

TEST #1
March 1, 2023

1. Define hypothesis, model, theory, and law. Explain the process of scientific inquiry in light of the three hallmarks of science. How do they work in unison to inform us of natural laws?
2. Retrograde motion of the planets eluded the correct explanation for Millenia.
 - a) What *is* retrograde motion of the planets?
 - b) How did Ptolemy explain retrograde motion?
 - c) How did Copernicus explain retrograde motion?
 - d) What was missing in Copernicus' model that prevented it from being accurate?
3. In his 3rd law of planetary motion, Kepler stated the relationship between the distance from the Sun and the planet's orbital period. State the law. What did Newton contribute and how can we use that to "weigh" the Sun?
4. When we launch rockets from Earth, their orbit will depend on the speed at which we launch them.
 - a) What happens if we launch a rocket with the first cosmic speed?
 - b) What happens if we launch a rocket with the speed that is between the first and second cosmic speeds?
 - c) What happens if we launch a rocket with the second cosmic speed?
 - d) What happens if we launch a rocket with the speed that is faster than the second cosmic speed?

By "what happens," I am asking what will be the shape of the orbit, and whether the rocket will be Earth-bound or not. If you sketch the orbits, that will make me particularly happy!

5. Say we wanted to build a vacation home on Mars. To plan it right, we need to prepare and not leave anything to chance.
 - a) What is the length of 1 Martian year if Mars orbits the Sun at a distance of 1.524 astronomical units?
 - b) How many days are in a Martian year if Mars revolves about its axis in 24 hours and 37 minutes?
 - c) How much sunlight will we receive on Mars compared to what we would receive on Earth under the same conditions?

- d) What is the length of the shortest path between Earth and Mars so that we can plan to embark on our trip?
 - e) *Bonus question:* How long will that trip take if we travel at a speed of 40 km/s?
6. Explain the formation of spectral lines and how we use them to measure the chemical composition of radiating bodies. You can focus only on absorption lines.