Analysis Procedure

In the solution of force-mass-acceleration problems for the plane motion of rigid bodies, the following steps should be taken once you understand the conditions and requirements of the problem:

1. Kinematics. First, identify the class of motion and then solve for any needed linear and angular accelerations which can be determined solely from given kinematic information. In the case of constrained plane motion, it is usually necessary to establish the relation between the linear acceleration of the mass center and the angular acceleration of the body by first solving the appropriate relative-velocity and relative-acceleration equations. Again, we emphasize that success in working force-mass-acceleration problems in this chapter is contingent on the ability to describe the necessary kinematics, so that frequent review of Chapter 5 is recommended.

2. Diagrams. Always draw the complete free-body diagram of the body to be analyzed. Assign a convenient inertial coordinate system and label all known and unknown quantities. The kinetic diagram should also be constructed so as to clarify the equivalence between the applied forces and the resulting dynamic response.

3. Equations of Motion. Apply the three equations of motion from Eqs. 6/1, being consistent with the algebraic signs in relation to the choice of reference axes. Equation 6/2 or 6/3 may be employed as an alternative to the second of Eqs. 6/1. Combine these relations with the results from any needed kinematic analysis. Count the number of unknowns and be certain that there are an equal number of independent equations available. For a solvable rigid-body problem in plane motion, there can be no more than the five scalar unknowns which can be determined from the three scalar equations of motion, obtained from Eqs. 6/1, and the two scalar component relations which come from the relative-acceleration equation.

*When an interconnected system has more than one degree of freedom, that is, requires more than one coordinate to specify completely the configuration of the system, the more advanced equations of Lagrange are generally used. See the first author's *Dynamics, 2nd Edition, SI Version*, 1975, John Wiley & Sons, for a treatment of Lagrange's equations.