

Louis M. Edwards Mathematics Super Bowl
Valencia Community College -- April 27, 2005

Group Round - Building the Solar System

Scoring

For this group round in addition to two points awarded for each correct answer (one point for "nearly correct" answers), teams with all answers correct receive a bonus of two points (one point for all answers at least "nearly correct"). Additionally, the first team to get all parts correct (not just "nearly correct") will receive an additional bonus of two points and the second team to get all parts correct (not just "nearly correct") will receive a bonus one point. If the points for the time bonus are not awarded due to no teams with all answers correct, they will be awarded to teams with all answers "nearly correct" in the order of submission.

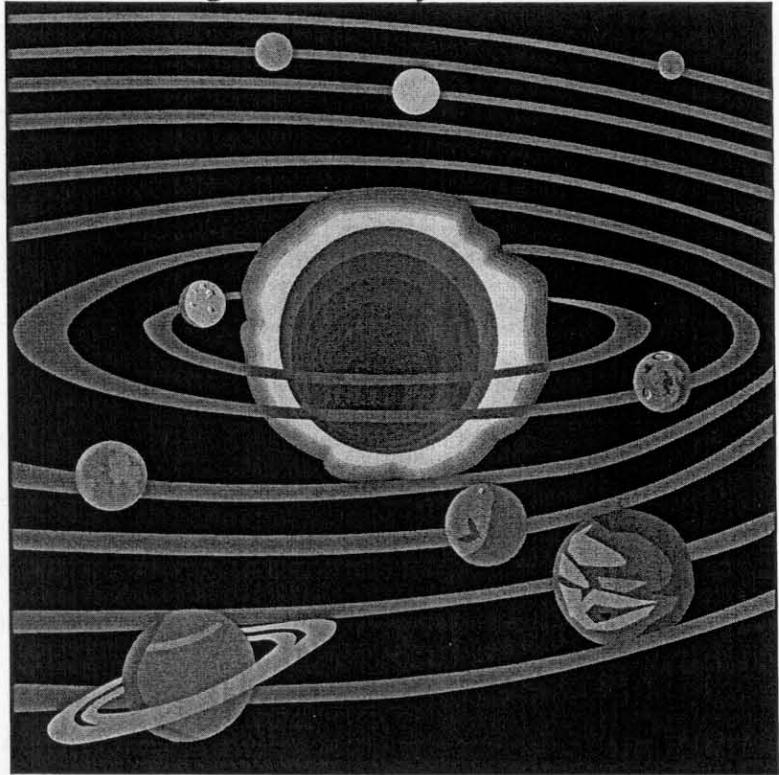
Problem

Hasshad Rodriguez, a philanthropic multi-billionaire, in an effort to better educate individuals about the characteristics of the solar system has decided to build a scale model that individuals can visit and see the various planets in their relative sizes and positions. Additionally he is going to expend a great deal to allow the planets to move in their orbits along special tracks built for them with orbit times that are accurate relative to each other.

In an effort to complete this model Hasshad has hired your team to help him with the initial planning phases. He would like for you to be able to answer the questions that follow the given information so the design phases of the project can commence.

Information that is provided to you...

- 1.) For this initial round of calculations, please assume the planets have circular orbits; appropriate adjustments for eccentricity will be made at a later point.
- 2.) Cost is no object. The necessary materials, property and equipment will be purchased to complete the project.
- 3.) Hasshad would like visitors that stay for the day learning about the solar system to be able to see Pluto complete an orbit around the sun. To accomplish this the speeds of the planets should be adjusted so that the orbit time of Pluto is eight hours and the orbit times of the other planets are proportionately diminished. The ratio of orbit times for the planets in the model should be the same as the ratio of the orbit times for the actual planets.
- 4.) All distances in the model should be to the same scale. This means that if the distance from Sol to Mercury is $1/20^{\text{th}}$ scale their diameters should also be $1/20^{\text{th}}$ scale.
- 5.) Hasshad would like for individuals to have to walk for a while to move from one planet's orbit to another, but doesn't want to make it a Herculean task. For the model the orbit of Pluto should be set to a radius of 4 km.



This table provides the necessary information about the solar system

Star/Planet	Diameter (km)	Radius of Orbit (km)	Time to complete 1 Orbit (days)
Sol	1391900	N/A	N/A
Mercury	4866	57950000	87.97
Venus	12106	108110000	224.7
Earth	12742	149570000	365.26
Mars	6760	227840000	686.69
Jupiter	139516	778140000	4332
Saturn	116438	1427000000	10761
Uranus	46940	2870300000	30685
Neptune	45432	4499900000	60191
Pluto	2274	5913000000	90800

The initial questions that Mr. Rodriguez would like answered are:

- 1.) How large will the sun, the largest object in the solar system, need to be in the model? (diameter to the nearest tenth of a millimeter)
- 2.) How large will Pluto, the smallest planet in the solar system, need to be in the model? (diameter to the nearest tenth of a millimeter)
- 3.) How fast will the fastest planet in the solar system be traveling? (speed to the nearest tenth of a kilometer per hour)
- 4.) How fast will the slowest planet in the solar system be traveling? (speed to the nearest tenth of a kilometer per hour)

Some material and assistance in the preparation of this question was obtained from Ron Hipschman's material at http://www.exploratorium.edu/ronh/solar_system/ and <http://www.exploratorium.edu/ronh/age/>

Answer 1 _____ mm .

Answer 2 _____ mm .

Answer 3 _____ kph .

Answer 4 _____ kph .