

# Galaxy Quiz – Answer Sheet

## Galaxy Clusters

**Q1: Which of the following statements about galaxy clusters is true?**

- A. Clusters contain mostly spiral galaxies
- B. **Dark matter constitutes about 80–85% of the mass in clusters**
- C. Clusters are typically less than 1 Mpc in diameter
- D. Clusters are fully virialized at all times

*Explanation: Dark matter constitutes a significant fraction of the mass in galaxy clusters.*

**Q2: What is the significance of the Sunyaev-Zeldovich effect in studying galaxy clusters?**

- A. It measures the temperature of the cluster gas
- B. It detects the gravitational lensing of clusters
- C. **It provides a mass-weighted measure of hot gas in clusters**
- D. It identifies the number of galaxies in a cluster

*Explanation: The Sunyaev-Zeldovich effect is crucial for understanding the hot gas in galaxy clusters.*

**Q3: How does the spatial distribution of galaxies in cD clusters differ from that in spiral-rich clusters?**

- A. cD clusters have a uniform distribution of galaxies
- B. Spiral-rich clusters have a smooth and circularly symmetric distribution
- C. **cD clusters show rapid density increase towards the center**
- D. Spiral-rich clusters have a higher concentration of elliptical galaxies

*Explanation: In cD clusters, the galaxy density increases towards the center, making them highly concentrated.*

## Density Wave Theory

**Q1: What is the primary classification scheme proposed by Hubble for galaxies?**

- A. The spiral classification
- B. **The tuning fork diagram**
- C. The elliptical classification
- D. The morphological sequence

*Explanation: Hubble proposed the tuning fork diagram to classify galaxies based on morphology.*

**Q2: Which type of galaxy is characterized by having a rotating disk and a central bulge but lacks spiral arms?**

- A. Elliptical galaxies
- B. **Lenticular galaxies**
- C. Irregular galaxies
- D. Barred spiral galaxies

*Explanation: Lenticular galaxies have a disk and bulge but no spiral arms.*

**Q3: What distinguishes Population I stars from Population II stars in galaxies?**

- A. Population I stars are older and redder
- B. Population I stars are found in the bulge of galaxies
- C. **Population I stars are young, hot stars associated with spiral arms**
- D. Population I stars are primarily found in elliptical galaxies

*Explanation: Population I stars are young and found in the spiral arms of galaxies.*

**Q4: What is the significance of the density wave theory in understanding spiral galaxies?**

- A. It explains the formation of elliptical galaxies
- B. **It describes how stars in spiral arms are formed from gas clouds**
- C. It accounts for the random motion of stars in the bulge
- D. It explains the lack of star formation in lenticular galaxies

*Explanation: The density wave theory explains the spiral arm structure of galaxies.*

**Q5: How do the properties of galaxies correlate with their classification in the Hubble sequence?**

- A. All properties correlate perfectly with Hubble type
- B. Only mass and luminosity correlate well with Hubble type
- C. **Many physical properties, such as star formation activity, correlate with morphology**
- D. There is no correlation between properties and Hubble type

*Explanation: Many properties like star formation activity correlate with the Hubble classification.*

# Elliptical and Dwarf Galaxies

**Q1: What is the modern view of elliptical galaxies regarding their composition?**

- A. They contain only old stars with no gas or dust
- B. They are composed of young stars and abundant gas
- C. **They may contain hot X-ray gas, dust, and cold gas**
- D. They are exclusively formed from mergers of dwarf galaxies

*Explanation: Elliptical galaxies may contain hot X-ray gas, dust, and cold gas.*

**Q2: Which law describes the surface brightness profile of elliptical galaxies?**

- A. The Tully-Fisher relation
- B. **The de Vaucouleurs law**
- C. The Hubble law
- D. The Sersic profile

*Explanation: The de Vaucouleurs law describes the surface brightness profile of elliptical galaxies.*

**Q3: What is the primary support mechanism for the structure of elliptical galaxies?**

- A. Rotation of stars
- B. **Random motions of stars**
- C. Gas pressure
- D. Magnetic fields

*Explanation: Elliptical galaxies are supported by random motions of stars.*

**Q4: How does the metallicity of stars in elliptical galaxies typically vary with radius?**

- A. It is uniform throughout the galaxy
- B. It decreases towards the center
- C. **It increases towards the center**
- D. It is higher in the outer regions

*Explanation: Metallicity tends to increase towards the center of elliptical galaxies.*

**Q5: What distinguishes dwarf elliptical galaxies (dE) from normal elliptical galaxies?**

- A. Dwarf ellipticals are larger and more luminous
- B. Dwarf ellipticals have a higher star formation rate
- C. **Dwarf ellipticals are dark matter dominated and follow different correlations**
- D. Dwarf ellipticals contain only young stars

*Explanation: Dwarf elliptical galaxies are often dark matter dominated and follow different correlations.*

## Galaxy Evolution

**Q1: What is the primary mechanism by which galaxies evolve over time?**

- A. Stellar explosions
- B. **Hierarchical merging of structures**
- C. Constant star formation
- D. Isolation from other galaxies

*Explanation: Galaxies evolve primarily through hierarchical merging of structures.*

**Q2: Which of the following timescales is associated with the lifetime of massive stars?**

- A. **~100 Myr**
- B. ~1 Gyr
- C. ~10 Gyr
- D. ~10 Myr

*Explanation: Massive stars have lifetimes on the order of ~100 million years.*

**Q3: What observational evidence supports the evolution of galaxies?**

- A. The presence of dark matter
- B. **Stellar populations in the Milky Way**
- C. The uniformity of cosmic microwave background radiation
- D. The distribution of quasars

*Explanation: Stellar populations in galaxies provide important evidence for their evolution.*

**Q4: What is the significance of the Butcher-Oemler effect in galaxy clusters?**

- A. It indicates the presence of dark matter
- B. **It shows that blue galaxies are more common at higher redshifts**
- C. It describes the merger rates of galaxies
- D. It explains the formation of elliptical galaxies

*Explanation: The Butcher-Oemler effect shows that blue galaxies are more common at higher redshifts.*

**Q5: How do stellar population synthesis models contribute to our understanding of galaxy evolution?**

- A. **They predict the mass of dark matter halos**
- B. They estimate the number of galaxies in the universe
- C. They simulate the number of galaxies in the universe
- D. They measure the distance to galaxies

*Explanation: Stellar population synthesis models help in predicting the mass of dark matter halos.*