A phonograph record is a vinyl disk that spins in a horizontal plane at exactly \(33 \frac{1}{3}\) revolutions per minute.

Suppose a small insect, such as a cockroach, is standing at the center of the record. The roach then runs away from the center along a radial line. (This means that from the roach’s point of view, she is running straight outward, but if you look from above the roach is moving in an outward spiral.)

Suppose the velocity of the roach with respect to the surface she is standing on is \(17.45\) cm/sec. (Actually that is a reasonable speed for a roach.) Now, suppose the coefficient of static friction between the roach and the surface is \(\mu_s = 0.1758\).

The diameter of the phonograph record is 30 cm. Before the roach makes it to the edge, she slips because the maximum value of static friction cannot provide the roach’s acceleration. At what radius from the center will the roach slip?

Several important points:
1.) No partial credit – you have to get it right, so be careful!
2.) It is silly to specify the coefficient of friction and the roach’s radial velocity so precisely as I did, but I did it so the answer would be a nice round number. If you do not get something very close to an integer number of centimeters, then you did it wrong.
3.) Do not confuse centimeters and meters. Use \(g = 9.8\) m/s\(^2\) = 980 cm/s\(^2\).
4.) The roach slips when her mass times the magnitude of her acceleration vector exceeds the maximum static frictional force.
5.) The answer is not 14.14 cm.

Answer: ________________________________