Exam 4
Review

EXAM COVERS
LECTURES 22-29
Theoretically is there a center of the universe? Is there an edge? Do we know where Earth is on this?

There is no center to the Universe,
What kind of light we should use to see through the interstellar dust that obscures the universe? What is the 21 cm emission line and what is its significance?

Light emitted at a wavelength of 21cm is in the microwave range of the electromagnetic spectrum and can penetrate interstellar/galactic dust that blocks out many portions of the electromagnetic spectrum.
What lies at the center of the Milky Way?

A super-massive black hole is at the center of our galaxy.
The Standard Candle Equation and the Hubble Expansion Law will be on the exam (more on these later...).

\[
\frac{F_a}{F_b} = \frac{L_a}{L_b} = \left(\frac{D_a}{D_b}\right)^2
\]

\[
V_{\text{rec}} = H_0 \cdot D
\]
Answers to questions found in class lecture notes:
Accretion disks around stellar-mass black holes emit most of their light as

A) Radio waves
B) Infrared light
C) Visible light
D) X-ray
What about globular clusters allows us to determine the Sun's distance from the center of the Galaxy?

A) The clusters are confined to a thin plane.
B) The clusters are all located at the same distance from the Sun.
C) The center of the distribution of clusters is far from the Sun.
D) All of the clusters are located in a region a few parsecs across.
If a star is neither expanding nor contracting, we may assume that throughout the star there is a balance between pressure and

A) temperature
B) density
C) luminosity
D) gravity
What causes Cepheid variables to vary in brightness?

A) Eclipses
B) Changes in nuclear energy generation rate
C) Periodic changes in radius
D) Obscuration by clouds of dust
It is possible to measure the distances to a Cepheid variable star because

A) All Cepheids have the same luminosity
B) Cepheids pulsate
C) Cepheids are found in globular clusters
D) The luminosity of a Cepheid can be determined from its period of pulsation
What is the diameter of the disk of the Milky Way?

A) 4.3 light years
B) 8,000 parsecs
C) 50,000 parsecs
D) 750,000 parsecs
What effect do interstellar dust particles have on the appearance of a distant star?

A) They make it look bluer and brighter
B) They make it look redder and brighter
C) They make it look bluer and dimmer
D) They make it look redder and dimmer
Spiral arm structure is best found by mapping the locations of

A) Globular clusters
B) Young, massive stars
C) RR Lyra variable stars
D) Solar mass and lighter stars
Which is true of spiral arms?

A) Once a star enters a spiral arm it remains there
B) Spiral arms are spun off the core of the galaxy
C) Spiral arms contain a very high density of less than one solar mass stars
D) Stars preferentially form in spiral arms
How do we know that the Milky Way has a spiral structure?

A) By observing the gravitational influence of the arms on nearby galaxies
B) By plotting the distances and directions of objects known to be in spiral arms
C) By observing the changing conditions as the Sun enters and leaves a spiral arm
D) By viewing the Milky Way from a point well above its plane
Which of the following objects are not found primarily in the spiral arms of the Galaxy?

A) white dwarf stars
B) HII regions
C) supernovas
D) O and B stars
What properties of the sun could be used to measure the total mass enclosed within the sun's orbit?

A) mass and orbital speed
B) mass and distance from the center
C) mass and age
D) orbital speed and distance from the center
If the orbital velocities of stars in the Milky Way were found to be half of what they are now measured to be

A) Our estimate of the mass of the Milky Way would decrease
B) Our estimate of the diameter of the Milky Way would decrease
C) Our estimate of the mass of the Milky Way would increase
D) Our estimate of the diameter of the Milky Way would increase
What evidence do we have that there is hidden mass in the galaxy?

A) cool clouds of hydrogen
B) RR Lyrae variable stars in globular clusters
C) flat rotation curve at large radii
D) dusty regions in the plane
The mass of the Milky Way is best determined by

A) measuring the total amount of hydrogen gas using the 21 cm line
B) counting the stars it contains
C) determining the gravitational force acting on stars
D) measuring the distribution of globular clusters
How was Hubble able to determine the distances of nearby galaxies?

A) by measuring trigonometric parallaxes
B) by observing Cepheid variables in them
C) by measuring the expansion speeds of supernova shells
D) by measuring their radial velocities
Early in the history of the universe, which was NOT true?

A) galaxies were closer together  
B) there were more galaxies  
C) galaxies interacted more frequently  
D) there were more elliptical galaxies
Which is not true of elliptical galaxies?

A) Their stars orbit in many different directions
B) They have large concentrations of gas
C) Some are formed in galaxy collisions
D) The contain mainly older stars
A Cepheid variable star is 900 times dimmer but has the same period as another Cepheid which is 100 pc away. How far is it?

A) 100 pc
B) 3000 pc
C) 90,000 pc
D) Really far
What would be the recession speed of a galaxy at a distance of 7 Mpc?

A) 0.1 km/s  
B) 10 km/s  
C) 245 km/s  
D) 490 km/s  
E) 980 km/s

Speed = H0 × distance \[ H0 = 70 \text{ km/s/Mpc} \]
There is often a giant elliptical galaxy at the center of a cluster of galaxies. Such galaxies are thought to arise from

A) Large amounts of gas collecting in the core
B) A collection of black holes at the center of the cluster
C) Interactions and collisions among cluster members
D) A giant spiral galaxy
If Hubble's constant were twice as large as we now think it is, our estimate of the age of the universe would

A) be unchanged
B) increase by a factor of 2
C) increase by a factor of 4
D) decrease by a factor of 2
E) decrease by a factor of 4
Quasars are receding from us at high velocities because

A) matter in black hole jets moves at close to the speed of light
B) matter moves rapidly when close to a black hole
C) quasars are at large distances
D) we smell bad
The variety of different active galaxies can be explained as due to

A) different orientations of the accretion disk
B) different forms of matter being accreted
C) different shapes of black holes
D) different velocities of black holes
Homework problems:
Evidence for matter between galaxies in clusters (intracluster matter) is provided by

a) X ray emission from a halo of gas centered on the cluster
b) star formation regions between galaxies in clusters
c) absorption lines in the spectra of cluster members
d) the rotation curves of clusters which are flatter than Keplerian
Which of the following would not be useful in determining the distance to another galaxy?

a) parallax
b) Cepheid Variables
c) the luminosities of globular clusters
d) the brightness of a supernova
Why has the 21cm emission line been especially useful for studying the structure of the Milky Way galaxy?

a) 21cm radiation is unaffected by interstellar dust.
b) Stars emit very strongly at 21cm.
c) 21cm emission is produced only in the core of the galaxy.
d) 21cm radiation travels to us at the speed of light.
Which of the following must be known in order to determine the amount of galactic mass that lies within the Sun's orbit?

a) the Sun's distance from the center and the orbital period
b) the Sun's mass and orbital period
c) the Sun's distance from the center and the size of its orbit
d) the Sun's mass and its distance from the center
Which best describes the rotation curve of the galaxy between the Sun's orbital distance and twice that distance?

a) flat
b) rising rapidly
c) falling steadily
d) many large fluctuations in orbital speed with distance
Which of the following statements describes the mass in the outer part of the Milky Way (beyond the orbit of the Sun)?

a) It emits a surprisingly small amount of light
b) There is essentially no mass out there.
c) There is no spiral arm structure in the outer galaxy.
d) The outer part of the galaxy is rapidly evaporating into intergalactic space.
Which statement is not true about the LG?

a) The LG is a rich cluster of galaxies.
b) The LG contains the Milky Way galaxy.
c) The LG contains the large and small Magellanic Cloud galaxies.
d) The number of galaxies in the LG is about 30.