UNIT 7 HOMEWORK AFTER SESSION ONE

- *Do the online SmartPhysics homework for* "Relative and Circular Motion"
- *Work Supplemental Problems SP7-1, SP7-2 & SP7-3 shown below*

➡**SmartPhysics:** *View the Prelecture "*Forces and Free Body Diagrams*" before the class of next session and answer the checkpoint questions.*

SP7-1) A disk is turning with uniform circular motion. A point on the rim of the disk is moving with velocity

$$\vec{v}_1 = (1.5 \text{ m/s})\hat{i} + (2.0 \text{ m/s})\hat{j}$$

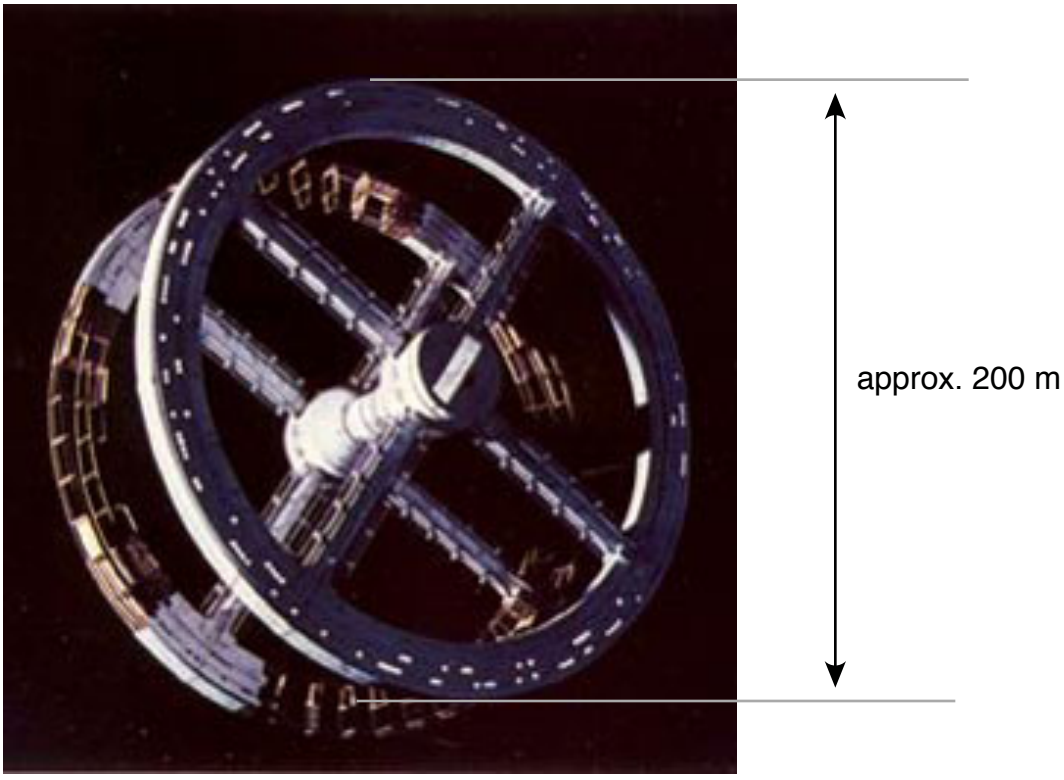
at $t_1 = 3.00$ ms and

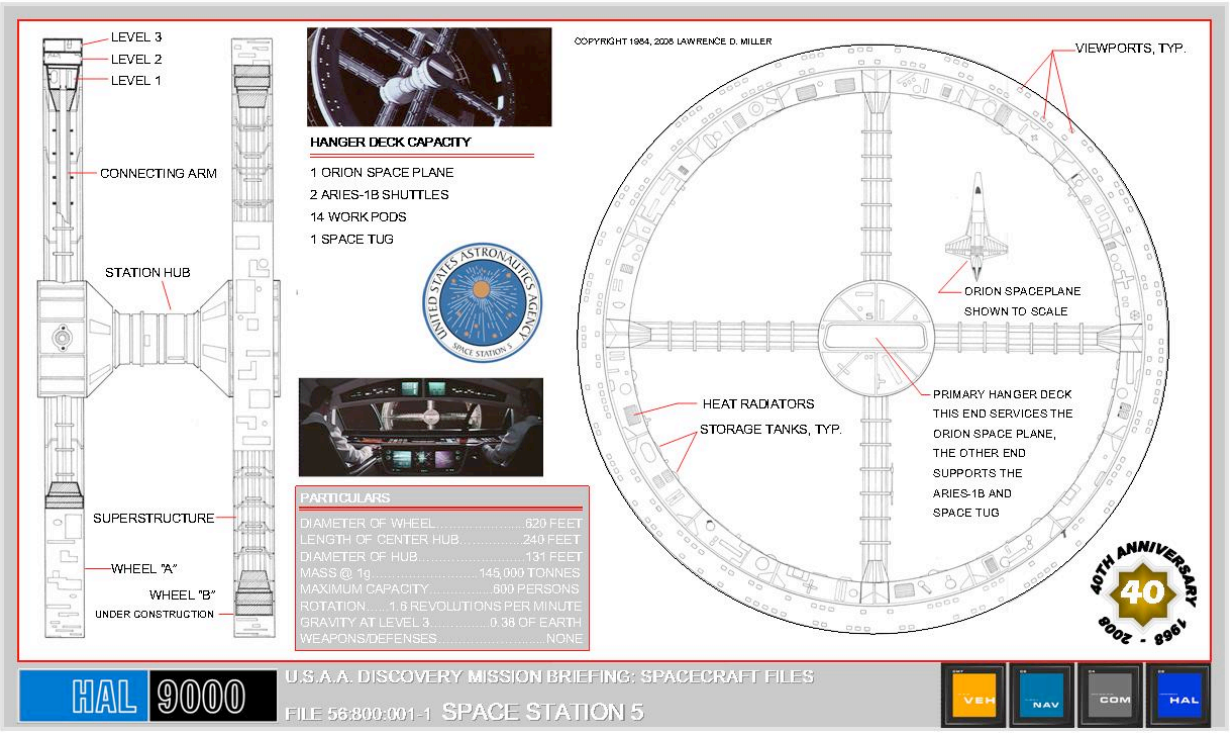
$$\vec{v}_2 = (-1.5 \text{ m/s})\hat{i} + (-2.0 \text{ m/s})\hat{j}$$

at $t_2 = 7.00$ ms. (a) What is the magnitude of the point's centripetal acceleration? (b) What is the point's average acceleration during the time interval $(t_2 - t_1)$?

SP7-2) (20 pts) The 1960's classic movie 2001: A Space Odyssey was, in its time, one of the most elaborate and technically accurate science fiction films ever produced. One of the more exotic items in the film was a giant space wheel which was intended to serve as a space station orbiting the Earth to be used as base for trips to the moon. According to the 2001 science advisor, the station was "designed" to have a diameter of 620 ft (200 m) and to rotate at a rate sufficient to cause occupants in the outer rings to experience a centripetal force roughly equal to the gravitational force of the moon. An object on the moon only experiences one-sixth the force that it would experience on the surface of the Earth.

2001 Space Wheel





http://www.starbase79.com/images/2001Space/2001SpaceStation.JPG (The parameters listed are not consistent with the movie.)

To do this problem you should open the movie entitled *RotatingStation1.mp4* or *RotatingStation2.mp4*. If you use Quicktime player to view the movies, exact timings can be found by opening Movie Properties under the Movie menu. Then select Movie and Time in the dialogue box.

(a) Explain how the spinning of the wheel can be used to create an artificial gravity for those in the outer ring. **(b)** Use basic geometry and some reasoning to figure out the approximate speed in m/s of the outer rim of the ring. i.e. what is the distance covered after 6 seconds of a point on the outer ring? i.e., what is the length of the circular arc in metres? (You may want to find the time for one-quarter revolution as an alternative method.) **(c)** Calculate the centripetal acceleration that a person in the rim of the wheel would experience and compare this to the gravitational acceleration on the surface of the moon. **(d)** Does the artificial gravity depicted for the space wheel approximately simulate that on the surface of the moon?

SP7-3) (Tipler 67) Earth rotates on its axis once every 24 hours, so that objects on its surface execute uniform circular motion about the axis with a period of 24 hours. Consider only the effect of this rotation on the person on the surface. (Ignore Earth's orbital motion about the Sun.) (a) What is the speed and what is the magnitude of the acceleration of a person standing on the equator? (Express the magnitude of this acceleration as a percentage of g.) (b) What is the direction of the acceleration vector? (c) What is the speed and what is the magnitude of the acceleration of a person standing on the surface at 35°N latitude? (d) What is the angle between the direction of the acceleration of the person at 35°N and the direction of the acceleration of the person at the equator if both persons are at the same longitude?