

Astronomy 1140 Quiz 3 Review

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October 27, 2017

I The Inner Planets

1. What are the terrestrial planets? What do they have in common?
 - Terrestrial planets: Mercury, Venus, Earth, Mars.
 - These planets have higher densities, heavier elements, rocky surface and iron cores.
2. What is a planet's albedo?
 - The albedo is a measure of how reflective the planet's surface is to incoming radiation.
 - An albedo of 0 means that all incoming radiation is absorbed, very little is reflected (think about asphalt).
 - An albedo of 1 means that all incoming radiation is reflected (think about snow).
3. Why is it helpful to have the mass and radius of a planet/moon?
 - These two will let you determine the density, which gives you a clue of its composition.

II Earth and the Moon

1. Roughly, what is the temperature at the surface of the Earth (in Kelvin)?
 - ~ 300 K.
2. What saves the Earth from the solar wind?
 - Its magnetic field, which deflects the incoming ionized particles.
 - A loop of charged particles following these magnetic field lines from the Earth make up the Van Allen belts.
3. Why does the Earth have a magnetic field?
 - Because of its metallic iron core in a hot molten state that is rapidly rotating.
4. Why does the Earth have lots of oxygen compared to, say, Venus?
 - Plants and other organic bodies are able to free the oxygen locked in CO_2 .

5. What is the most common element in Earth's atmosphere?

- Nitrogen.

6. How does the Moon's density compared to other bodies in the solar system?

- The Moon's density is 3.34 g/cm^3 , much smaller than that of the Earth, Mercury and Venus, which is about $5.2 - 5.5 \text{ g/cm}^3$. It is similar to Mars, however, which is 3.93 g/cm^3 .
- Implies that the Moon (and by extension Mars) must not have a large iron core like these planets, or else it would have much higher density.
- The lack of an iron core also means there is no dynamo effect to create a magnetic field on the Moon.

7. Briefly describe the Greenhouse Effect. What is the most common greenhouse gas on Earth?

- The Greenhouse Effect is the warming of a planet by sunlight and by having its own emitted radiation trapped by its atmosphere, much like a greenhouse.
- This happens when molecules of greenhouse gases such as water and carbon dioxide in the atmosphere absorb/reflect the infrared radiation the planet emits and prevent it from going into space.
- The trapped radiation stays on the planet, warming it.
- The most common greenhouse gas on Earth is water vapor.

8. What are the major layers of the Earth?

- Solid inner core, liquid (iron) outer core, mantle, and then crust.

9. Briefly describe plate tectonics.

- The lithosphere on the crust moves around the Earth's surface.
- Interesting phenomena happen because of this, such as the continents drifting away from each other from rift zones (like the Mid-Atlantic) and forming mountains/volcanoes where the plates collide.

10. What makes up the plates on the Earth?

- Lithosphere.

11. Compare and contrast the highlands and maria on the Moon.

- Highland - the oldest part of the Moon's surface. These are large craters formed from early bombardment. Are much more disparate in height, as you might imagine.
- Maria - Younger part of the Moon's surface. They are formed when lava partially filled in older craters and then cooled. Tend to be flatter.

12. What long term effects are happening to the Earth's rotation and Moon's orbit by tides?

- The Moon's orbit is drifting away from the Earth.
- The Earth's rotation is slowed down.

III Mercury and Venus

1. Why would Venus be considered a "twin" or "sister" of Earth? What properties do they share?
 - Venus is the most similar planet to Earth in terms of its size, mass, density and distance from the Sun!
 - Mars, however, is closer in terms of rotation around its axis.
2. What is the ratio of Mercury's orbital period to rotational period? What does this imply about the solar day on Mercury?
 - Mercury's year is 1.5x its sidereal day.
 - This implies that the solar day (the time it takes for the Sun to get to the same point on Mercury's sky) is actually 2 Mercury years.
3. Why is Venus known as the Morning/Evening Star, but Mercury is not?
 - Both planets must stay close to the Sun in our sky, as they have interior orbits with respect to the Earth.
 - Mercury, however, is very faint and close to the Sun, so it's quite difficult to see even in the morning/evening.
 - Venus has a more favorable orbit to be seen.
4. Why is Mercury's surface similar to that of the Moon's? What feature do they share that causes this?
 - Both the Moon and Mercury have no atmosphere.
 - This means they both have little protection from meteors and are thus heavily crated by such objects.
 - Other bodies, such as the Earth, also experience impacts, but are somewhat more protected by their atmosphere. If these bodies are active as well, these craters can be resurfaced.
 - Unlike the Moon, however, Mercury has a rather large iron core and is much denser.
5. Why is Mercury's orbit around the Sun similar to that of the Moon's around the Earth?
 - Both feel strong tidal forces from their parent body that causes tidal locking.
6. Which has a hotter surface, Mercury or Venus? Why?
 - Although Mercury is closer, Venus is much hotter because of its runaway Greenhouse Effect.
7. Why does Venus have a weak magnetic field?
 - It rotates very slowly (> 20 Earth days) and so the dynamo in its core is not nearly as strong as Earth's.
 - In fact, Venus rotates "backwards" with respect to its orbit than the rest of the planets. It ends up having a longer day than its own year!
8. What are the main gases in Venus' atmosphere?

- Carbon dioxide and sulfuric acid.
9. What are some of the differences between the Greenhouse Effect on the Earth versus that on Venus?
- Venus is in a runaway state where the effect keeps compounding in on itself. As such, it is the primary determinant of Venus' temperature.
 - The effect is still only moderate on the Earth, raising the temperature by only 20-30 degrees (Kelvin/Celsius) compared to what it would be from the Sun alone.
 - The Earth also has organic processes that recycles some of the heavy Greenhouse elements, unlike Venus, where they remain locked in the atmosphere.
10. Which planet has the higher difference between its day and night temperatures, Venus or Mercury?
- Mercury. It has little atmosphere and is inefficient at redistributing its heat, so combined with its very long solar day, the day side is very hot, while the night side is very cold, as it has not faced the Sun for several Earth months!

IV Mars

1. How do Mar's mass, size, day and year compare to Earth's?
- Mass: 0.1 Earth masses.
 - Radius: 0.5 Earth radii.
 - Day: 1.03 Earth days.
 - Year: 1.88 Earth years.
2. How does Mar's average temperature compare to the Earth's? What about Mar's maximum temperature?
- Mars' average temperature is 220 K, much colder than Earth's.
 - Its maximum temperature, however, is 293 K, or about 70 degrees Fahrenheit.
3. What is "retrograde motion" and why does it occur in the sky for Mars.
- Mar's retrograde motion (moving backwards across the sky) happens when the Earth's orbit overtakes that of Mars.
 - Even though Mars is moving in the same direction in its orbit, because the Earth is now on a different side of Mars and moving faster than it, Mars' motion appears to switch to the opposite direction.
4. Does Mars have seasons?
- Yes, Mars has an axial tilt similar to that of the Earth.
 - The seasons are even stronger because it has a larger eccentricity orbit around the Sun than the Earth does.
5. Why is Mars red?
- Iron oxide on the surface makes it appear rust-red.

6. What are the polar ice caps on Mars made of?
 - Frozen CO₂, also known as dry ice, with frozen water underneath.
7. What is the name of the extremely large volcano on Mars? Why are volcanos much larger on Mars than on Earth?
 - Olympus Mons.
 - Volcanoes are larger because Mars has much less surface gravity to fight against, so the land can rise up higher.
8. What type of volcano is common on both Mars and Venus?
 - Shield volcanoes.
 - Both Olympus Mons on Mars and Maat Mons on Venus are shield volcanoes.
9. What are the names of Mars' two moons?
 - Phobos and Deimos. Both are much smaller than our moon, only about 10 km across, making them the size of a city.
10. Why does Mars have an "anti-Greenhouse" effect?
 - It is not massive enough to retain Greenhouse gases and thus is colder than it otherwise would be.