

Hinsdale Central Science Olympiad

ASTRONOMY

Division C: 2019-2020 Season

Captains Exchange

Names: _____

Given Constants:

Sgr A's mass

Sun's mass: $1.99E30$ kg

Gravitational constant: $6.67E-11$

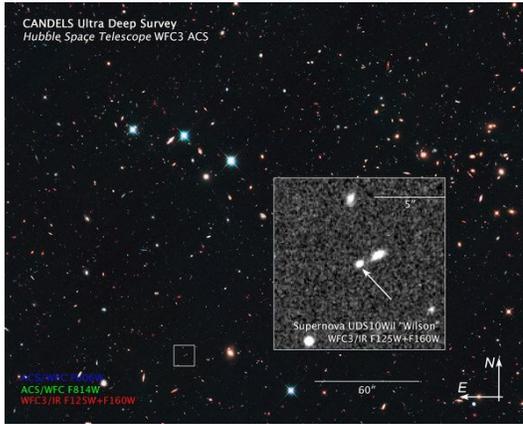
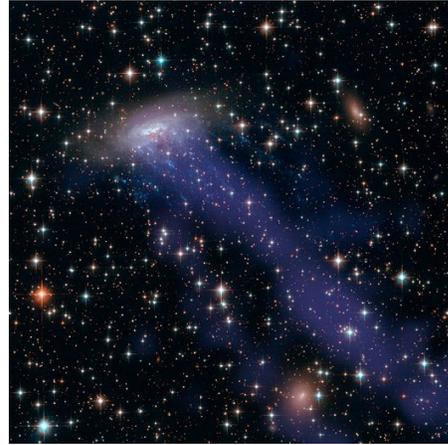
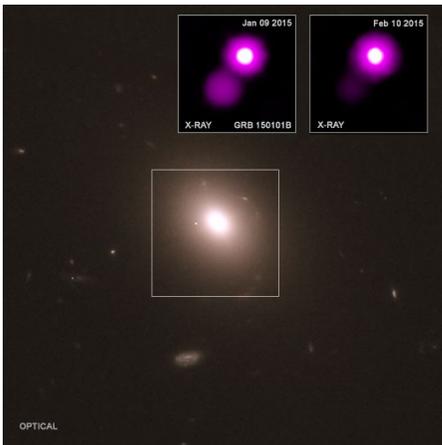
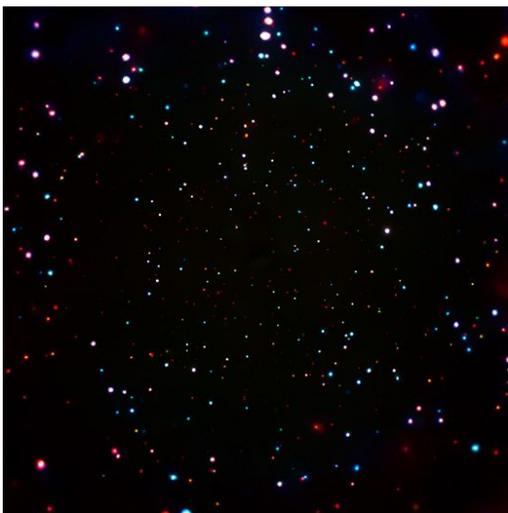
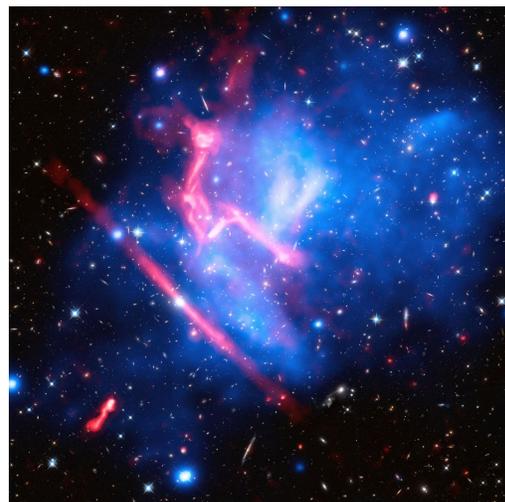
1 AU = $1.496E8$ km

1 pc = 206,265 AU

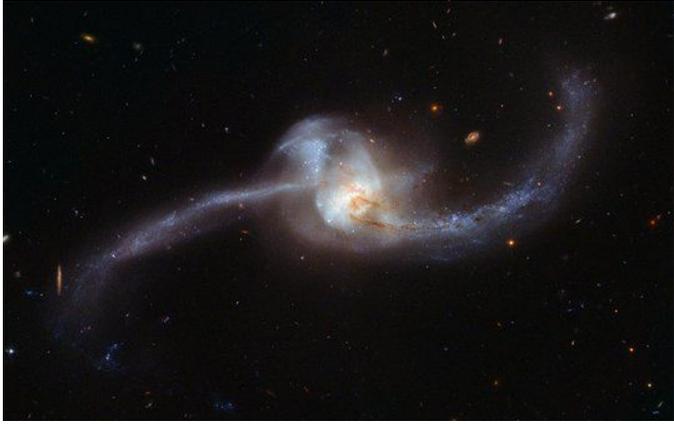
Hubble's Constant: 74 km/s/mpc

Speed of light = $3.00E5$ km/s

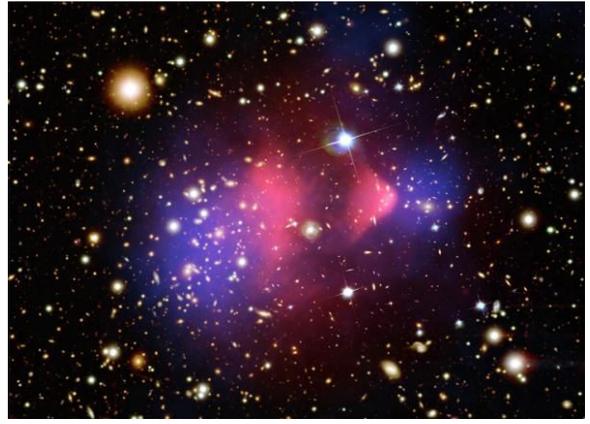
Absolute magnitude of Type Ia SNe = -19.3

A**B****C****D****E****F**

G



H



I



J



1. Which object is characterized by its twisted cosmic knot?

a. This object is marked by speckled patches of bright blue; forming its sweeping curves, known as tidal tails. What are tidal tails?

b. What stage of merging is this object in?

2. Which image is MACS J0717.5+3745?

a. What kind of object is MACS?

b. Result of how many galaxies colliding?

3. Which object was the first quasar to ever be discovered? (which image and name)

a. Draw a Quasar and label the parts

4. Which one of the objects is a supergiant elliptical galaxy?

a. What Constellation is it located in?

b. What is the core of this object?

c. What creates its blue plasma jet?

5. List all the images that are classified as galaxy clusters?

1. Spiral galaxies are defined by
 - a. Consist primarily of stellar remnants
 - b. Range in shape from circular to very stretched out
 - c. Identical to lenticular galaxies
 - d. Rich in dust and gas with stars still forming in their arms
 - e. None of the above
2. What is an open cluster?
 - a. Tight spherical collection of stars that orbits a galactic core
 - b. Very large group of stars
 - c. Stars that share the same giant molecular cloud and roughly the same age
 - d. Precursor to globular clusters
 - e. A and C
3. The usual endpoint of stellar evolution is the formation of
 - a. Compact star
 - b. Supernova
 - c. Brown dwarf
 - d. Asymptotic-giant-branch phase
 - e. White dwarf
4. Which is false about elliptical galaxies?
 - a. Devoid of gas
 - b. Star making process has ended
 - c. Dominant type of galaxy in the universe
 - d. Primarily due to primordial collapse
5. Result of a binary system in which one of the stars is a white dwarf
 - a. Quasars
 - b. Type Ia supernova
 - c. Cepheids
 - d. Type II supernova
 - e. None of the above

6. What is the most abundant element in the sun?

- a. Helium
- b. Hydrogen
- c. Oxygen
- d. Nitrogen
- e. carbon

7. Amount of “normal” matter in the universe

- a. 70%
- b. Less than 5%
- c. 81.5%
- d. 32.9%

8. List spectral type in order from coolest to hottest

9. Define gravitational lensing:

10. What is the significance of the WHIM?

- a. Contains nearly half of the universe’s missing baryonic matter.
- b. Contains nearly half of the universe’s dark matter.
- c. Serves as a tool to assess stellar evolution and predict development.
- d. Explains the presence of exotic pentaquartic matter.

11. Explain the significance of the letters used for spectral type classification.

Tie-Breaker #1: In the 1860s this astronomer first distinguished stars into four spectral types.

12. Using the Hubble Constant, estimate the age of the universe in billions of years and name this “constant”. (3 pts)

13. A star has its strongest spectral lines in the ionized helium spectrum. What spectral class is this star? (1pt)

- b. If this was on a much larger scale and Star A was rotating in an arm of the Milky Way, why or why not would using Kepler's Third Law be accurate for determining its mean distance from the centre?
 - c. Assume the star that formed black hole B had the same mass as B. Determine the volume of Star B at the moment just before its collapse.
4. A type Ia supernova is observed to have an apparent magnitude of 2.7. What is its distance in parsecs?
5. What is the distance of a galaxy that is moving with a positive recessional velocity of 6000km/s?

6. The mass of a given star is $5.0E2$ solar masses. Knowing that it is 67pc away find it's Schwarzschild radius in metres (1pt)

7. Alpha-Hydrogen emissions have a lab-tested wavelength of 656.28 nm. The graph below shows a galaxy's spectrograph. Label all parts of your answer.
- Determine the velocity and direction of the galaxy in km/s. (1pt)
 - Determine the distance to the galaxy from Earth in megaparsecs. (2pts)
 - If the galaxy's apparent magnitude is 18.7, estimate the apparent magnitude from exactly 10 pc away using the distance modulus. (1pt)
 - Is the answer for part b logistically valid? In other words, would it be a relatively correct calculation? Explain why or why not. (3pts)

