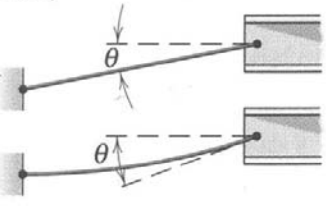
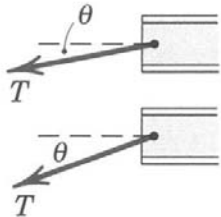

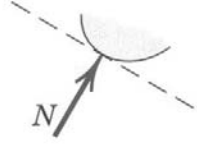

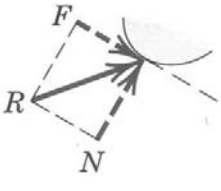
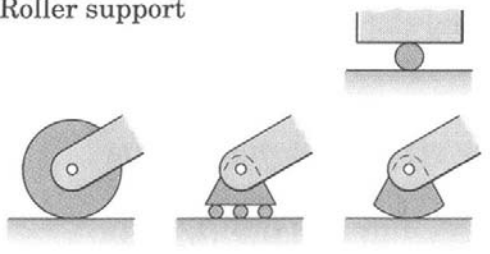
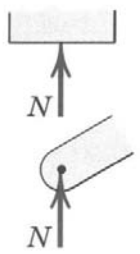
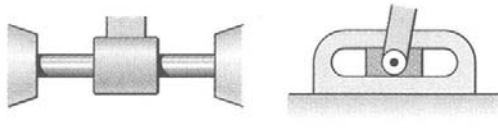
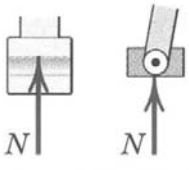
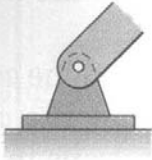
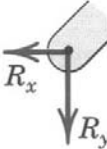
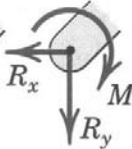
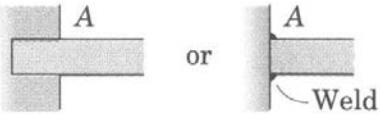
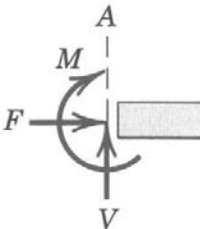
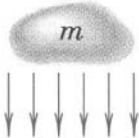
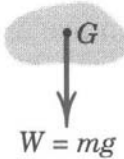
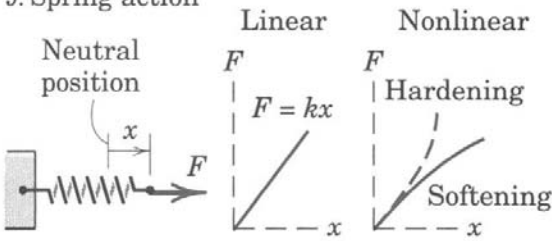
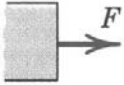


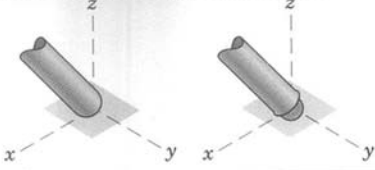
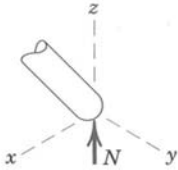
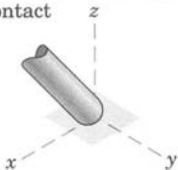
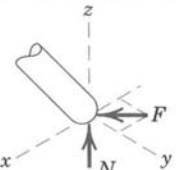
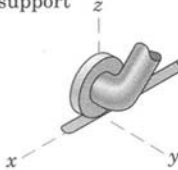
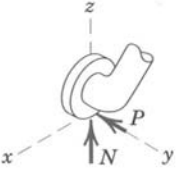

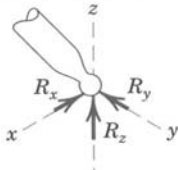
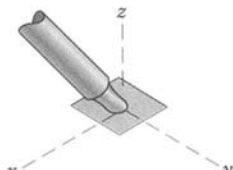
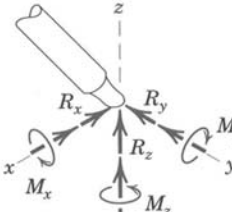
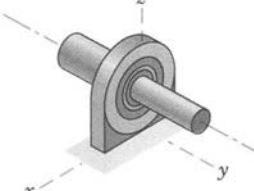
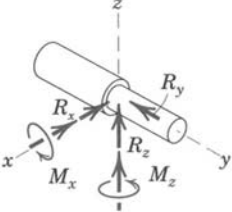
MODELING THE ACTION OF FORCES IN TWO-DIMENSIONAL ANALYSIS

Type of Contact and Force Origin	Action on Body to be Isolated
<p>1. Flexible cable, belt, chain, or rope</p> <p>Weight of cable negligible</p> <p>Weight of cable not negligible</p> 	 <p>Force exerted by a flexible cable is always a tension away from the body in the direction of the cable.</p>
<p>2. Smooth surfaces</p> 	 <p>Contact force is compressive and is normal to the surface.</p>
<p>3. Rough surfaces</p> 	 <p>Rough surfaces are capable of supporting a tangential component <math>F</math> (frictional force) as well as a normal component <math>N</math> of the resultant contact force <math>R</math>.</p>
<p>4. Roller support</p> 	 <p>Roller, rocker, or ball support transmits a compressive force normal to the supporting surface.</p>
<p>5. Freely sliding guide</p> 	 <p>Collar or slider free to move along smooth guides; can support force normal to guide only.</p>

MODELING THE ACTION OF FORCES IN TWO-DIMENSIONAL ANALYSIS (cont.)

Type of Contact and Force Origin	Action on Body to be Isolated	
<p>6. Pin connection</p> 	<p>Pin free to turn</p> 	<p>Pin not free to turn</p>  <p>A freely hinged pin connection is capable of supporting a force in any direction in the plane normal to the axis; usually shown as two components <math>R_x</math> and <math>R_y</math>. A pin not free to turn may also support a couple <math>M</math>.</p>
<p>7. Built-in or fixed support</p> 		<p>A built-in or fixed support is capable of supporting an axial force <math>F</math>, a transverse force <math>V</math> (shear force), and a couple <math>M</math> (bending moment) to prevent rotation.</p>
<p>8. Gravitational attraction</p> 		<p>The resultant of gravitational attraction on all elements of a body of mass <math>m</math> is the weight <math>W = mg</math> and acts toward the center of the earth through the center mass <math>G</math>.</p>
<p>9. Spring action</p> 		<p>Spring force is tensile if spring is stretched and compressive if compressed. For a linearly elastic spring the stiffness <math>k</math> is the force required to deform the spring a unit distance.</p>

## MODELING THE ACTION OF FORCES IN THREE-DIMENSIONAL ANALYSIS

Type of Contact and Force Origin	Action on Body to be Isolated
<p>1. Member in contact with smooth surface, or ball-supported member</p> 	 <p>Force must be normal to the surface and directed toward the member.</p>
<p>2. Member in contact with rough surface</p> 	 <p>The possibility exists for a force <math>F</math> tangent to the surface (friction force) to act on the member, as well as a normal force <math>N</math>.</p>
<p>3. Roller or wheel support with lateral constraint</p> 	 <p>A lateral force <math>P</math> exerted by the guide on the wheel can exist, in addition to the normal force <math>N</math>.</p>
<p>4. Ball-and-socket joint</p> 	 <p>A ball-and-socket joint free to pivot about the center of the ball can support a force <math>R</math> with all three components.</p>
<p>5. Fixed connection (embedded or welded)</p> 	 <p>In addition to three components of force, a fixed connection can support a couple <math>M</math> represented by its three components.</p>
<p>6. Thrust-bearing support</p> 	 <p>Thrust bearing is capable of supporting axial force <math>R_y</math> as well as radial forces <math>R_x</math> and <math>R_z</math>. Couples <math>M_x</math> and <math>M_z</math> must, in some cases, be assumed zero in order to provide statical determinacy.</p>