Circular Motion Problems (SLAPT prep)

1. A 1200 kg car is driving on a level road at 5.0 m/s. It drives in a circle with a radius of 30.0 m. What is the centripetal acceleration of the car? What is the net radial force on the car? What friction force is required to keep the car moving in a circle?

2. If the coefficient of friction is 0.800, what is the maximum speed the car from the previous problem can have while maintaining its course?

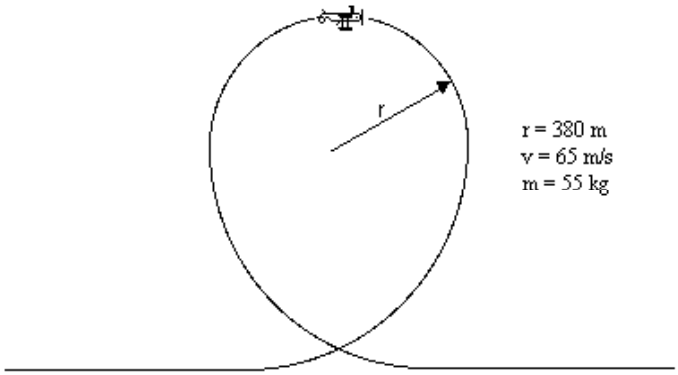
3. In aviation, a "standard turn" for a level flight of a propeller-type plane is one in which the plane makes a complete circular turn in 2.00 minutes. If the speed of the plane is 170 m/s,
   a. What is the radius of the circle? b. What is the centripetal acceleration of the plane?

4. A 1200 kg car travels 11.1 m/s over the top of a hill with a 25 m radius of curvature. What is the centripetal acceleration of the car? What is the magnitude and direction of the net force on the car? What is the magnitude of the normal force on the car?

5. What happens to the magnitude of the normal force on the car as the car travels faster? What is the maximum speed the car can have before it "takes off" at the top of the hill?

6. A 1200 kg car travels 11.1 m/s through the bottom of a hill with a 25 m radius of curvature. What is the centripetal acceleration of the car? What is the magnitude and direction of the net force on the car? What is the magnitude of the normal force on the car?

7. A 55 kg pilot flies around a loop as shown in the diagram to the right.

   a. Draw a force diagram for the pilot when she is at the top of the loop.

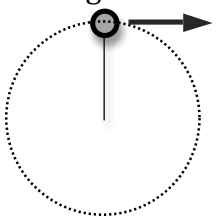
   b. Find the magnitude and direction of the normal force on the pilot.

   c. Does the pilot feel heavier or lighter than normal at the top of the loop?

8. The moon's mass is $7.35 \cdot 10^{22}$ kg, and it moves around the earth approximately in a circle or radius $3.82 \cdot 10^{5}$ km. The time required for one revolution is 27.3 days. Calculate the centripetal force that must act on the moon. How does this compare to the gravitational force that the earth exerts on the moon at that same distance?

9. A 60. g ball is tied to the end of a 50. cm-long string and swung in a vertical circle. The center of the circle is 150 cm above the floor. The ball is swung at the minimum speed necessary to make it over the top without the string going slack.

   If the string is released at the instant the ball is at the top of the loop, where does the ball hit the ground?



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10. The design for the space station below has two ring structures which will be occupied by astronauts. The radius of the smaller ring is ½ that of the larger ring. The entire space station spins on its axis so that the occupants feel like they are in a gravitational field. The speed of the rotation is such that an astronaut in the smaller ring feels like he is standing on the earth. How does an astronaut standing in the larger ring feel?