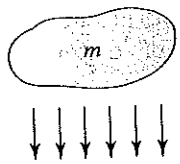
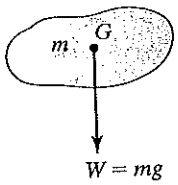
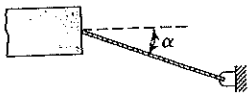
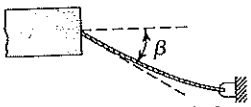
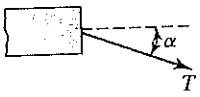
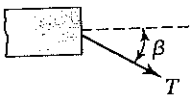
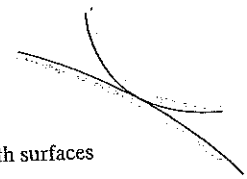
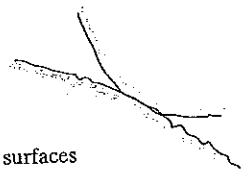
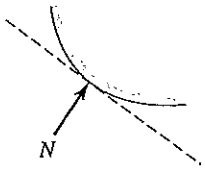
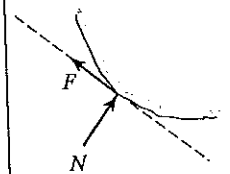
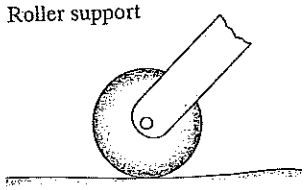
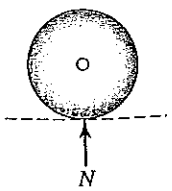
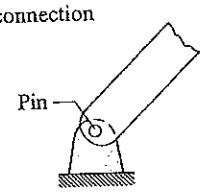
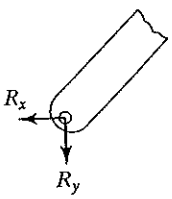
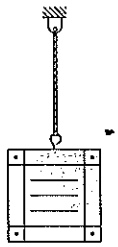
Free-body diagrams for some of the most common force configurations are illustrated in Figure 4.17.

Figure 4.17
Free-body diagrams for some common force configurations.

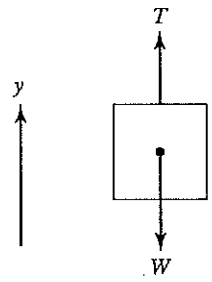
Configuration	Free-body diagram	Comments
Gravitational force 		The gravitational force acts through the center of gravity G.
Cable force  Weight of cable neglected  Weight of cable included	 	The tension force T in a cable is always directed along the axis of the cable.
Contact force  Smooth surfaces  Rough surfaces	 	For smooth surfaces, the contact force N is toward the body, normal to the tangent drawn through the point of contact. For rough surfaces, there are two forces, a normal force N and a friction force, F. These two forces are perpendicular to each other. The friction force F acts in the direction opposing the impeding motion.
Roller support 		A roller supports a normal force but no friction force because a friction force would cause the roller to rotate.
Pin connection 		A pin connection can support a reaction force in any direction in the plane normal to the pin's axis. This force may be resolved into its x and y components, R_x and R_y.

PRACTICE!

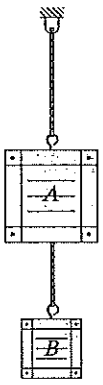
1. A crate hangs by a rope as shown. Construct a free-body diagram of the crate.



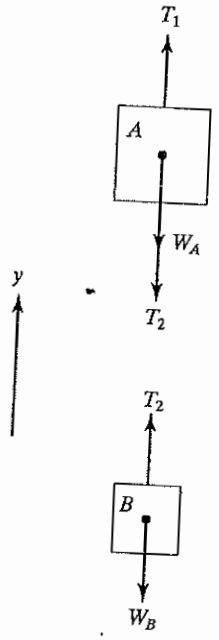
Answer:



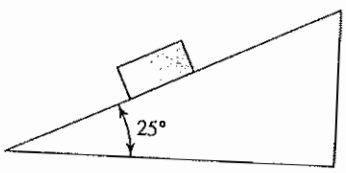
2. Two crates hang by ropes from a ceiling as shown. Construct a free-body diagram of (a) crate *A* and (b) crate *B*.



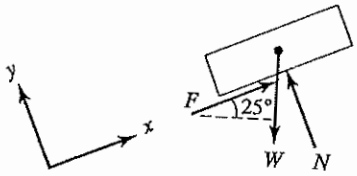
Answer:



3. A wooden block rests on a rough inclined plane as shown. Construct a free-body diagram of the block.



Answer:



4. An obliquely loaded I-beam is supported by a roller at A and a pin at B as shown. Construct a free-body diagram of the beam. Include the weight of the beam.