… from Kinematics
to …

DYNAMICS

Chapter 5. Force and Motion
Chapter 6. Motion Along a Line
Chapter 7. Newton’s Third Law
Chapter 8. Motion in Plane

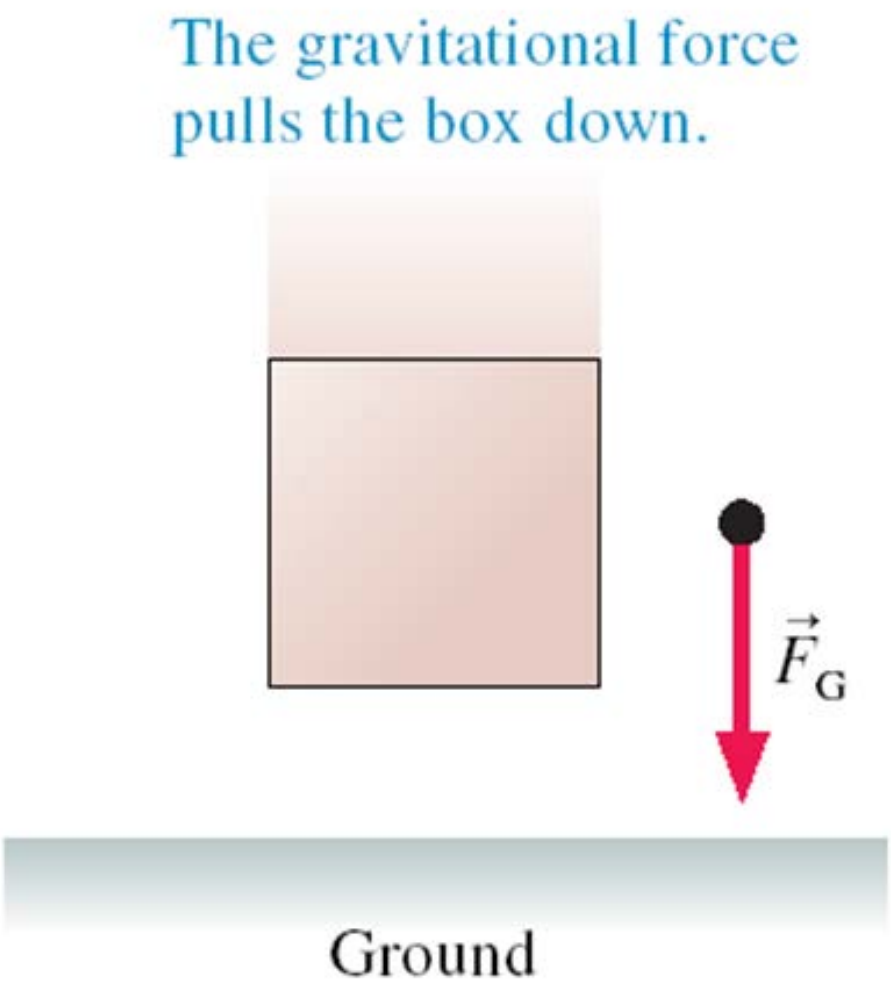
What is a force?

- A force is a push or a pull on an object.
- A force is a **vector**. It has both a magnitude and a direction.
- A force requires an agent. Something does the pushing or pulling.
- A force is either a **contact force** or a **long-range force**. **Gravity** is the only long-range force we will deal with until much later in the book.

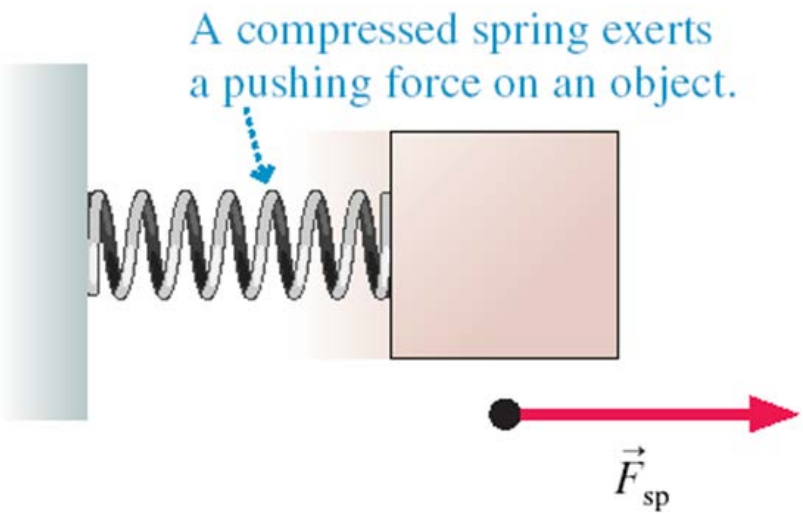
There are **4** *known* forces in nature

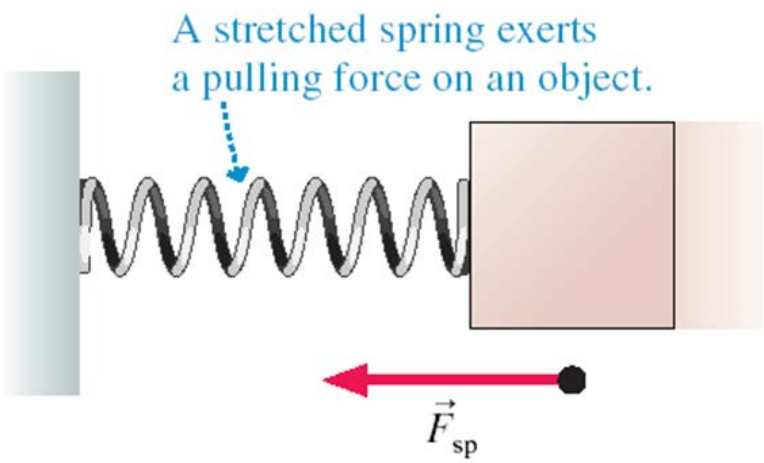
Interaction	Relative strength	Range (m)
Strong	10^{38}	10^{-15}
Weak	10^{36}	∞
Electromagnetic	10^{25}	10^{-18}
Gravity	1	∞

A short catalog of daily forces:
Gravity

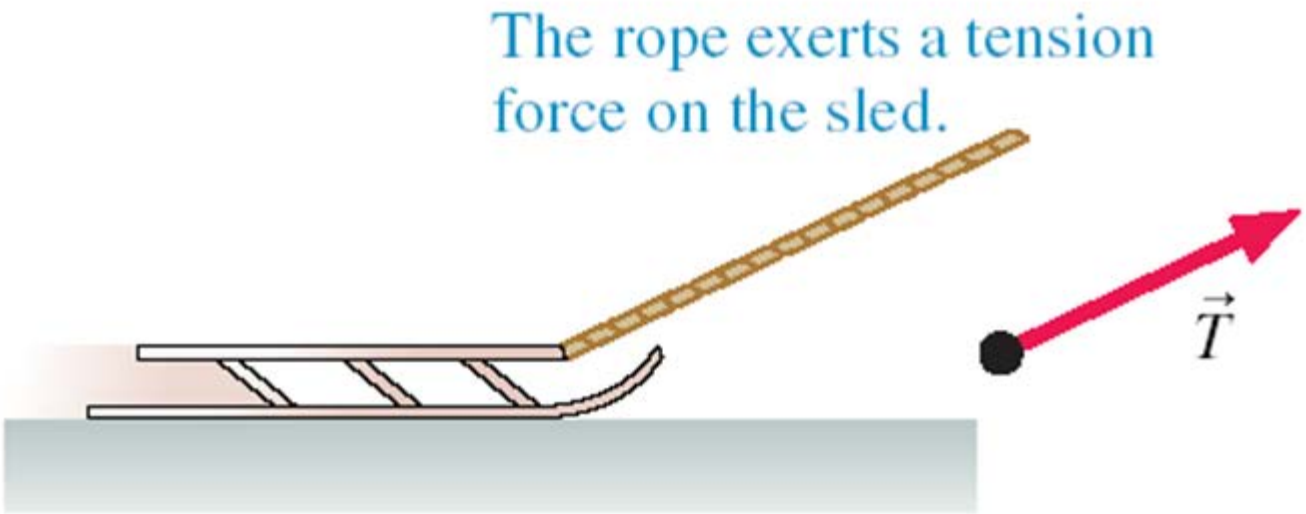


A short catalog of daily forces:
Spring Force





A short catalog of daily forces:
Tension



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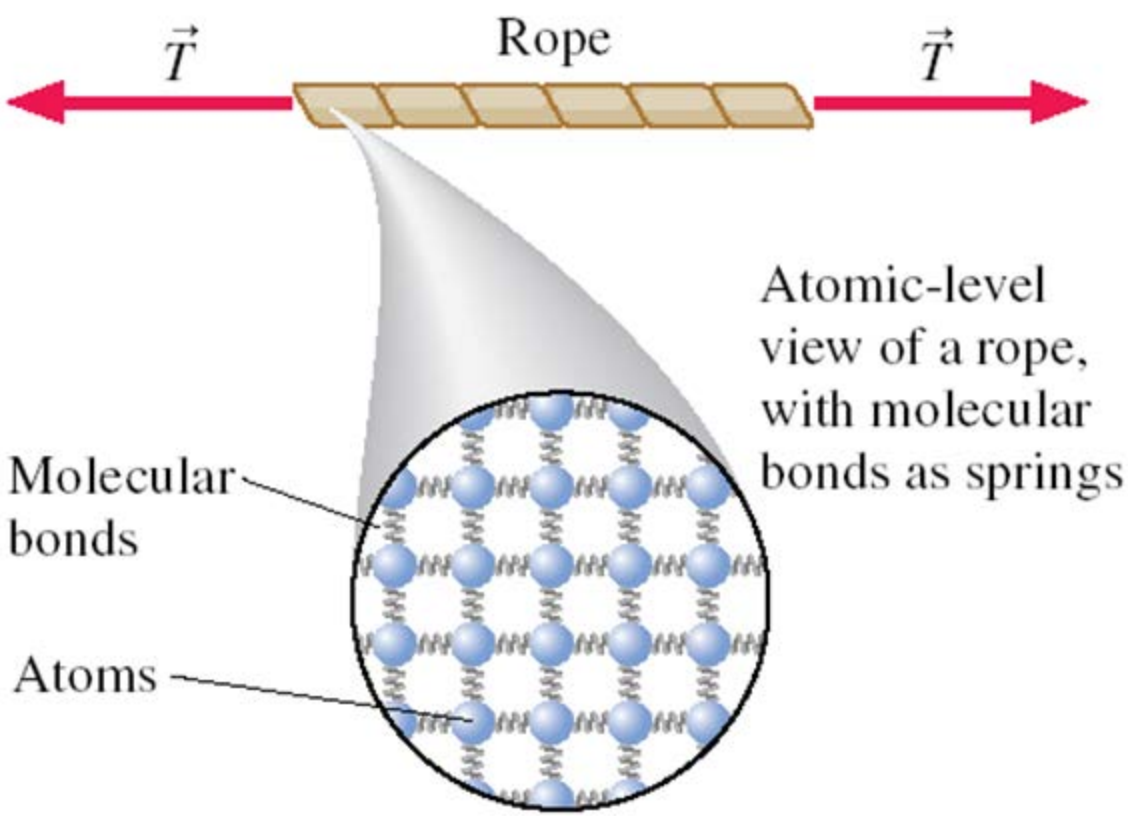
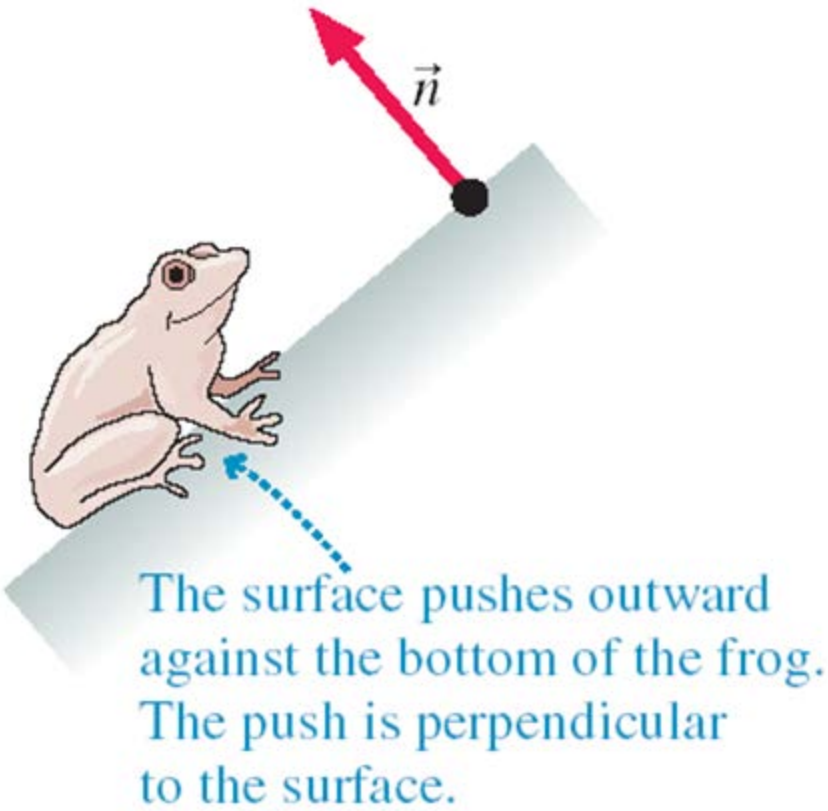
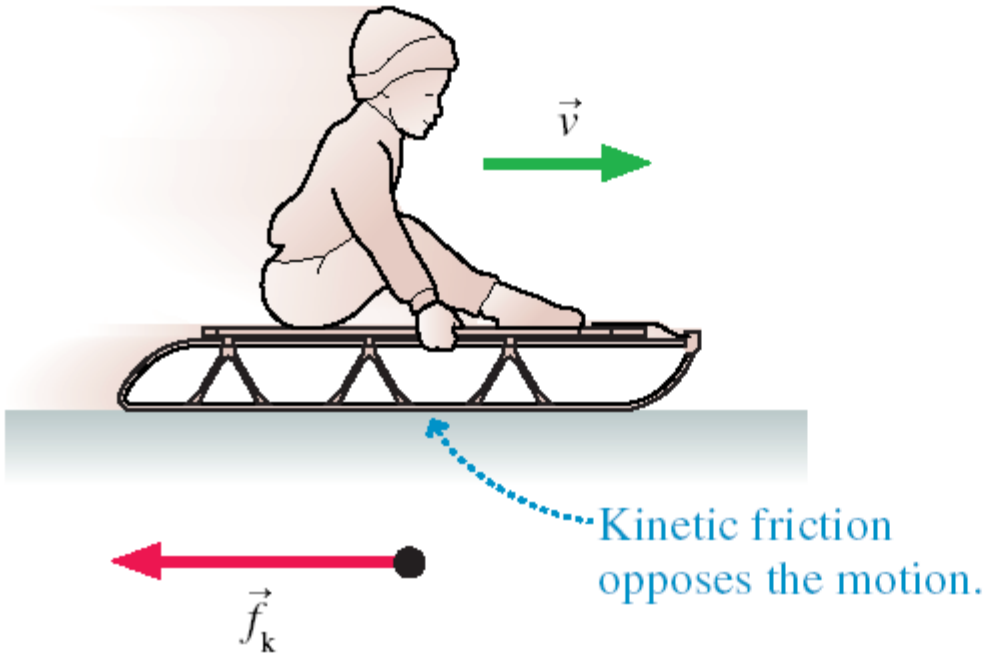
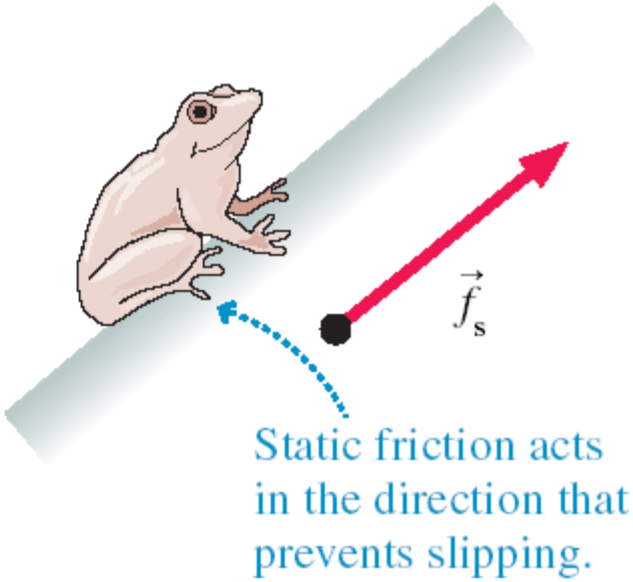


A short catalog of daily forces:
Normal Force



A short catalog of daily forces:
Kinetic and Static Friction





Newton's Laws

Newton's second law An object of mass m subjected to forces $\vec{F}_1$, $\vec{F}_2$, $\vec{F}_3$, . . . will undergo an acceleration $\vec{a}$ given by

$$\vec{a} = \frac{\vec{F}_{\text{net}}}{m} \tag{5.4}$$

where the net force $\vec{F}_{\text{net}} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \cdots$ is the vector sum of all forces acting on the object. The acceleration vector $\vec{a}$ points in the same direction as the net force vector $\vec{F}_{\text{net}}$.

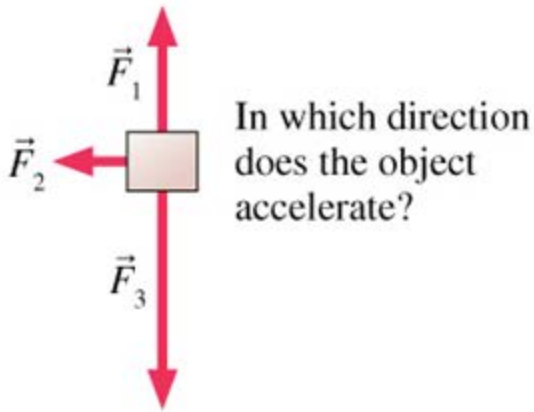
- **One Newton** (N) is the force that causes **1 kg** of mass to accelerate at **1 m/s/s**.

Newton's Laws

Newton's first law An object that is at rest will remain at rest, or an object that is moving will continue to move in a straight line with constant velocity, if and only if the net force acting on the object is zero.

- The tendency of an object to resist change in its velocity is called **mass**.
- Mass is an intrinsic property of an object.

Three forces act on an object. In which direction does the object accelerate?



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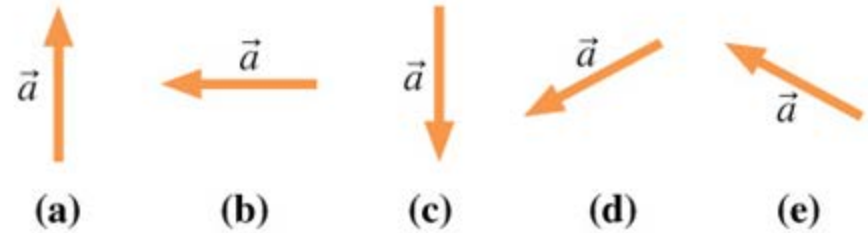

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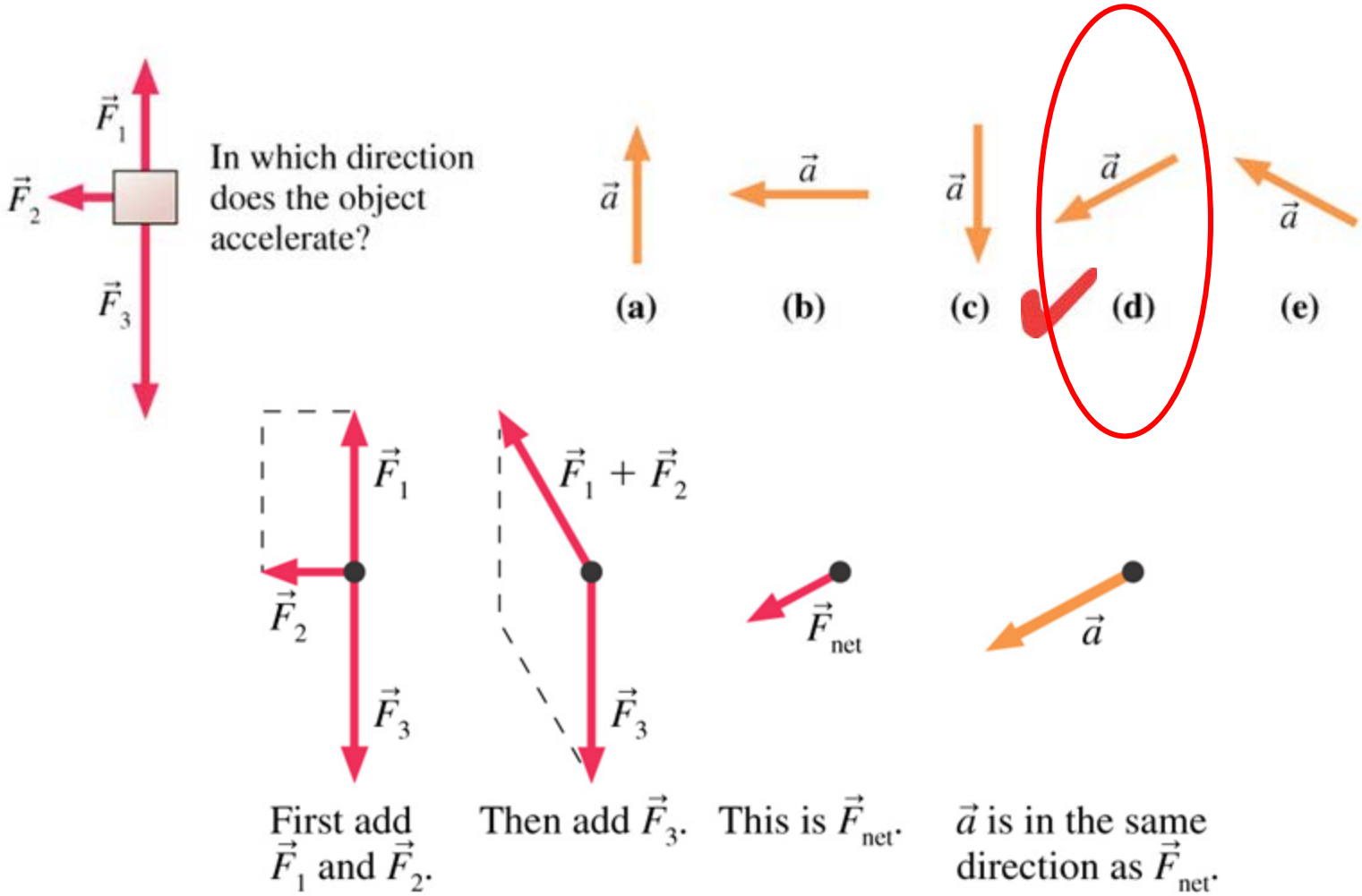
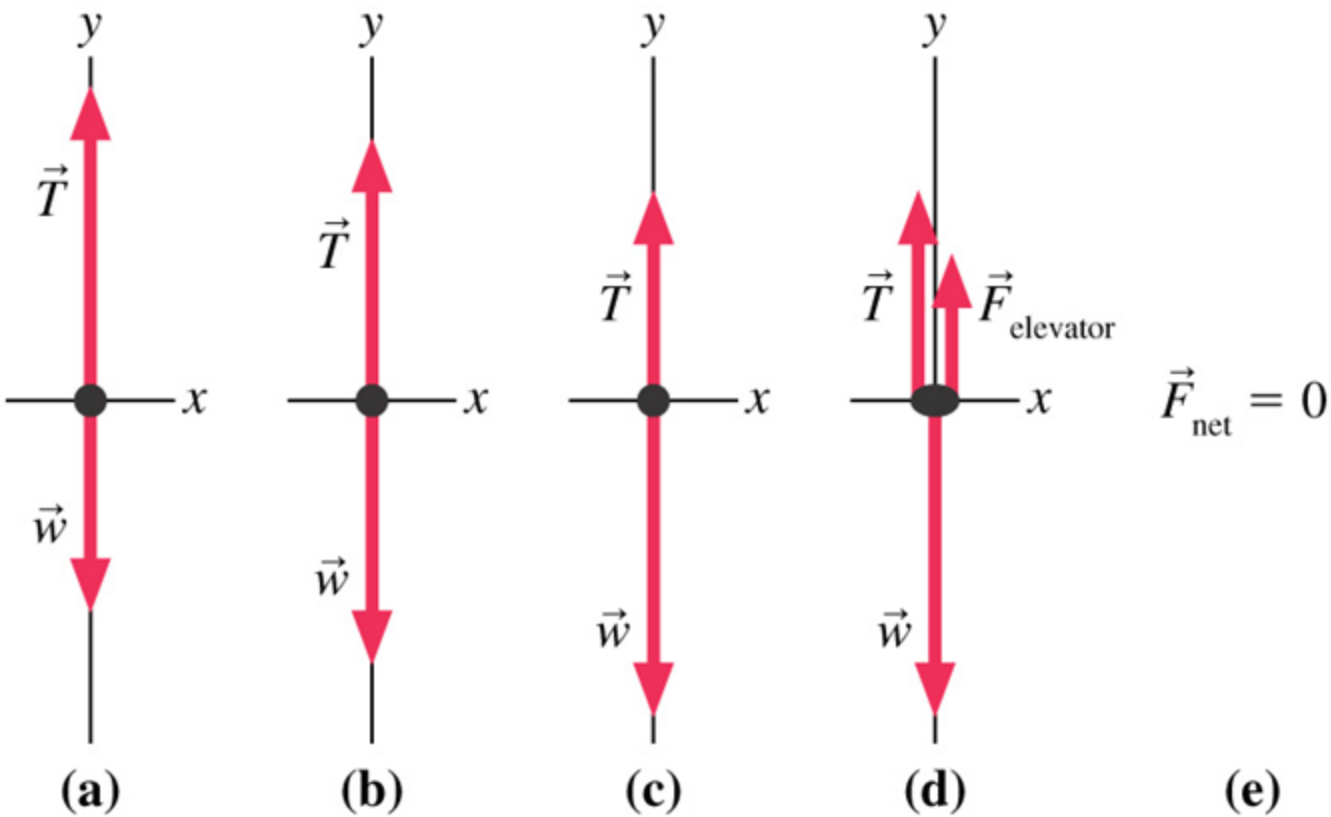
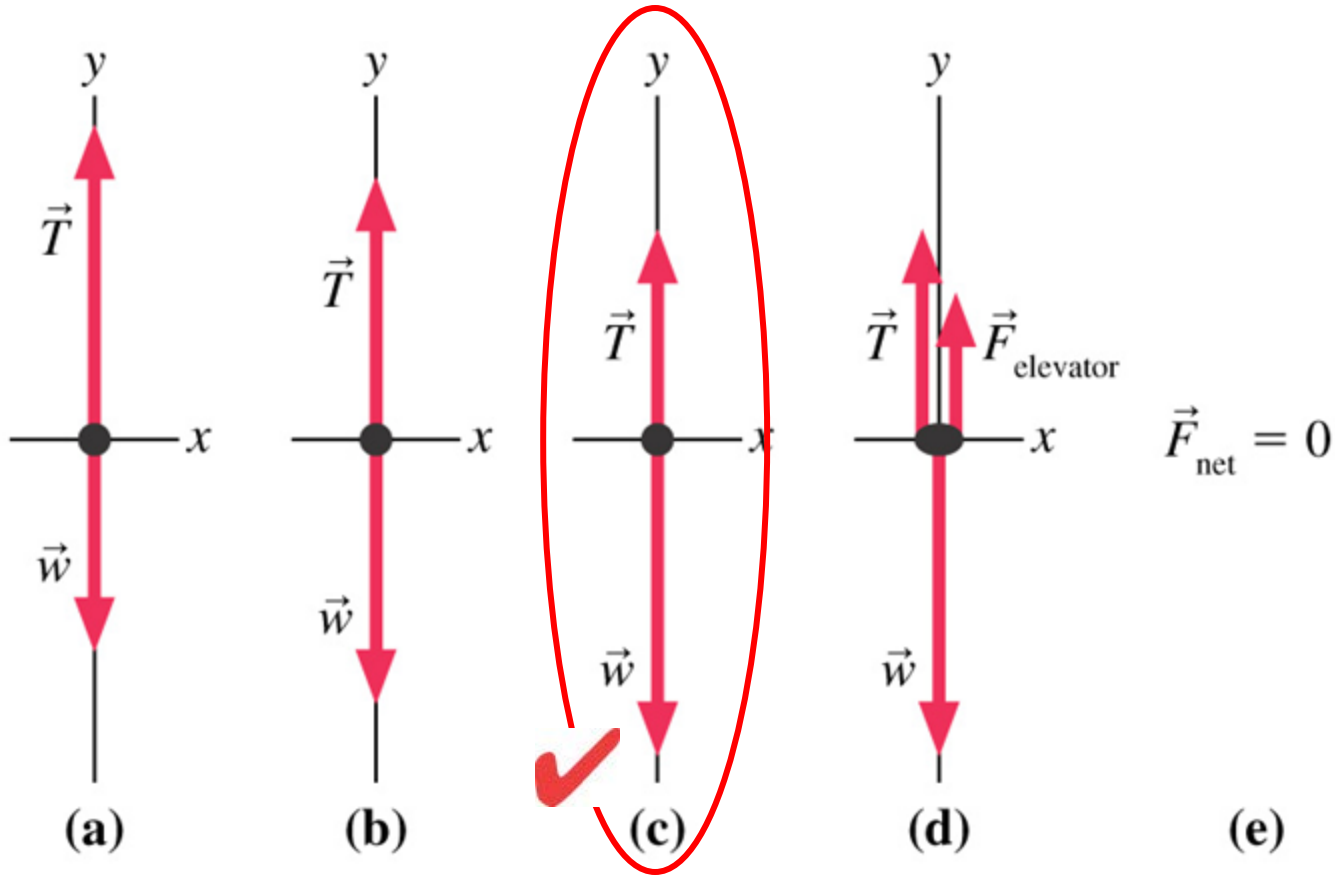


An elevator suspended by a cable is moving upward and slowing to a stop. Which free-body diagram is correct?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