8.5: In Summary

1. To solve problems involving motion in two dimensions, you should break up all the forces into their components along a suitable pair of orthogonal axes, then apply Newton's second law to each direction separately: $F_{net,x} = ma_x$, $F_{net,y} = ma_y$. It is convenient to choose your axes so that at least one of either a_x or a_y will be zero.
2. An object thrown with some horizontal velocity component and moving under the influence of gravity alone (near the surface of the Earth) will follow a parabola in a vertical plane. This results from horizontal motion with constant velocity, and vertical motion with constant acceleration equal to $-g$, as described by equations (8.2.4).
3. To analyze motion up or down an inclined plane, it is convenient to choose your axes so that the x axis lies along the surface, and the y axis is perpendicular to the surface. Then, if θ is the angle the incline makes with the horizontal, the force of gravity on the object will also make an angle θ with the *negative* y axis.
4. Recall that the force of kinetic friction will always point in a direction opposite the motion, and will have magnitude $F^k = \mu_k F^n$, whereas the force of static friction will always take on whatever value is necessary to keep the object from moving, up to a maximum value of $F^s_{max} = \mu_s F^n$.
5. An object moving in an arc of a circle of radius R with a speed v experiences a *centripetal acceleration* of magnitude $a_c = v^2/R$. "Centripetal" means the corresponding vector points towards the center of the circle. Accordingly, to get an object of mass m to move on such a path requires a *centripetal force* $F_c = mv^2/R$.
6. To describe the motion of a particle on a circle of radius R, we use an angular position variable $\theta(t)$, in terms of which we define angular displacement $\Delta\theta$, angular velocity $\omega = d\theta/dt$, and angular acceleration $\alpha = d\omega/dt$. The equations for motion in one dimension with constant acceleration apply to circular motion with constant α with the changes $x \rightarrow \theta$, $v \rightarrow \omega$ and $a \rightarrow \alpha$.
7. The displacement along the circle, s, corresponding to an angular displacement $\Delta\theta$, is (in magnitude) $s = R|\Delta\theta|$. Similarly, the (linear) speed of the particle (magnitude of its velocity vector) is equal to $v = R|\omega|$, and the tangential component of its acceleration vector has magnitude $a_t = R|\alpha|$. In addition to this, the particle always has a radial acceleration component a_r equal to the centripetal acceleration of point 5 above.