Lab #3b: A Scale Model of the Solar System

In comparison to distances we use every day, the sizes of the planets and the distances within the Solar System are huge. It is difficult to visualize the enormity of these distances without resorting to some familiar reference, like the number of dollar bills laid end to end that would stretch from Earth to the Moon. (The answer is about 2.46 billion dollars.) It is also difficult to understand the enormity of the Solar System and the relative smallness of the planets.
In this lab, we will try to show the relative sizes of the planets and the distances between them simultaneously by using a scale model.
The tables below indicate the data of the planets (including minor planet Pluto) and the names of all the moons larger than 400 km in diameter. Size means diameter; distance means distance from the Sun.

Name	Size [km]	Model size [mm]	Sun distance [million km]	Model distance [m]
Sun	1,400,000	93	0	0
Mercury	4,900	0.33	57.9	3.9
Venus	12,100	0.81	108.2	7.2
Earth	12,800	0.85	149.6	10
Moon	3,400	0.23	0.38 (from Earth)	0.02 from Earth
Mars	6,800	0.45	227.9	15.2
Jupiter	143,000	9.5	778.3	51.9
Saturn	121,000	8.1	1,427	95.1
Uranus	51,000	3.4	2,870	191
Neptune	50,000	3.3	4,497	300
Pluto	2,200	0.15	5,914	394

Planet	Moon(s) > 400 km	Small moons < 400 km
Mercury	-	No moons at all.
Venus	-	No moons at all.
Earth	Moon	No small moons.
Mars	-	Phobos, Deimos.
Jupiter	Io, Europa, Ganymede, Callisto	More than a hundred.
Saturn	Mimas, Enceladus, Thethys, Dione, Rhea, Titan, Iapetus	More than a hundred.
Uranus	Miranda, Ariel, Umbriel, Titania, Oberon	Many.
Neptune	Triton	Many.
* Pluto	Charon	Nyx, Hydra.

PROCEDURE AND LAB REPORT

Date:_____ Your name: _____Partner's name: _____ Section: ___/___

Maximum two students may work together as partners!
For this exercise you'll need a pair of 11"x17" large sheets with the scaled-down drawing of each planet and its moon system. These are available in the lab.

1. *Check the table:*

Using the table, choose one planet (not Earth) and check to see if the scale size and distance are calculated correctly.
Write your calculation on the provided sheet, next to each planet.
Label each planet with its name.
(The sizes and the distances are scaled down by a factor of 1.5×10^{10}, i.e. 15 billion.)

2. *Layout:*

Starting with the model of the Sun and measuring outward, lay out the scale models of the planets using the measuring wheel. This will be done for the whole class together; one copy will need to be cut out for each planet's drawing with its moons, writing the name of the planet and the names of the moons on each. Then, you'll walk the necessary *model distance* and lay the paper pieces on the ground.

3. *Luminosity:*

The luminosity of the Sun is 4×10^{26} watts. Our scale model of the Solar System is 15 billion times smaller. Recall that the apparent brightness of an object depends on the inverse square of its distance from you. How many watts should the scale put out? _____

4. *Layout:*

The distance to the nearest star, Proxima Centauri, is 40 trillion kilometers (4×10^{13} km). Traveling at a speed of 300,000 kilometers per second, light takes 4.2 years to reach us from Proxima Centauri.
How far would Proxima be in our scale model? _____
Find a city at that distance using the map of your area. _____

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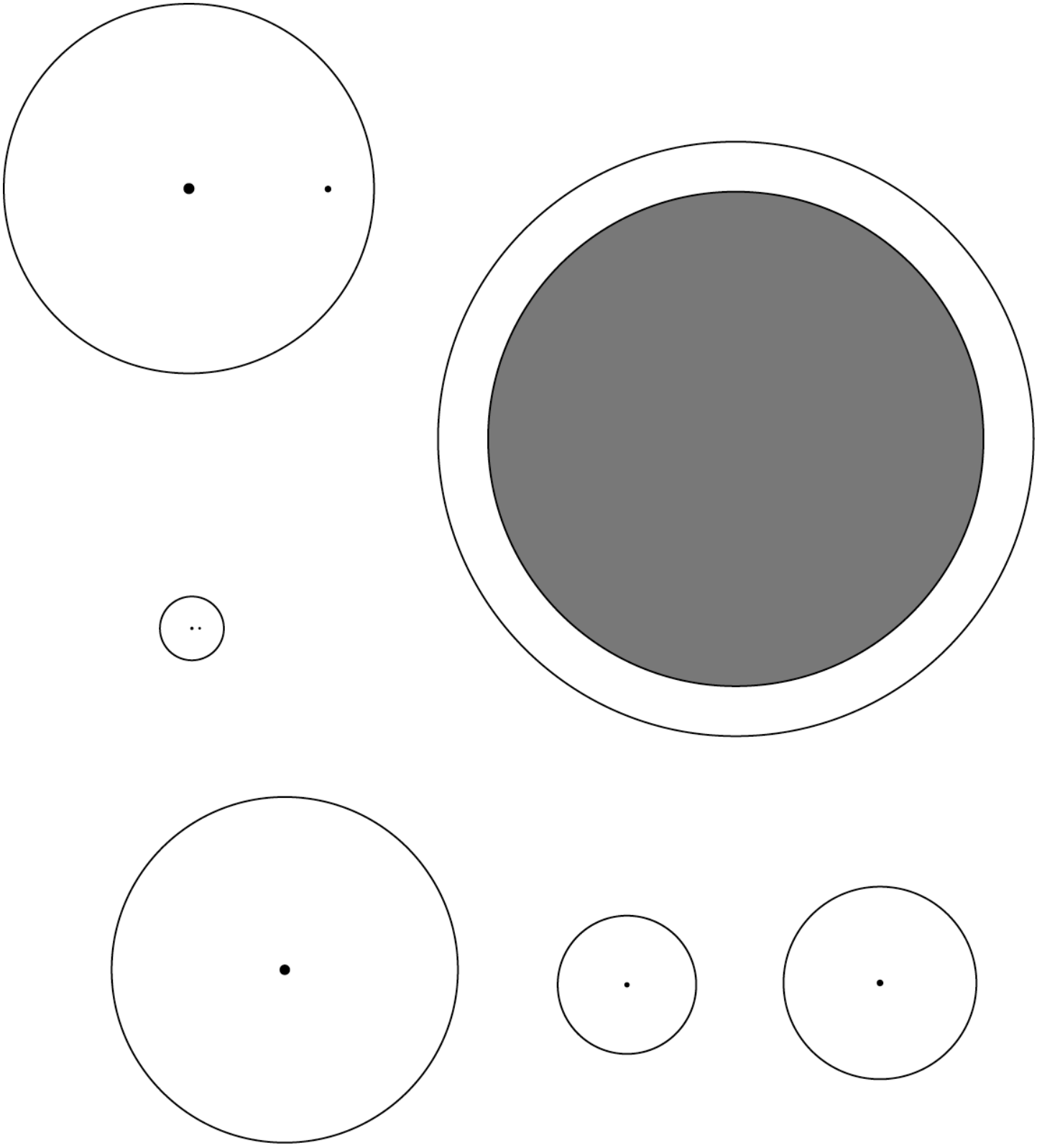

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