



# Reach for the Stars

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Practice Test

2020-2021 Season

Team Name: \_\_\_\_\_ Team #: \_\_\_\_\_

Participant Names: \_\_\_\_\_  
\_\_\_\_\_

## Information

- This exam contains 6 parts, 79 questions, and 180 points total.
- You may take this test apart. Put your team number on each page. There is not a separate answer page, so write all answers on this exam.
- You are permitted the resources specified on the 2021 rules.
- Don't worry about significant figures, use 3 or more in your answers. However, be sure your answer is in the correct units.
- For calculation questions, any answers within  $\pm 10\%$  (inclusive) of the answer on the key will be accepted.
- Ties will be broken by section score in reverse order (i.e. Section F score is the first tiebreaker, Section A the last).
- Written by RiverWalker88. Feel free to PM me if you have any questions, feedback, etc.
- Good Luck! Reach for the stars!

## Constants and Conversions

### CONSTANTS

Stefan-Boltzmann Constant =  $\sigma = 5.67 \times 10^{-8} \text{ W/m}^2\text{K}^4$

Speed of light =  $c = 3 \times 10^8 \text{ m/s}$

Mass of the sun =  $M_{\odot} = 1.99 \times 10^{30} \text{ kg}$

Radius of the sun =  $R_{\odot} = 6.96 \times 10^5 \text{ km}$

Temperature of the sun =  $T_{\odot} = 5778 \text{ K}$

Luminosity of the sun =  $L_{\odot} = 3.9 \times 10^{26} \text{ W}$

### UNIT CONVERSIONS

1 AU =  $1.5 \times 10^6 \text{ km}$

1 ly =  $9.46 \times 10^{12} \text{ km}$

1 pc =  $3.09 \times 10^{13} \text{ km} = 3.26 \text{ ly}$

1 year = 31557600 seconds

### USEFUL EQUATIONS

Wien's Law:  $\lambda_{peak} = \frac{2900000}{T}$

- $T$  = Temperature (K)
- $\lambda_{peak}$  = Peak Wavelength in Blackbody Spectrum (nanometers)

Parallax:  $d = \frac{1}{p}$

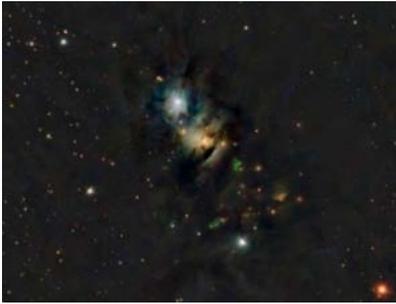
- $d$  = Distance (pc)
- $p$  = Parallax Angle (arcseconds)

### Part A: Astrophotographical References

9 questions, 18 points total

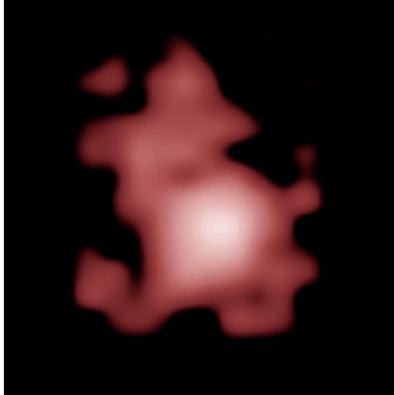
For each of the following, identify the star or deep space object pictured in the image. Each is worth 2 points.

1. Optical wavelength image.



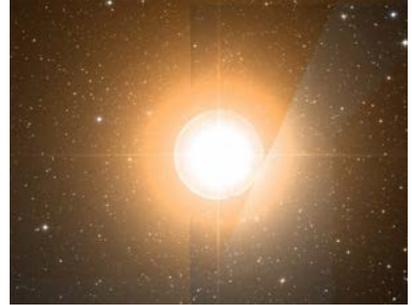
\_\_\_\_\_

2. Infrared wavelength image.



\_\_\_\_\_

3. Optical wavelength image.



\_\_\_\_\_

4. Optical wavelength image.



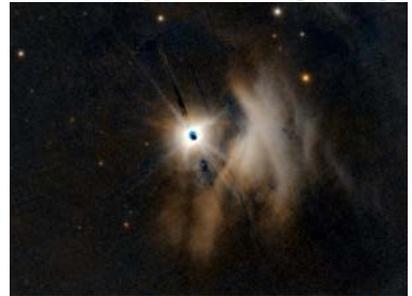
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5. Optical wavelength image.



\_\_\_\_\_

6. False-color optical wavelength image.



\_\_\_\_\_

7. Optical wavelength image.



\_\_\_\_\_

8. Optical wavelength image.



\_\_\_\_\_

9. An artist's impression.



\_\_\_\_\_

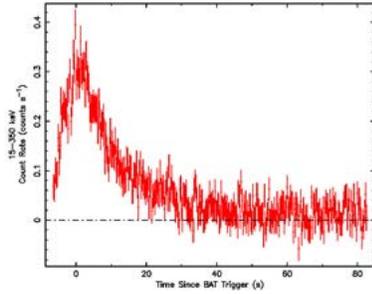
**Part B: Fascinating, Notable Object Features**

18 questions, 26 points total

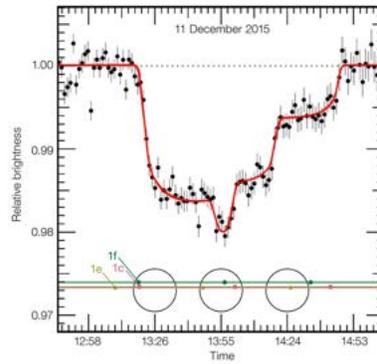
10. (1 point) Which of the following stars is a variable star with rapid pulsations and small, irregular light curve amplitudes?
- A. T Tauri
  - B. Deneb
  - C. Vega
  - D. Zeta Ophiuchi
11. (1 point) Which of the following DSOs contains an inactive supermassive black hole?
- A. Large Magellanic Cloud
  - B. NGC 5128
  - C. NGC 1333
  - D. M60
12. (1 point) Which of the following DSOs has the highest rate of star formation?
- A. Baby Boom Galaxy
  - B. NGC 6334
  - C. M101
  - D. M31
13. (1 point) Which of the following is a "compact radio source"?
- A. Sirius
  - B. Altair
  - C. Small Magellanic Cloud
  - D. Sgr A\*
14. (1 point) The first brown dwarf ever to be identified in a star-forming region was found in which of the following objects?
- A. Rho Ophiuchi Cloud Complex
  - B. Small Magellanic Cloud
  - C. Large Magellanic Cloud
  - D. Messier 8
15. (1 point) Which of the following objects is a binary system with high orbital ellipticity and asynchronized periods of the component stars?
- A. Vega
  - B. Spica
  - C. Sirius
  - D. Betelgeuse
16. (2 points) Which object on specified in the rules manual is unusually luminous in the X-Ray wavelength, 40 light years away, and contains evidence of the presence of the elements magnesium, neon, and iron?
17. (2 points) Which object specified in the rules manual contains a massive, heavily active star-forming regions, with stellar winds, supernovae that cause shock waves, has been heated to millions of degrees, and contains one of the brightest X-Ray sources (Melnick 34)?
18. (2 points) Which object specified in the rules manual contains a hot central blue star, tornado-like twisting structures caused by mixing of hot and cold in the clouds, and contains Bok globules.
19. (1 point) The clouds around the dragonfish nebula are emitting unusually more waves of which wavelength in comparison to similar objects.
- A. Radio
  - B. Ultraviolet
  - C. Gamma
  - D. Microwave
20. (1 point) What type of galaxy is M104?
- A. Spiral
  - B. Lenticular
  - C. Irregular
  - D. Elliptical
21. (1 point) Vega will likely become the Earth's north star again in about how many years?
- A. 3,000
  - B. 12,000
  - C. 1.3 million
  - D. It will never become the north star.
22. (1 point) What type of galaxy is NGC 4308?
- A. Spiral
  - B. Barred Spiral
  - C. Irregular
  - D. Elliptical

23. (1 point) Which of the following light curves matches that of T Tauri?

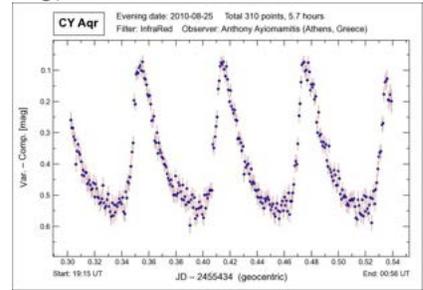
A.



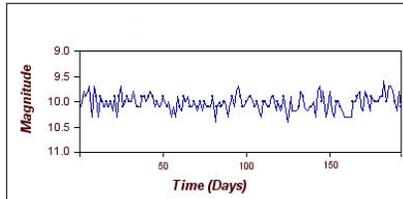
B.



C.



D.



24. (a) (2 points) DLA0817g was discovered by what instrument?

(b) (2 points) About how long after the Big Bang did this galaxy form?

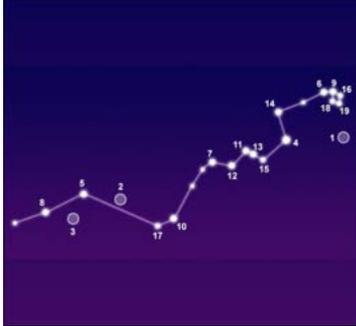
25. (3 points) Why does Zeta Ophiuchi appear as a dim red star in visible light, but a hot, blue star in infrared?

26. (2 points) What is the period of Algol?

**Part C: C is for Constellations**

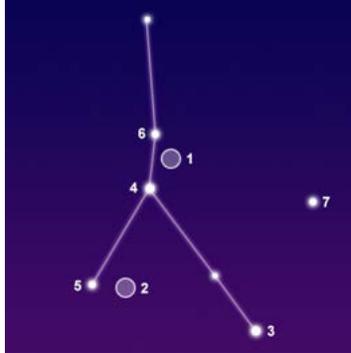
10 questions, 19 points total

27. (1 point) Identify the constellation:



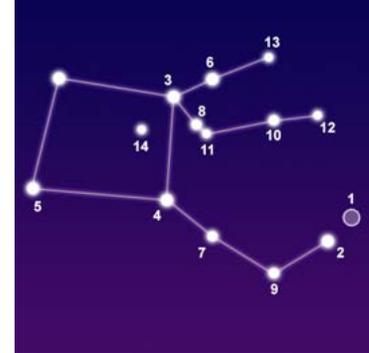
- A. Andromeda
- B. Leo
- C. Vela
- D. Hydra

28. (1 point) Identify the constellation:



- A. Lacerta
- B. Cancer
- C. Aries
- D. Caelum

29. (1 point) Identify the constellation:



- A. Pegasus
- B. Horologium
- C. Grus
- D. Fornax

30. (1 point) In the northern hemisphere, Indus is best viewed in which of the following seasons?

- A. Autumn
- B. Winter
- C. Spring
- D. Summer

32. (1 point) In the northern hemisphere, Orion is best viewed in which of the following seasons?

- A. Autumn
- B. Winter
- C. Spring
- D. Summer

31. (1 point) In the northern hemisphere, Carina is best viewed in which of the following seasons?

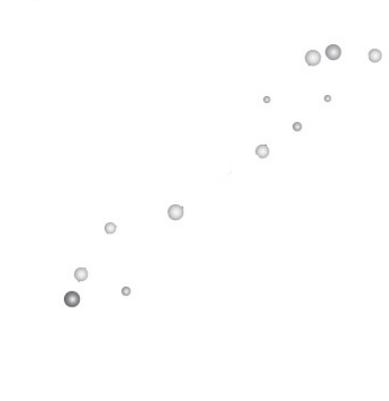
- A. Autumn
- B. Winter
- C. Spring
- D. Summer

33. (1 point) In the northern hemisphere, Lyra is best viewed in which of the following seasons?

- A. Autumn
- B. Winter
- C. Spring
- D. Summer

**For each of the following star charts, identify the constellation pictured (1 point). Then, connect the necessary stars to form the constellation pictured (3 points).**

34. (4 points) Connect stars & identify.



35. (4 points) Connect stars & identify.



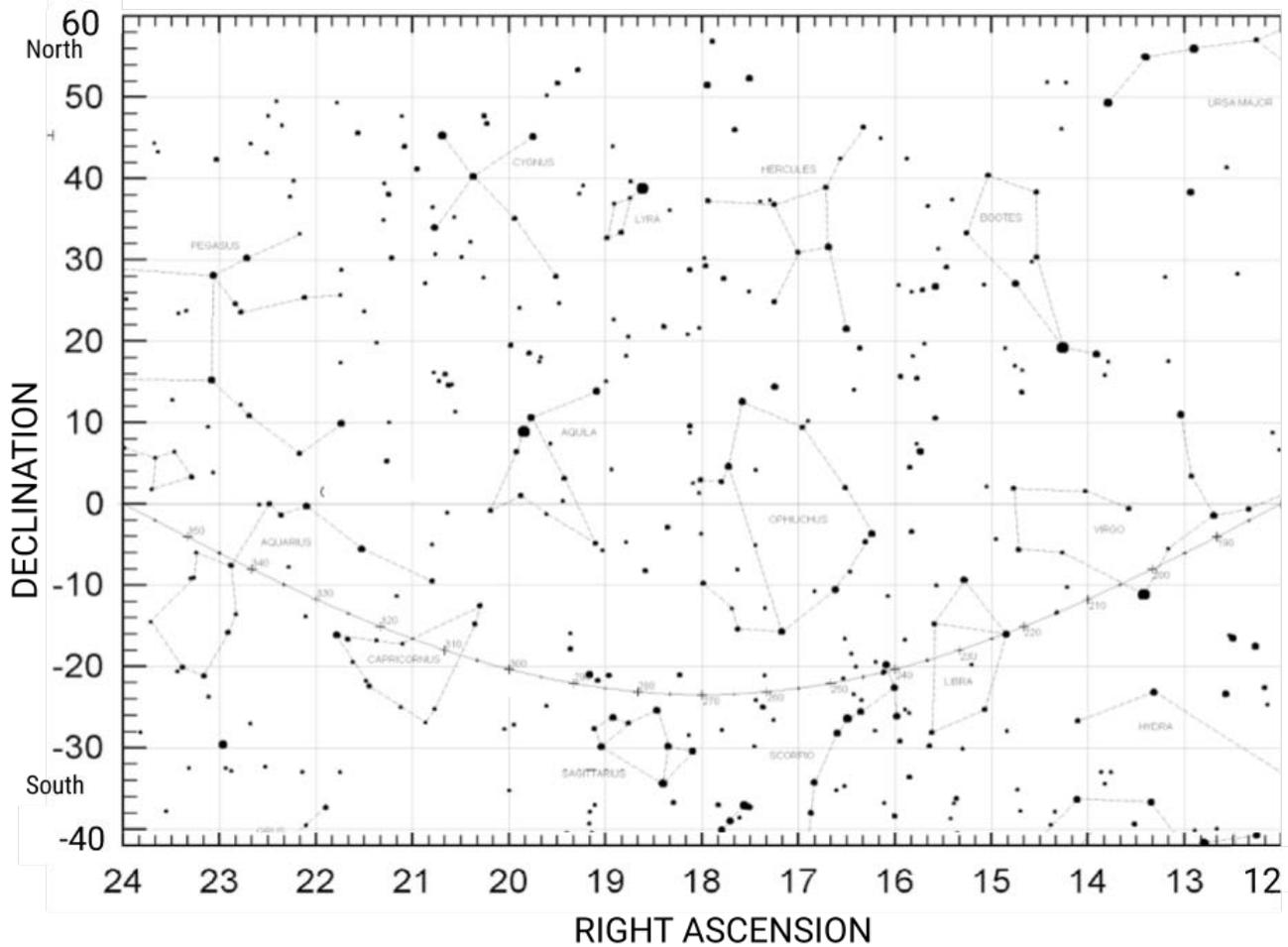
36. (4 points) Connect stars & identify.



**Part D: Sky Scholar**

7 questions, 14 points total

Use the star chart below to answer the questions in this section.



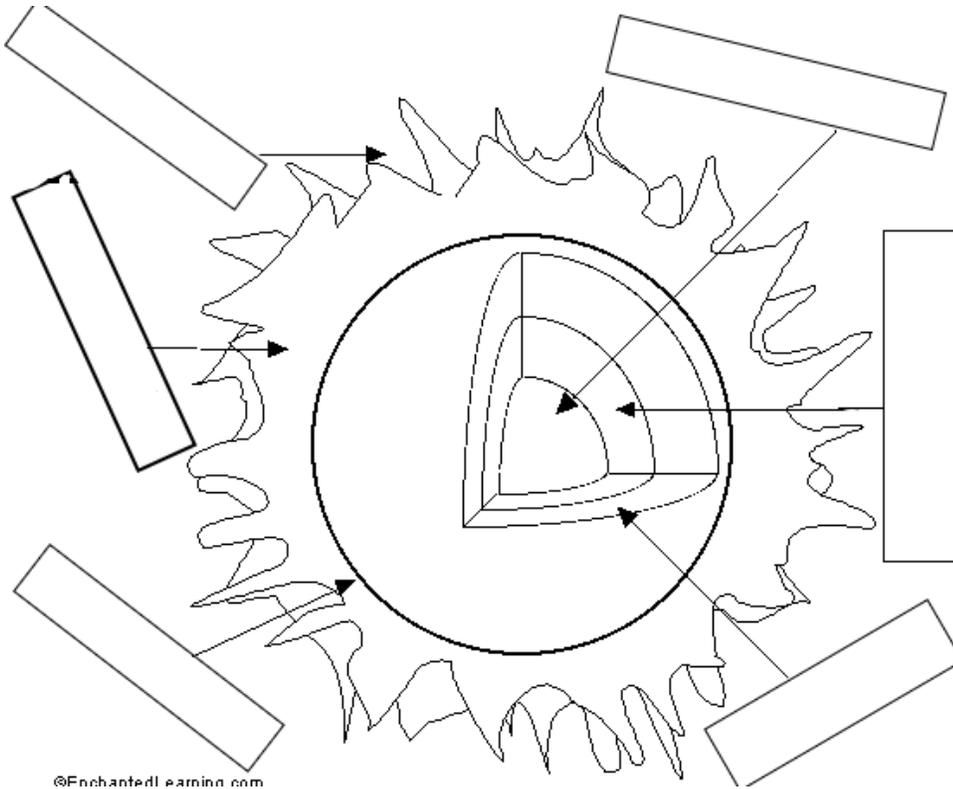
- 37. (2 points) What is the line that crosses the diagram starting and ending at the middle and bending downward at the middle called?
- 38. (2 points) What is straight line that spans the diagram at a Declination of 0 called?
- 39. (2 points) This map shows the sky that is seen from how much of Earth?
- 40. (2 points) What are the coordinates of Polaris on this map?
- 41. Find the star that lies at approximately 19hr 48min + 0° 54'.
  - (a) (2 points) What constellation is this star in?
  - (b) (2 points) Is this star closer to the celestial equator or the ecliptic?
  - (c) (2 points) How does this star's brightness compare to the brightness of the rest of the stars in the box formed by the coordinate plane it lies in?

**Part E: Starry Night**

25 questions, 67 points total

42. (1 point) Which of the following is an example of a star?
- A. Earth
  - B. The Sun
  - C. The Moon
  - D. DLA 0817g
43. (1 point) Which of the following star masses will most likely form a planetary nebula?
- A.  $0.25 M_{\odot}$
  - B.  $2.5 M_{\odot}$
  - C.  $25 M_{\odot}$
  - D.  $250 M_{\odot}$
44. (1 point) How will the mass of a red giant star compare with that of the young star that it was formed from?
- A. It will be more massive
  - B. It will be less massive
  - C. It will be equally massive
  - D. It will be impossible to know without further observation.
45. (1 point) Which of the following is the remnant of the death of a star?
- A. Planet
  - B. White Dwarf
  - C. HII region
  - D. Protostar
46. (1 point) Which of the following best describes a supernova?
- A. A massive explosion caused by the collision of two galaxies.
  - B. An extremely bright explosion caused by aging stars.
  - C. A large area of dust in the night sky, containing numerous emission nebulae and formation sites for young protostars.
  - D. A small explosion caused by orbital debris that crosses planetary orbits.
47. (1 point) As stars get cooler, they contain:
- A. More heavy metal spectral lines
  - B. Fewer heavy metal spectral lines
  - C. More hydrogen spectral lines
  - D. Fewer hydrogen spectral lines
48. (1 point) Which of the following is the best example of the use of observatories in the ultraviolet wavelength.
- A. Mapping interstellar matter.
  - B. Observing Hot White dwarf stars.
  - C. Cooler objects, such as Red Dwarf Stars.
  - D. Observing neutron star binary systems.
49. (3 points) Order the steps for the formation of a planetary nebula.
- i. The temperature increases so much that UV radiation ionizes the surrounding cloud.
  - ii. The outer shells pulsate violently.
  - iii. Inner carbon core stops generating energy, while the outer-core shells continue to burn hydrogen and helium.
  - iv. The envelope expands and cools.
  - v. The remainder contracts and heats up.
  - vi. Series of helium-shell flashes begin.

- 50. (2 points) What chemical process powers stars?
- 51. (2 points) If I look up at the sky tonight and see a star that has a reddish tint, what is the most likely evolutionary stage that this star is in?
- 52. (2 points) Planetary nebulae considered relatively rare astronomical objects. What causes this?
- 53. (3 points) How does the formation of a Type II Supernova compare with the formation of a Type Ia supernova?
- 54. (2 points) What type of stars are in the spectral classes WN and WC?
- 55. (2 points) List the spectral classes in the order that they would be found on the X-Axis on an H-R Diagram.
- 56. (6 points) Label this diagram of the internal structure of the sun.



- 57. (3 points) A star is 10 parsecs away. What is the magnitude difference of this star?

Final Answer: \_\_\_\_\_

58. WASP-32 is a real star in the Milky Way. This star has a:

- o Radius:  $1.11 R_{\odot}$
- o Luminosity:  $1.5 L_{\odot}$
- o Absolute Magnitude: 4.3
- o Apparent Magnitude: 11.26

(a) (4 points) How far away is WASP-32?

Final Answer: \_\_\_\_\_ pc

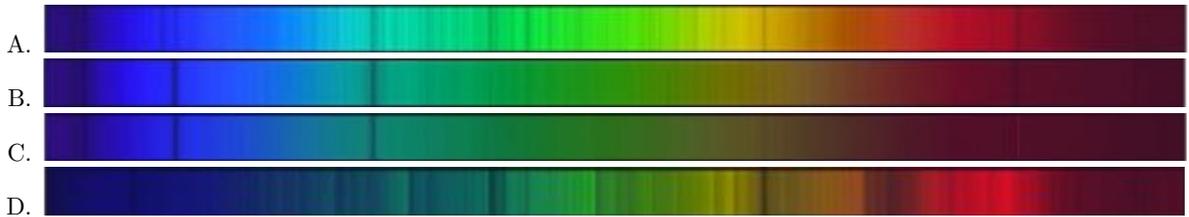
(b) (4 points) How bright does WASP-32 appear to earth? That is to say, what is its intensity, or apparent brightness (not apparent magnitude!) at Earth?

Final Answer: \_\_\_\_\_  $W/m^2$

(c) (4 points) What is the flux on the surface of WASP-32?

Final Answer: \_\_\_\_\_  $W/m^2$

(d) (2 points) Which of the following spectra most likely represents that of this star?



59. Rapeto is a real main-sequence star in the Milky Way. This star has a:

- o Luminosity:  $2.20 L_{\odot}$
- o Spectral Class: F8
- o Distance: 162 ly

Assume the distance was calculated using parallax.

(a) (2 points) What is the luminosity class of Rapeto?

(b) (4 points) If Rapeto emitted a blackbody spectrum, what wavelength would it peak in?

Final Answer: \_\_\_\_\_ nm

(c) (4 points) What is the absolute magnitude of Rapeto?

Final Answer: \_\_\_\_\_

(d) (4 points) What is the apparent magnitude of Rapeto?

Final Answer: \_\_\_\_\_

(e) (4 points) What is the parallax angle of Rapeto?

Final Answer: \_\_\_\_\_ arcseconds

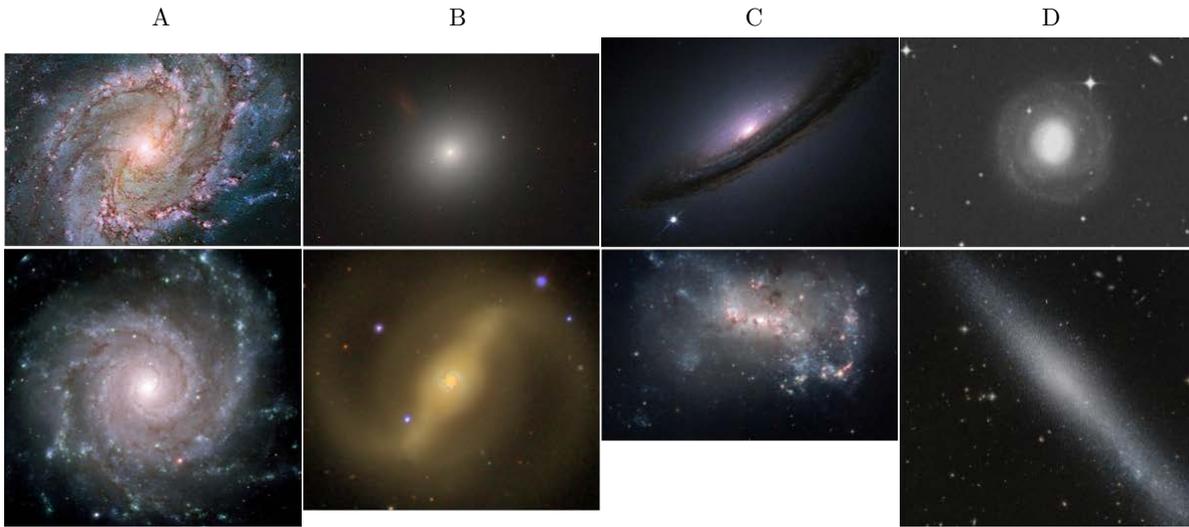
(f) (3 points) Is the distance measurement to Rapeto reliable? Justify your answer.

**Part F: GALAXIES**

10 questions, 20 points total.

59. (1 point) Which of the following is an example of a galaxy?
- A. Vega
  - B. The Moon
  - C. The Milky Way
  - D. The Sun
60. (1 point) Which two features mainly differentiate an active galaxy from a normal galaxy?
- A. Size
  - B. Distance
  - C. Luminosity
  - D. Spectrum
  - E. Mass
  - F. Star Type
61. I find a star cluster that has very red, and very old stars.
- (a) (1 point) What type of star cluster is this?
- A. Open Cluster
  - B. Globular Cluster
  - C. Red Cluster
  - D. Spectral Cluster
- (b) (1 point) In what part of a spiral galaxy would I *most likely* find this star cluster?
- A. Halo
  - B. Disk
  - C. Bulge
  - D. Nucleus
- (c) (1 point) Which of the following best describes the *most likely* orbital pattern of this star cluster in the galaxy?
- A. Random orbits in three dimensions.
  - B. Ordered orbits about the center of the galaxy, along a plane with all the other stars.
  - C. Disordered orbits in three dimensions, near the center of the galaxy.
  - D. Just passing through the galaxy, no orbit about the center.
62. (1 point) If two spiral galaxies collide, the collision site will likely become
- A. starburst.
  - B. red.
  - C. a supermassive black hole.
  - D. relatively cool.
63. (2 points) What is a galaxy?
64. (2 points) What is the Hubble Classification of the Milky Way?
65. (2 points) What feature makes a galaxy considered "starburst"?

66. (8 points) For each of the following, match the galaxy picture to its Hubble class.



- |          |           |           |           |
|----------|-----------|-----------|-----------|
| E        | F         | G         | H         |
| _____ S0 | _____ Sc  | _____ SBc | _____ E7  |
| _____ Sa | _____ SBa | _____ E0  | _____ Irr |

# Congratulations!

You have reached the end!