

Name \_\_\_\_\_  
(Last, First)

**Test 2** Planetary and Stellar Astronomy 2017

The exam has 20 multiple choice questions (3 points each) and 9 short answer questions (5 points each. One short answer question is extra credit). This is a closed-book, closed-notes exam. You can use a pen/pencil, eraser and calculator for the exam. No wireless devices, phones or pre-programmed equations are allowed. **Please write your name on each sheet of paper in the space provided.**

I agree to adhere to the W&M Honor Code in all aspects of this test

Your Signature: \_\_\_\_\_

**Useful Formulas and Values**

$$M_{sun} = 1.99 \times 10^{30} \text{ kg}$$

$$M_{earth} = 5.97 \times 10^{24} \text{ kg}$$

$$M_{moon} = 7.35 \times 10^{22} \text{ kg}$$

$$R_{sun} = 6.96 \times 10^8 \text{ m}$$

$$R_{earth} = 6.38 \times 10^6 \text{ m}$$

$$R_{moon} = 1.74 \times 10^6 \text{ m}$$

$$d_{earth \rightarrow moon} = 3.84 \times 10^5 \text{ km}$$

$$G = 6.67 \times 10^{-11} \frac{m^3}{s^2 kg}$$

$$g = 9.80 \text{ m/s}^2$$

$$c = 3.00 \times 10^8 \text{ m/s}$$

$$10^9 \text{ nm} = 10^6 \mu\text{m} = 1 \text{ m}$$

$$1 \text{ AU} = 1.5 \times 10^{11} \text{ m}$$

$$1 \text{ ly} = 9.46 \times 10^{15} \text{ m}$$

$$1 \text{ pc} = 3.26 \text{ ly}$$

$$1 \text{ pc} = 3.09 \times 10^{16} \text{ m}$$

$$d = vt$$

$$F = \frac{GMm}{d^2}$$

$$V = \sqrt{\frac{GM}{d}}$$

$$V = \sqrt{\frac{2GM}{R}}$$

$$g = \frac{GM}{R^2}$$

$$p^2 = a^3$$

$$M = \frac{4\pi^2 a^3}{Gp^2}$$

$$\frac{L}{2\pi d} = \frac{\alpha}{360^\circ}$$

$$V_{sphere} = \frac{4}{3}\pi r^3$$

$$A = \pi r^2 = \pi D^2/4$$

$$C = 2\pi r$$

$$E = \frac{hc}{\lambda}$$

$$T = \frac{2.9 \times 10^6 \text{ nm} \cdot K}{\lambda_{max}}$$

$$v = c \cdot \frac{\Delta\lambda}{\lambda_o}$$

$$R = 1.097 \times 10^7 \text{ m}^{-1}$$

$$\frac{1}{\lambda} = R(\frac{1}{4} - \frac{1}{n^2})$$

$$\text{Area}_{sphere} = 4\pi R^2$$

$$v = c = \lambda\nu$$

$$\theta = 2.5 \times 10^5 \frac{\lambda}{D}$$

Light gathering power  $\propto D^2$

$$\text{frac left} = 2^{-\frac{t}{H}}$$

$$1 \text{ y} = 3.16 \times 10^7 \text{ s}$$

$$1000 \text{ m} = 1 \text{ km}$$

$$1 \text{ m} = 100 \text{ cm}$$

$$3600 \text{ arcsec} = 1 \text{ degree}$$

$$\sigma = 5.671 \times 10^{-8}$$

$$h = 6.62 \times 10^{-34} \text{ J s}$$

$$L = \sigma T^4$$

$$L = \text{Power/Area}$$

**Multiple Choice Section. Circle the letter of the correct answer**

1. In our solar system, which of the following planets is **not** a member of the Jovian group?  
(A) **Mars**  
(B) Saturn  
(C) Neptune  
(D) Jupiter
2. These are small rocky bodies primarily found between Mars and Jupiter.  
(A) Comets  
(B) **Asteroids**  
(C) Meteors  
(D) UFO's
3. Which is the correct sequence?  
(A) Inner planets, Kuiper Belt, outer planets, asteroid belt, Oort Cloud  
(B) Inner planets, outer planets, asteroid belt, Oort Cloud, Kuiper Belt  
(C) Inner planets, asteroid belt, Kuiper Belt, outer planets, Oort Cloud  
(D) **Inner planets, asteroid belt, outer planets, Kuiper Belt, Oort Cloud**
4. By measuring the argon-40 content of a rock you find that only 25% of the potassium-40 remains in the rock. How long ago was this rock formed? (potassium-40 has a half-life of 1.25 billion years.)  
(A) 1.25 billion years.  
(B) **2.50 billion years**  
(C) 3.75 billion years  
(D) 10.0 billion years
5. The Kepler space telescope, which holds the record for observing evidence for the largest number of exoplanets, using this technique:  
(A) Doppler shifts  
(B) Stellar wobbling  
(C) **Transits**  
(D) Direct observation
6. The waves that geologists and geophysicists use to probe the inside of Earth are  
(A) **seismic waves.**  
(B) gravitational waves.  
(C) radio waves.  
(D) microwaves.
7. The age of Earth is considered to be  
(A) about 100 million years.  
(B) **about 4.6 billion years.**  
(C) about 4.6 million years.  
(D) 93 million years.

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8. The presence of oxygen in Earth's atmosphere is thought to result directly from what type of process?  
**(A) Biological activity of plants and animals**  
(B) Volcanic eruptions  
(C) Outgassing of the oceans  
(D) Original condensation of interplanetary gas clouds
9. What is the origin of the majority of lunar craters?  
(A) impacts by space probes  
(B) surface collapse after loss of groundwater by evaporation  
(C) volcanic explosions  
**(D) impacts by meteoric material**
10. Which best explains the creation of the lunar maria?  
**(A) Craters flooded by massive magma flows**  
(B) Collapsed volcanic caldera  
(C) Dry beds of ancient seas  
(D) They were there when the Moon was initially created
11. Which of the following theories for the origins of the Moon is generally accepted by astronomers?  
(A) The Moon formed alongside the Earth  
**(B) The Moon is the result of a collision between the Earth and a Mars sized object in the early days of the Solar System**  
(C) The Moon was originally a bulge on the Earth that was flung off by the rapidly spinning Earth  
(D) The Moon formed somewhere else and was later captured by the Earth
12. Which of the planets fits the following description: a solid, cool surface, with occasional dust clouds and a thin CO<sub>2</sub> atmosphere?  
(A) Venus  
(B) Jupiter  
**(C) Mars**  
(D) Mercury
13. The surface and near-surface atmospheric conditions on Venus are  
(A) no atmosphere, very variable temperature.  
(B) dense methane, ammonia, and H<sub>2</sub>O atmosphere, low temperature.  
(C) CO<sub>2</sub> atmosphere, low pressure, and low temperature.  
**(D) CO<sub>2</sub> atmosphere, high pressure, and high temperature.**

14. The reason Venus has very few impact craters compared to the Moon is believed to be that  
(A) **lava flows have covered all but the most recent craters.**  
(B) Venus formed closer to the Sun than did the Moon, where the cratering rate was much lower.  
(C) the surface of Venus is subducted back down into the mantle over periods of several hundred million years.  
(D) erosion due to wind and rainfall has eroded away all but the most recent craters.
15. Compared to that of Earth, the mass of Jupiter is  
(A) several thousand times larger.  
(B) about the same.  
(C) about 11 times as large.  
(D) **about 300 times larger.**
16. Which is the least dense planet in the solar system?  
(A) Uranus  
(B) Mercury  
(C) **Saturn**  
(D) Jupiter
17. The physical structure of Saturn's rings is  
(A) a thin, solid ring of rock and ice that is partly transparent.  
(B) hot, ionized gas in a series of sheets within the planet's magnetosphere.  
(C) a thin but extensive gas cloud over the equator.  
(D) **a sequence of many hundreds of separate rings made of ice and rock particles.**
18. The four giant moons of Jupiter were discovered by  
(A) the Pioneer spacecraft.  
(B) **Galileo.**  
(C) Ptolemy.  
(D) Newton.
19. The most active volcanic object in the solar system is  
(A) Earth, with many continuously active volcanoes and numerous earthquakes.  
(B) **Io, the inner Galilean moon of Jupiter.**  
(C) Venus, its high surface temperature indicating molten lava while its cloud cover is made up of volcanic gases.  
(D) the Moon, where volcanism is causing many new craters per year.
20. Titan is a satellite of Saturn. It is unusual among all the planetary moons because of its  
(A) strong magnetic field.  
(B) location.  
(C) **dense atmosphere.**  
(D) rings.

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**Short Answer Section    Your answer must be legible for credit.**

1. List the 8 planets in order outward from the Sun. Identify which planets are terrestrial or Jovian.

Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune  
Terrestrial planets - Mercury, Venus, Earth, Mars  
Jovian planets - Jupiter, Saturn, Uranus, Neptune

2. What causes a planet to have a magnetic field and what does it tell us about the planet's interior?

Planets have a magnetic field if they are rotating and have a liquid conducting core. This is caused by the dynamo effect.

3. What is the 'snow line' and how does it effect the planets orbiting the Sun?

The snow line is the point from the Sun where water ice melts. Outside of the snow line the water stays ice. Inside the snowline, water ice melts and the water is dispersed. The snow line is between Mars and Jupiter. Inside the snow line are the terrestrial planets. Outside of the snow line are the Jovian planets.

4. Name the two main geological features of the Moon's surface.

Maria and Highlands.

5. Name three significant events in the 'space race'.

Sputnik, first animal in space, first man in space, first object to reach the moon, first women in space, Apollo landing men on the moon etc.

6. Which of the terrestrial planets have natural satellites (moons) and how many moons do they have?

Mercury and Venus have no satellites. Earth has the one large Moon. Mars has two small moons (phobos and Deimos).

7. Of the terrestrial planets, which have or have had in the past, volcanoes? Which planet has the largest volcano?

Mars, Earth and Venus all have or have had volcanoes. Olympus Mons is on Mars and is the largest volcano in the solar system.

8. The main components of the atmospheres of Jupiter and Saturn are:

Hydrogen and Helium.

9. Europa's surface is smooth ice with numerous cracks. What is believed to be under the ice and why would we want to explore it?

Below Europa's surface is believed to be a salt water liquid ocean which covers the entire moon. It could possibly support life.