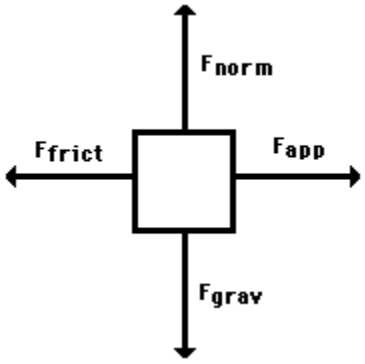
Drawing Free-Body Diagrams

Free-body diagrams are diagrams used to show the relative magnitude and direction of all forces acting upon an object in a given situation. The size of the arrow in a free-body diagram is reflects the magnitude of the force. The direction of the arrow shows the direction which the force is acting. Each force arrow in the diagram is labeled to indicate the exact type of force. It is generally customary in a free-body diagram to represent the object by a box and to draw the force arrow from the center of the box outward in the direction which the force is acting. An example of a free-body diagram is shown at the right.



The free-body diagram above depicts four forces acting upon the object. Objects do not necessarily always have four forces acting upon them. There will be cases in which the number of forces depicted by a free-body diagram will be one, two, or three. There is no hard and fast rule about the number of forces which must be drawn in a free-body diagram. The only *rule* for drawing free-body diagrams is to depict all the forces which exist for that object in the given situation.

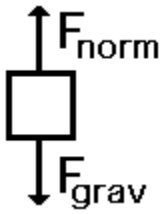
Free Body Diagrams Questions

Apply the method described in the paragraph above to construct free-body diagrams for the various situations described below. Answers are shown and explained at the bottom of this page.

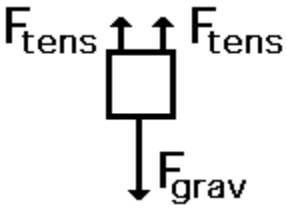
1. A book is at rest on a table top. Diagram the forces acting on the book.
2. A girl is suspended motionless from the ceiling by two ropes. Diagram the forces acting on the combination of girl and bar.
3. An egg is free-falling from a nest in a tree. Neglect air resistance. Diagram the forces acting on the egg as it is falling.
4. A flying squirrel is gliding (no *wing flaps*) from a tree to the ground at constant velocity. Consider air resistance. Diagram the forces acting on the squirrel.
5. A rightward force is applied to a book in order to move it across a desk with a rightward acceleration. Consider frictional forces. Neglect air resistance. Diagram the forces acting on the book.
6. A rightward force is applied to a book in order to move it across a desk at constant velocity. Consider frictional forces. Neglect air resistance. Diagram the forces acting on the book.
7. A college student rests a backpack upon his shoulder. The pack is suspended motionless by one strap from one shoulder. Diagram the vertical forces acting on the backpack.
8. A skydiver is descending with a constant velocity. Consider air resistance. Diagram the forces acting upon the skydiver.
9. A force is applied to the right to drag a sled across loosely-packed snow with a rightward acceleration. Diagram the forces acting upon the sled.
10. A football is moving upwards towards its peak after having been *booted* by the punter. Diagram the forces acting upon the football as it rises upward towards its peak.
11. A car is coasting to the right and slowing down. Diagram the forces acting upon the car.

Free Body Diagrams Answers

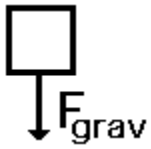
1. A book is at rest on a table top. A free-body diagram for this situation looks like this:



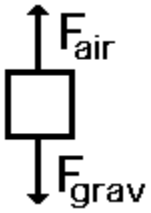
2. A girl is suspended motionless from the ceiling by two ropes. A free-body diagram for this situation looks like this:



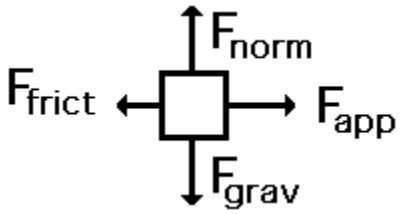
3. An egg is free-falling from a nest in a tree. Neglect air resistance. A free-body diagram for this situation looks like this:



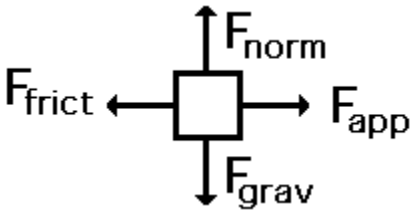
4. A flying squirrel is gliding (no *wing flaps*) from a tree to the ground at constant velocity. Consider air resistance. A free-body diagram for this situation looks like this:



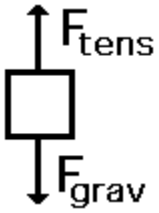
5. A rightward force is applied to a book in order to move it across a desk with a rightward acceleration. Consider frictional forces. Neglect air resistance. A free-body diagram for this situation looks like this:



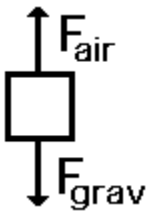
6. A rightward force is applied to a book in order to move it across a desk at constant velocity. Consider frictional forces. Neglect air resistance. A free-body diagram for this situation looks like this:



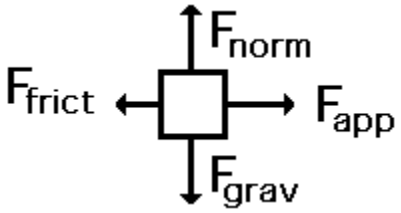
7. A college student rests a backpack upon his shoulder. The pack is suspended motionless by one strap from one shoulder. A free-body diagram for this situation looks like this:



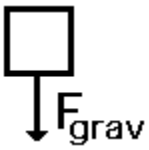
8. A skydiver is descending with a constant velocity. Consider air resistance. A free-body diagram for this situation looks like this:



9. A force is applied to the right to drag a sled across loosely-packed snow with a rightward acceleration. A free-body diagram for this situation looks like this:



10. A football is moving upwards towards its peak after having been *booted* by the punter. A free-body diagram for this situation looks like this:



11. A car is coasting to the right and slowing down. A free-body diagram for this situation looks like this: