Name: _____ Date: _____

GALAXIES PRE-LAB

Using your lecture textbook and/or any other acceptable source of information, answer each question in complete sentences. Be sure to define any relevant terms.

1. Sketch the Hubble Classification Scheme of Galaxies (the Hubble "tuning fork" diagram)

2. Explain the following term relating to the classification of galaxies.
   a. Spiral/Barred Spiral Galaxy

   b. Elliptical Galaxy

   c. Irregular Galaxy

   d. Subtypes of Spiral Galaxies:

   e. Subtypes of Elliptical Galaxies:

Name: _____ Partners: _____

Date: _____ _____

_____

GALAXIES LAB EXERCISE

OUR GALAXY: MILKY WAY

Our own galaxy is, in many ways, one of the most difficult ones to observe. We can see some of the structure of our galaxy in the night sky. In a clear, dark sky, the Milky Way galaxy appears as a glowing band of light stretching across the sky. The faint glow is the combined light of countless faint stars. Telescopic surveys of the Milky Way show that there are large amounts of gas and dust and many hot blue stars. Unfortunately, the gas and dust limits our view of more distant features and structures in our galaxy. There is no way to get a complete view of the Milky Way since we are located inside it.

The first image to be displayed is a side profile of our galaxy in IR. The image is shown as a map of the entire sky as seen from Earth.

1. Which galaxy type does the Milky Way appear to be? Explain how you determined this.

The next image is an artist's conception of the face-on view of the Milky Way. We can never look at our galaxy this way, but this image is based on information that we have gathered about the structure of the Milky Way.

2. Which galaxy type does the Milky Way appear to be? Explain how you determined this.

3. Explain why it is possible to have two different classifications for the Milky Way from the two different views.

ELLIPTICAL GALAXIES

Now you will see high resolution images of two elliptical galaxies. Using a ruler, measure the longest and shortest sides of each galaxy. The subtypes of elliptical galaxies are based on these measurements.

Find the subtype of these galaxies with the following:

$$\text{Subtype} = 10 \times \frac{(\text{longest side} - \text{shortest side})}{\text{longest side}}$$

4. Elliptical 1: longest side: _____ shortest side: _____
   Subtype: _____

5. Elliptical 2: longest side: _____ shortest side: _____
   Subtype: _____

CLASSIFYING GALAXIES

Next we will practice classifying different galaxies. Using galaxies images that will be displayed on the computer write the classification, with estimated subtype and describe your reasoning for assigning that classification.

Table 1: Classification of Galaxies

Galaxy	Classification	Reasons
1		
2		
3		
4		
5		
6		
7		
8		
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10		
11		
12		
13		
14		
15		

RELATIVE DISTANCES OF CLUSTERS OF GALAXIES

Before proceeding with this section, review the instructions on the use of the Palomar Sky Survey at the beginning of the Stars and Nebulae Laboratory. In particular, remember the grid system we used to locate objects on the photographs. Divide the print into 9 sections both horizontally and vertically. Number the rows 1 through 9 and letter the columns A through I. **DO NOT MAKE ANY MARKS ON THE PHOTOGRAPHS, OR YOU WILL RECEIVE A <u>ZERO</u> FOR THIS LAB!**

All of the large, bright galaxies on the O-1563 print belong to a group or cluster of galaxies called the Virgo Cluster. It is in fact the nearest rich cluster of galaxies. Thus we can say that these galaxies are all at the same distance from us (about 45,000,000 light years) and, therefore, any differences we find in the size or brightness between different galaxies are reflections of the intrinsic properties of these galaxies and are not due to differences in their distance from us.

A more distant cluster of galaxies, the Hercules Cluster, is in the center of the second print (O-83). A very distant cluster is also on this print. We can, therefore, compare the appearance of galaxies at different distances and arrive at techniques to estimate relative distances. On print O-83 examine the cluster of galaxies near the center of the plate (E3, E4, E5, F5). This is the Hercules Cluster.

6. Describe a method that you could use to determine the relative distance of the Virgo Cluster (O-1563) and the Hercules Cluster (O-83). (There are many different methods.) Be sure to state any assumptions necessary for your method to work.

We have found that galaxies are basically the same from one cluster to another, so the five largest galaxies in a near cluster may be presumed to have approximately the same average size as the five largest galaxies in a more distant cluster.

7. Estimate how many times farther away the Hercules Cluster is than the Virgo Cluster by measuring the approximate size of the largest galaxies with a ruler and comparing their sizes. (Show how you made your estimate. Be sure and measure at least five galaxies in each cluster. Avoid peculiar galaxies).

Galaxy	Virgo	Hercules
1	_____	_____
2	_____	_____
3	_____	_____
4	_____	_____
5	_____	_____
average	_____	_____

8. If the distance to the Virgo Cluster is 45 million light years, what is the distance to the Hercules Cluster?

Examine another cluster at O-83; E7 to G7. It is very faint. This cluster is actually one of the most distant objects known and is thus representative of a much earlier stage of the universe. Cosmologists, therefore, would like to know if galaxies in this cluster are different from galaxies in nearby clusters.

9. Comparing the photograph of the faint cluster with that of the Virgo Cluster, what selection effects do you think might be present in looking at the photograph of the distant cluster? (In other words, would you expect to see the same range of galaxies in the faint cluster on the same photographic print as in a nearby cluster?) Explain.

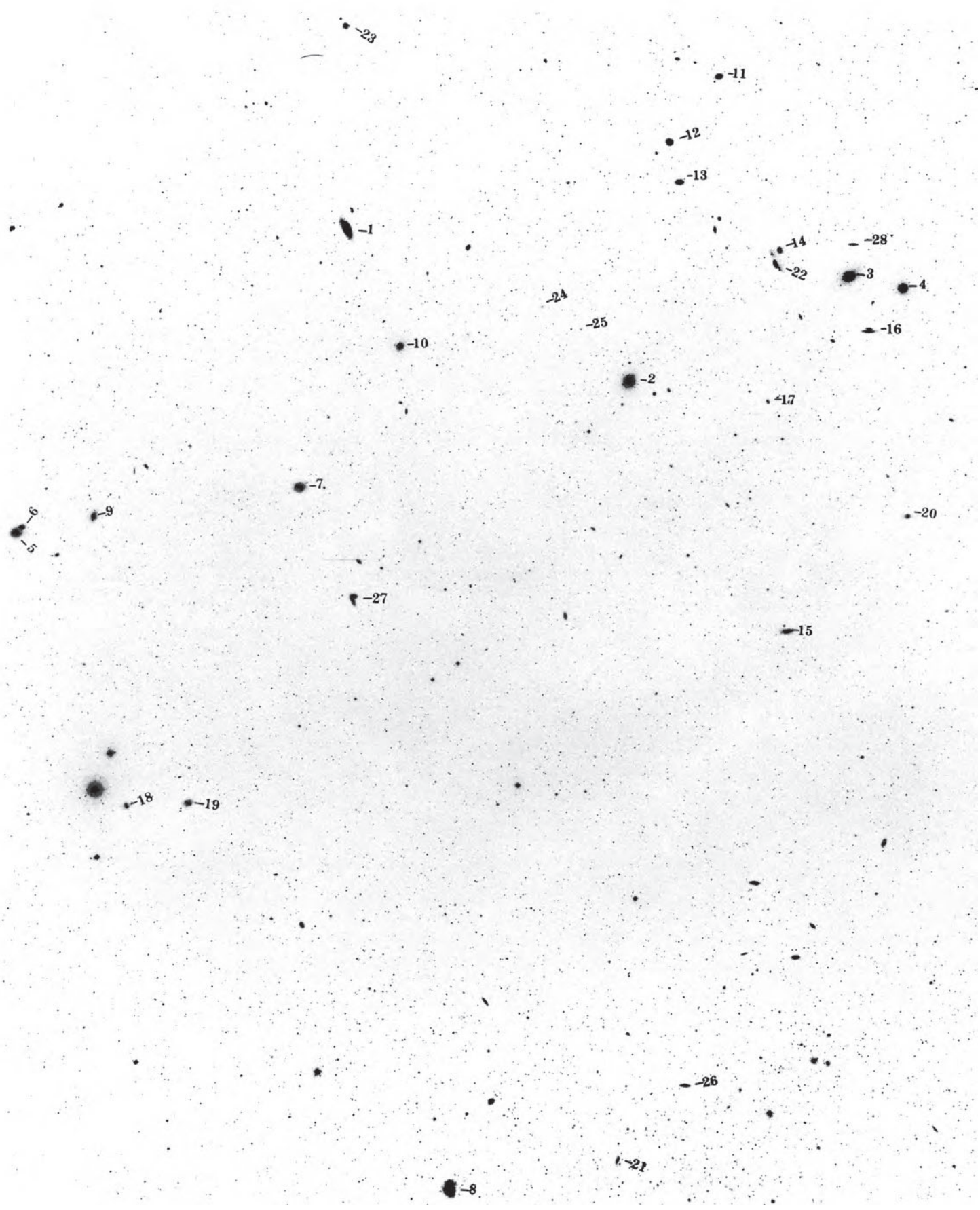
10. How many times farther away is it than the Hercules Cluster? Show your method.

11. What is the distance to this faint cluster?

Occasionally, we can see a galaxy with a very unusual shape. Look at the highly distorted galaxy on O 1536; number 22.

12. Why do you think the galaxy looks as it does?

13. Based on your answer to the previous question, give the location of two other examples that are similar.


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