Astronomy 2020 – Space Astronomy & Exploration **Fall 2020**
Homework #3 Due: Oct. 5, 2020

In questions 1-3 below, choose the best answer. Then explain your reasoning in a few complete sentences. Why is your answer correct?

1. (2 pts). What roles did the Space Shuttle play in making the International Space Station?
   a. The space shuttles were used to power and fuel the ISS.
   b. The space shuttles transported people and parts to build the ISS.
   c. The space shuttles were used to bring the ISS back to Earth for repairs.
   d. The space shuttles provided satellite guidance to the ISS.
   e. All of the above

2. (2 pts). Which statement(s) best explain the uniqueness of the Apollo program?
   a. It is the only NASA program to have a serious mission failure.
   b. It is the largest and most expensive program in NASA history.
   c. It is the first program to send more than one American into space.
   d. It is the only program to date to send a person to another celestial body.
   e. b and d.

3. (2 pts.) Suppose the angular separation of two stars is smaller than the angular resolution of your eyes. How will the stars appear to your eyes?
   a. You will not be able to see these two stars at all.
   b. The two stars will look like a single point of light.
   c. The two stars will appear to be touching, looking rather like a small dumbbell.
   d. You will see two distinct stars.
   e. You will see only the larger of the two stars, not the smaller one.

4. (5 pts). Let's explore some of the emerging commercial space companies that were formed over the past decade. Pick one of the following to investigate: Bigelow Aerospace, Blue Origin, Astrobotics, or Swarm Technologies. Do some research on this company on the web and answer the following questions:
   a. Define the term "business plan" and the components which comprise one. What is the company's business plan?
   b. How far has the company progressed toward achieving its goals to date?
   c. How is the company funded? Who are its investors?
   d. What is your assessment of this company? Will it be successful and achieve its goals?

5. (3 pts). One similarity between the Space Shuttle and SpaceX's Falcon rocket is the concept of reusability.

a. Why is this important?

b. How did the Space Shuttle apply the principle of reusability? Explain if it was successful.

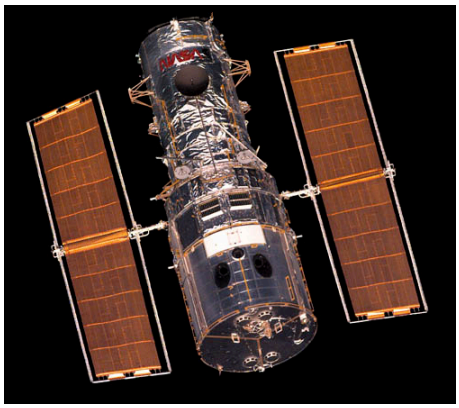
c. What about the SpaceX Falcon is reusable? Is it successful? Why or why not?

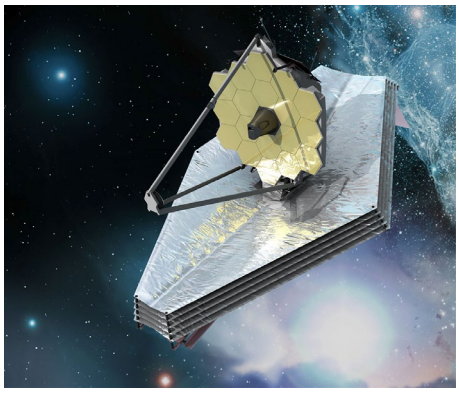
6. (6 pts). Let's compare the **Hubble Space Telescope** operating at ultraviolet wavelengths (λ = 0.2 microns, where 1 micron = 10^{-6} meters) with the **James Webb Space Telescope** operating at infrared wavelengths (λ = 10 microns). Use the information on each telescope provided by the assigned reading and the class notes to answer the following questions:

a. Calculate and compare the Light Collecting Area of each telescope. What do these imply about the relative sensitivity of each telescope to probe faint objects such as distant galaxies in the early Universe?

b. What is the angular resolution for each telescope at its operating wavelengths given above? Given the difference in diameter of the primary mirrors of each telescope, how do you explain the difference in angular resolution for each telescope?

c. Discuss the different science that will be pursued by each telescope – one operating in the ultraviolet and the other in the infrared.





7. (4 pts.) Suppose you have a satellite TV dish that is 0.5-meter in diameter. Using the same formula for angular resolution that you used above for the telescopes above, calculate the angular resolution of your satellite dish with a wavelength of 21-centimeters. Would this be useful as an astronomical radio telescope?

8. (2 pts.) Suppose a wealthy donor to the University of Colorado proposed to build a major observatory with a mirror diameter of 10-meters on the campus. Would it make a good observing site? Explain why or why not.