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|  | Freebody Diagrams |

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| While studying mechanics, when we examine the forces acting on an object their are five "classic" types that are usually considered:* weight
* normal
* friction
* tensions
* applied forces

 We use **freebody diagrams** to illustrate the magnitude and direction of all of the forces acting directly on a single object (usually represented by a rectangle). Consider a scenario in which a mass is being pulled across a table by a cord. mhtml:file://F:\Physics\FHS%20Unit%20Three%20--%20Force%20and%20Motion\PhysicsLAB%20Freebody%20Diagrams.mht!http://dev.physicslab.org/img/669545f2-8c7e-46c5-a734-93ee8ec6cc61.gifThe **weight vector** begins at the object's center of mass and points towards the center of the earth.  mhtml:file://F:\Physics\FHS%20Unit%20Three%20--%20Force%20and%20Motion\PhysicsLAB%20Freebody%20Diagrams.mht!http://dev.physicslab.org/img/4b99673f-0568-4c9d-9f1f-6f4d840e6393.gif A **normal vector** begins at the point of contact between the mass and its supporting surface. It is directed perpendicularly away from the surface and passes through the object's center of gravity. mhtml:file://F:\Physics\FHS%20Unit%20Three%20--%20Force%20and%20Motion\PhysicsLAB%20Freebody%20Diagrams.mht!http://dev.physicslab.org/img/cf5d1954-4bde-4243-b00a-56f009de4cc3.gif **Tensions** are forces conducted along strings, ropes, and wires. They begin at the point of contact and point in the direction in which they are pulling.  mhtml:file://F:\Physics\FHS%20Unit%20Three%20--%20Force%20and%20Motion\PhysicsLAB%20Freebody%20Diagrams.mht!http://dev.physicslab.org/img/5523856a-a8a3-4f08-84c9-593da7f3d0bf.gif **Friction forces** begin at the same point as the normal and act parallel to the sliding surface. They always oppose motion. mhtml:file://F:\Physics\FHS%20Unit%20Three%20--%20Force%20and%20Motion\PhysicsLAB%20Freebody%20Diagrams.mht!http://dev.physicslab.org/img/e0edddc2-c088-4043-91aa-bb1ccda92ffb.gif **Applied forces** is a catch-all, generic category encompassing any other interactions. In our current example, there are no generic applied forces.  If a force acts at an angle, then we usually work with its x- and y-components.mhtml:file://F:\Physics\FHS%20Unit%20Three%20--%20Force%20and%20Motion\PhysicsLAB%20Freebody%20Diagrams.mht!http://dev.physicslab.org/img/89176806-0f1f-4941-81f7-83381a569367.gifIf an object is in **static (at rest) or dynamic (constant velocity) equilibrium**, then all of the forces acting on it are balanced. * The magnitude of the forces acting to the left equals the magnitude of the forces acting to the right.
* The magnitude of the forces acting upwards equals the magnitude of the forces acting downwards.

mhtml:file://F:\Physics\FHS%20Unit%20Three%20--%20Force%20and%20Motion\PhysicsLAB%20Freebody%20Diagrams.mht!http://dev.physicslab.org/img/754dab73-ca05-4a51-9fac-92f154786b62.gifIn this case:  **x: f = T cos θ** **y: mhtml:file://F:\Physics\FHS%20Unit%20Three%20--%20Force%20and%20Motion\PhysicsLAB%20Freebody%20Diagrams.mht!http://dev.physicslab.org/img/78450b8d-b4af-43a9-9b7d-c0f44cfd4316.gif+ T sin θ = mg**  If the forces were not balanced, then the object would be **accelerated** in the direction of the unbalanced force. For example, using the same forces as in our previous example, if T cos θ were greater than f, then **Newton's Second Law** will allow us the ability to calculate the object's acceleration towards the right as it starts gaining speed.  net F = ma**T cos θ - f = ma (a > 0)**  However, if T cos θ were less than f, then the object would still move towards the right but it would be losing speed.net F = ma**T cos θ - f = ma (a < 0)**    |
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