

**Answer all questions in the space provided. If you have any questions, raise your hand.
100 points possible. No calculators or electronic devices of any type.**

1 (2 pts) Mars has no magnetic field. What property of magnetic field generation does Mars lack?

- (a) fluid is convecting (internal heat source)
- (b) moderately rapid rotation
- (c) electrically conducting fluid

2 (2 pts) What process is responsible for the heat generated in the interior of Jupiter?

- (a) gravitational contraction
- (b) radioactive heating
- (c) solar heating
- (d) tidal heating

3 (2 pts) Which list of meteorite types is arranged from most primitive to least primitive?

- (a) carbonaceous chondrite, ordinary chondrite, iron
- (b) iron, carbonaceous chondrite, ordinary chondrite
- (c) ordinary chondrite, iron, carbonaceous chondrite
- (d) ordinary chondrite, carbonaceous chondrite, iron

4 (2 pts) An object 0.4 AU from the Sun is in a 4:1 resonance with the Earth. How long would it take this object to orbit the Sun?

- (a) 0.25 years
- (b) 1 year
- (c) 2.5 years
- (d) 4 years

5 (2 pts) What is a common characteristic of the exoplanets discovered by the radial velocity method?

- (a) small planets in close orbits
- (b) large planets in close orbits
- (c) small planets in distant orbits
- (d) large planets in distant orbits

6 (2 pts) What is unusual about the position of Uranus and Neptune in the Nice Model of solar system formation?

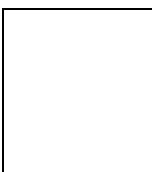
- (a) They formed at their present position but their order is reversed
- (b) They formed at a much closer distance and were kicked to larger orbits
- (c) They formed in another system and then were captured by the Sun
- (d) They formed at a much farther distance and then migrated in

7 (2 pts) Why are very few (about 2) asteroids spherical in shape?

- (a) Very few asteroids are rubble piles
- (b) Very few asteroids are larger than 400 km in diameter
- (c) Very few asteroids are composed of iron
- (d) Very few asteroids are primitive

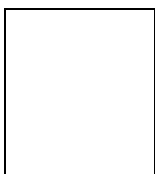
8 (2 pts) Why do spacecraft not suffer a collision with an asteroid when they travel through the asteroid belt?

- (a) Iron asteroids are very rare
- (b) The separation between asteroids is very large
- (c) The average asteroid is much smaller than the spacecrafts
- (d) The large asteroids have all been ejected by Jupiter



9 (8 pts) Explain why there are no 2 billion-year-old short-period comets.

10 (8 pts) Explain how we know that most of the asteroids in the asteroid belt are small just by noticing that most meteorites that fall to the Earth are *Ordinary Chondrites*.



11 (8 pts) Explain why nearly all worlds with sizes less than about 200 km have surfaces that are crater-saturated.

12 (8 pts) We do **not** have samples of the surfaces of the satellites of the outer solar system. Explain how we know anything about the **compositions** of their surfaces.

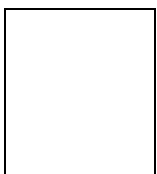


Methane (CH_4) is very common on the surfaces and in the atmospheres of worlds in the **outer** solar system.

13 (8 pts) Explain why methane is very rare in the **inner** solar system.

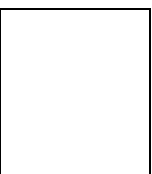
14 (4 pts) Methane is a clear colorless gas. Explain why atmospheres rich in methane are colorful and opaque.

15 (6 pts) Explain why methane can exist as a **liquid** on the surface of Saturn's satellite Titan.

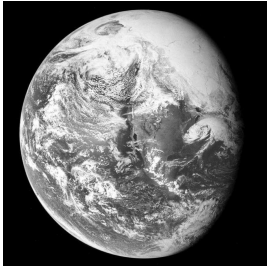


16 (8 pts) Explain why you could **not** form Jupiter 1 AU from the Sun.

17 (8 pts) Explain why you could **not** form Jupiter 30 AU from the Sun.



For each of the following **currently geologically active** worlds, tell me: **(1)** the composition of the surface (be as specific as you can), **(2)** the source of energy that drives the geological activity, and **(3)** the types of processes that are modifying the surface.

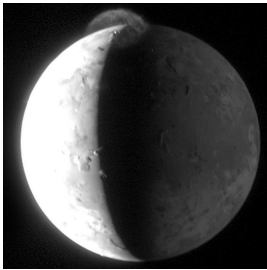


18 (6 pts) Earth

Surface Composition:

Energy Source:

Processes modifying surface:

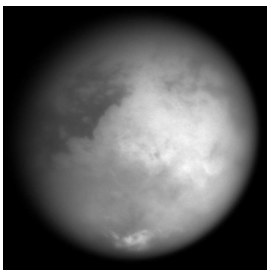


19 (6 pts) Io - Jupiter's innermost regular satellite

Surface Composition:

Energy Source:

Processes modifying surface:



20 (6 pts) Titan - Satellite of Saturn

Surface Composition:

Energy Source:

Processes modifying surface:

