a. oxygen.
b. nitrogen.
c. carbon.
d. helium.
e. hydrogen.

_____ 10. Not counting the E Ring, the rings of Saturn ...

a. orbit Saturn as a single solid object.
b. extend both above and below Saturn's equatorial plane for about 100 km.
c. extend out to a distance roughly ten times Saturn's radius.
d. are composed primarily of dust grains and rocky material.
e. None of the above.

_____ 11. The Roche limit around a planet is the radius ...

a. at which orbital resonances are dominated by tidal forces.
b. at which gravity roughly equals shear forces pulling objects apart.
c. of the last collision of moons around that planet.
d. to the orbit of the innermost moon larger than 500 km.
e. at which Kirkwood gaps begin to appear in rings.

_____ 12. Gaps in Saturn's rings result from ...

a. orbital resonances with Saturn's larger moons.
b. small moons co-orbiting with the rings.
c. collisions between moonlets.
d. Both (a) and (b).
e. Both (b) and (c).

_____ 13. What is the dominant component of the rings of Saturn?

a. Metal.
b. Rock.
c. Ice.
d. Gas.
e. Plasma.

_____ 14. Which of the Galilean satellites is so heavily cratered that additional craters are just likely to erase old ones?

a. Callisto.
b. Europa.
c. Ganymede.
d. Io.
e. All four are very heavily cratered.

_____ 15. What produces the heat that drives Io's volcanic activity?

a. The heat from its formation.
b. Radioactive decay of unstable isotopes.
c. A recent collision with a large asteroid.
d. Orbital resonances which keep its orbit slightly elliptical and tidal flexing from Jupiter.
e. Interactions with Jupiter's magnetic field.

_____ 16. Which of the Galilean satellites has the fewest impact craters on its surface?

a. Callisto.
b. Europa.
c. Ganymede.
d. Io.
e. All of the four have few craters on their surfaces.

_____ 17. List the Galilean satellites in order of increasing distance from Jupiter.

a. Callisto - Europa - Ganymede - Io.
b. Europa - Io - Callisto - Ganymede.
c. Ganymede - Callisto - Io - Europa.
d. Io - Europa - Ganymede - Callisto.
e. Ganymede - Europa - Callisto - Io.

_____ 18. Which of the Galilean satellites appears to have an ocean beneath its icy crust?

a. Titan.
b. Triton.
c. Ganymede.
d. Callisto.
e. Europa.

_____ 19. The Cassini mission is in orbit around which planet?

a. Jupiter.
b. Neptune.
c. Pluto.
d. Saturn.
e. Earth.

_____ 20. Which of the following worlds does not have an atmosphere?

a. Ganymede.
b. Titan.
c. Triton.
d. Pluto.
e. All of the above have an atmosphere with a pressure of at least one microbar.

_____ 21. Which world does Titan's atmosphere most resemble, if we consider only the dominant gas in its atmosphere and its surface pressure?

a. Mercury.
b. Venus.
c. Earth.
d. Mars.
e. Enceladus.

_____ 22. Which of the following moons do astronomers suspect have subsurface liquid water?

a. Enceladus.
b. Europa.
c. Ganymede.
d. Titan.
e. All of the above.

_____ 23. Miranda is ...

a. the largest moon of Saturn.
b. the largest moon of Uranus.
c. the largest moon of Neptune.
d. the innermost and smallest of the five large moons of Uranus.
e. the first Kuiper Belt Object discovered.

_____ 24.. Which of the following most closely resembles the Death Star?

a. Enceladus.
b. Mimas.
c. Miranda.
d. Io.
e. Iapetus.

_____ 25. How long can the tail of a comet be?

a. Up to 100 km.
b. Up to 1,000 km.
c. Up to 30,000 km
d. Up to one million km.
e. Up to 100 million km.

_____ 26. The reservoir of short-period comets is ...

a. the Main Asteroid Belt.
b. the Trojan satellites of Jupiter.
c. the Kuiper Belt.
d. the Oort Cloud.
e. interstellar space.

_____ 27. Which of the following have we not yet done to explore comets?

a. Crashed an impactor into one at high speed.
b. Orbited one.
c. Landed on one.
d. Returned dust samples from one to the Earth.
e. We have done all of the above.

_____ 28. Meteors are most likely to be ...

a. cometary debris.
b. pieces of asteroids.
c. interactions of the Solar wind with the Earth's magnetic field.
d. ejecta from impacts on Mars or the Moon.
e. cosmic rays.

_____ 29. What property distinguishes Pluto from the eight major planets?

a. Its orbit has a higher inclination than the eight.
b. Its orbit is eccentric enough that it crosses the orbit of another planet.
c. It failed to clear its orbit.
d. It has significantly less mass than any of the eight.
e. All of the above.

_____ 30. What is unusual about Triton?

a. It and Pluto orbit their common center of mass, which is outside Pluto.
b. Its orbit is retrograde, suggesting that it was captured.
c. Its density suggests that it is composed of rock and metal.
d. Its atmosphere blocks views of its surface, like Venus.
e. It is probably from the Main Asteroid Belt.

_____ 31. What is necessary to measure the mass of an object in the Kuiper Belt?

a. It has to have a moon.
b. Far-infrared observations to measure its temperature and thus its radius.
c. An accurate estimate of its optical albedo.
d. Determining the semi-major axis, inclination, and eccentricity of its orbit.
e. Determining its rotation period.

_____ 32. Triton's surface ...

a. is covered in craters.
b. is constantly being resurfaced by active volcanic flows.
c. shows evidence of geologic activity and a thin atmosphere
d. is hidden beneath a thick layer of clouds.
e. has the most active plate tectonics of any world beside the Earth.

_____ 33. Which of the following has NOT been observed on Pluto's surface?

a. a possible cryovolcano.
b. ice mountains thousands of meters high.
c. pits probably from outgassing.
d. evidence for convective cells in ice layers.
e. All of the above have been observed on Pluto's surface.

_____ 34. How could Pluto's surface be mapped prior to the arrival of the New Horizons mission?

a. With radar.
b. By observing the mutual eclipses of Pluto and its largest moon.
c. By measuring its magnetic field strength.
d. By tracking Pluto's orbit around the Sun with very high angular resolution.
e. All of the above.

_____ 35. What is the predicted mass of Planet Nine?

a. Large enough to be a brown dwarf.
b. Larger than Jupiter, but not massive enough to be a brown dwarf.
c. Larger than Neptune, but smaller than Jupiter.
d. Larger than Earth, but smaller than Neptune.
e. Smaller than Earth.

_____ 36. Which of the following is NOT an orbital property common to all eight major planets?

a. They orbit the Sun in roughly the same plane (within about 7 degrees).
b. Their orbits around the Sun are close to circular.
c. The periods of their orbit around the Sun equal their rotational periods.
d. They orbit the Sun in the same direction.
e. The eight major planets have all of the above in common.

_____ 37. Why do the terrestrial worlds differ so much from Solar composition?

a. They formed from the atmosphere of the Sun.
b. They migrated inward after forming far from the Sun in the outer Solar System.
c. They formed inside the radius at which ice mantles could not exist on dust grains.
d. Ice grains are limited to highly eccentric and highly inclined orbits.
e. Dust grains only exist in the outer Solar System.

_____ 38. Observations of young stellar objects and the material around them ...

a. are consistent with what probably happened to the Solar System.
b. show that the formation of the Solar System was an extremely rare event for a young star.
c. show that outflows from young stars usually prevent disks from forming around them.
d. reveal that double stars are usually required to form planets.
e. show that giant planets should be uncommon.

_____ 39. In the Nice model, what leads to a close encounter between two giant planets?

a. Orbital resonances, which increase the eccentricity of one of their orbits.
b. Interactions of their magnetic fields.
c. Tidal locking of their rotation and orbital periods.
d. The formation of ring systems.
e. The effects of general relativity.

_____ 40. Which of the following is likely to have resulted from a massive collision?

a. The moons of Mars.
b. Saturn's rings.
c. The Main Asteroid Belt.
d. Earth's Moon.
e. All of the above.