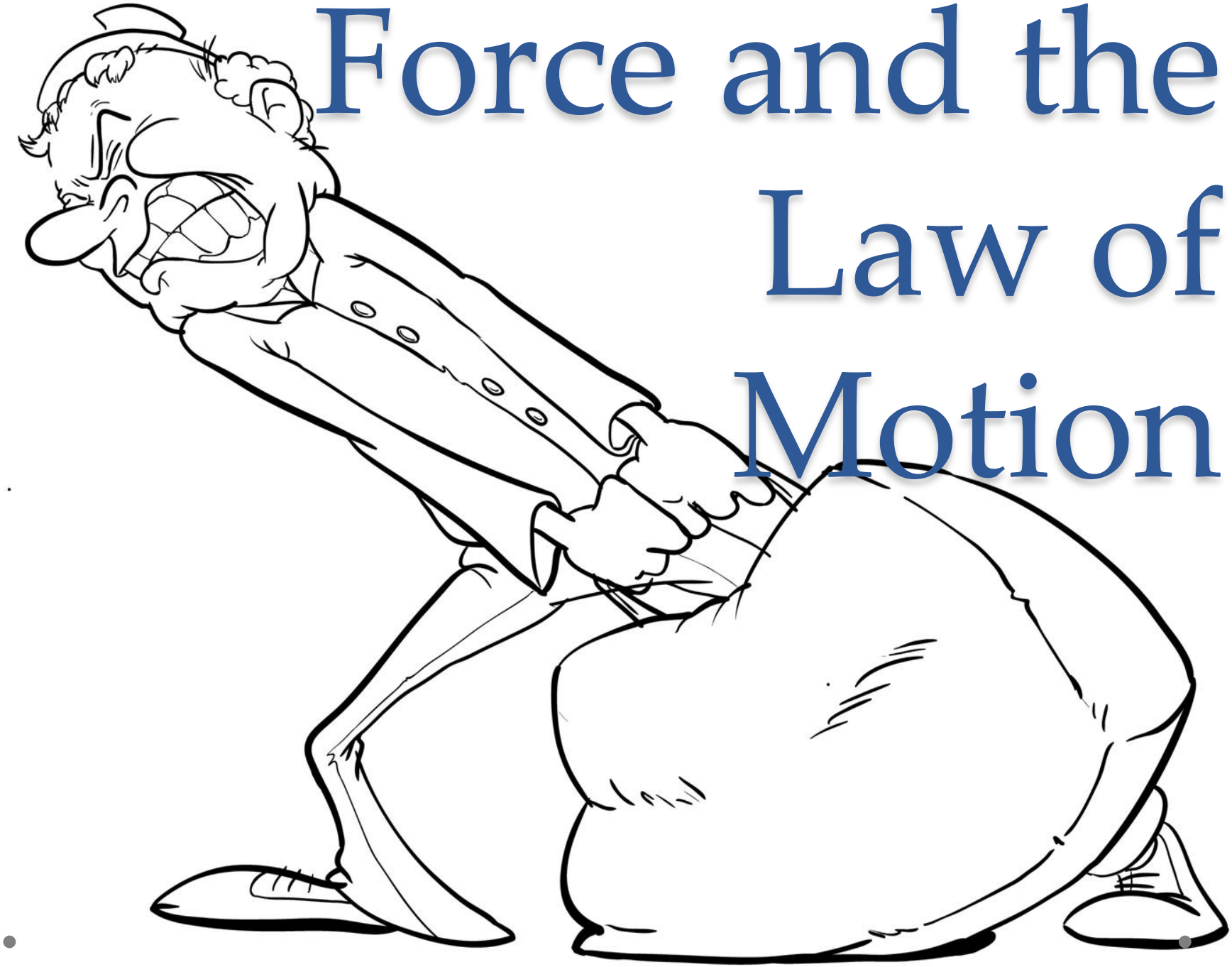
Force and the Law of Motion



Changes in Motion

- Force is an action exerted on an object in order to change the object's state of rest or motion

- Force is a vector:
  - It depends on magnitude and direction.

Forces

- Cause:
  - A stationary object to move
  - A moving object to stop
  - A moving object to change direction

Sir Isaac Newton

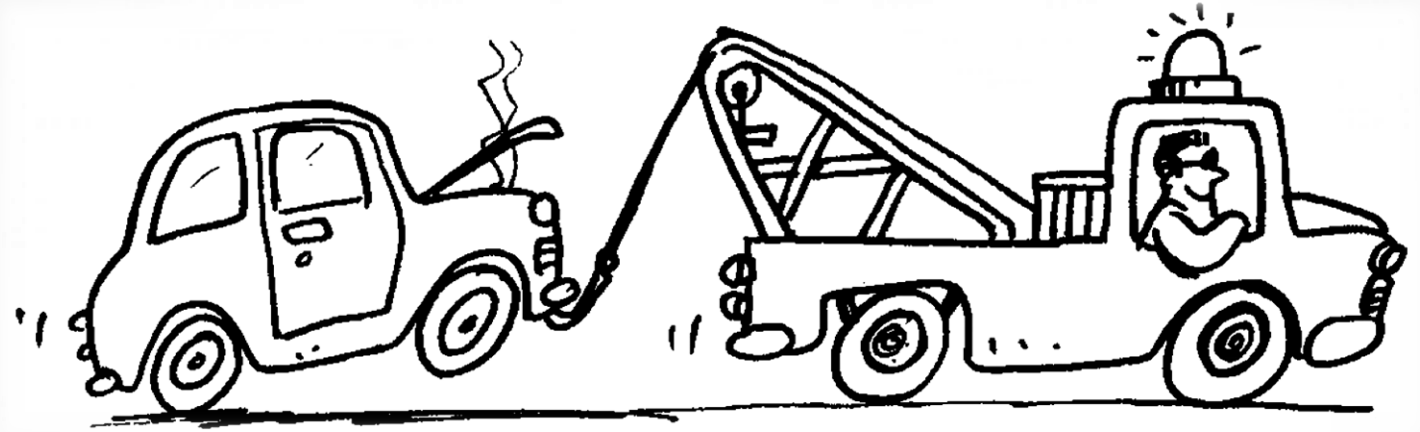
- Contributed major knowledge to the modern understanding of force and motion.
- A unit of Force is a **Newton**

1 N = 1 kg * 1m/s^2

Two Types of Forces

- Contact Forces
  - Physically Interacting objects
- Field Forces
  - Non-physical interaction between objects

Contact Forces



- Physical contact between objects.

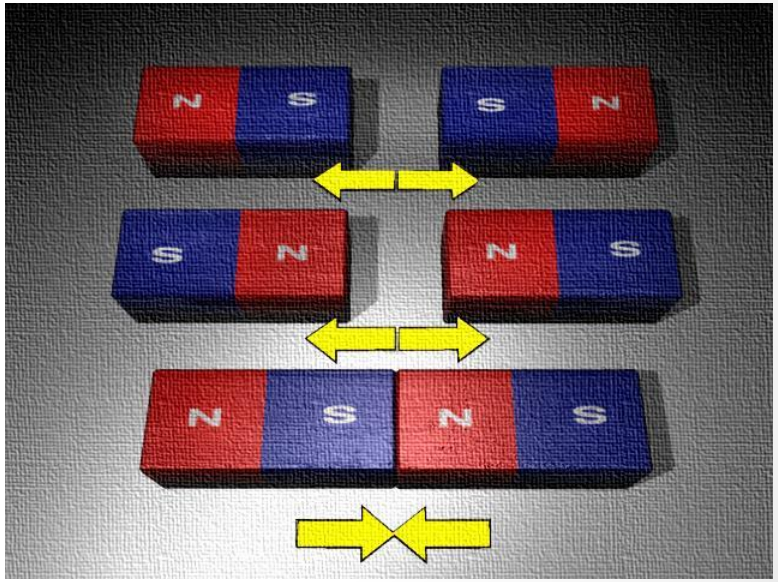
Examples

- Pull on a spring, it stretches.
- Push a cart, it moves.
- Catch a ball, it stops.

Field Forces

- Non-physical contact between objects

- Gravitation Force

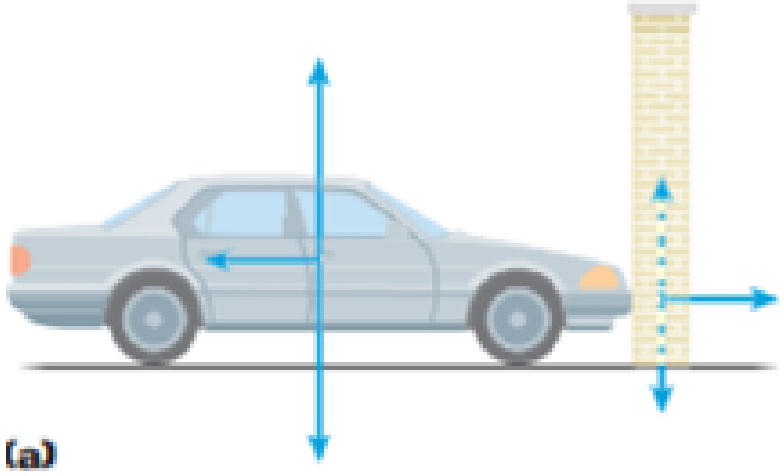


- Attraction through electrical charges

Diagram

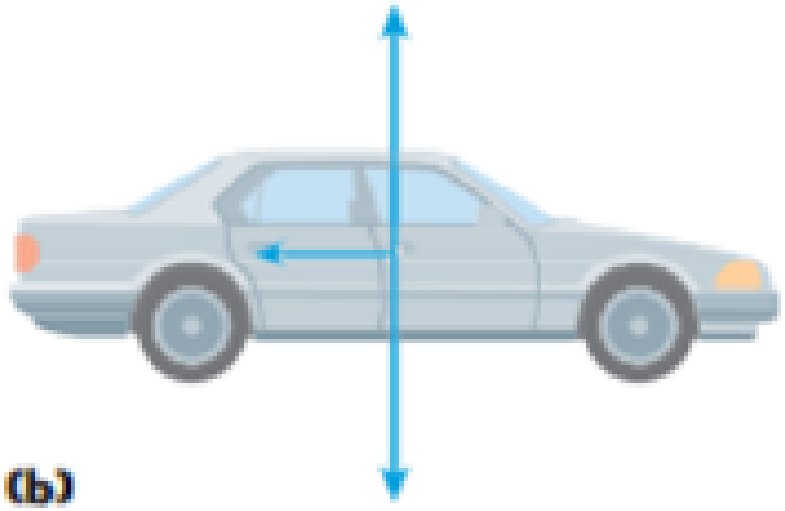
- In physics, Free-Body Diagrams are used for problems.
  - Only considers forces acting on the object.

Example of Free-Body Diagram



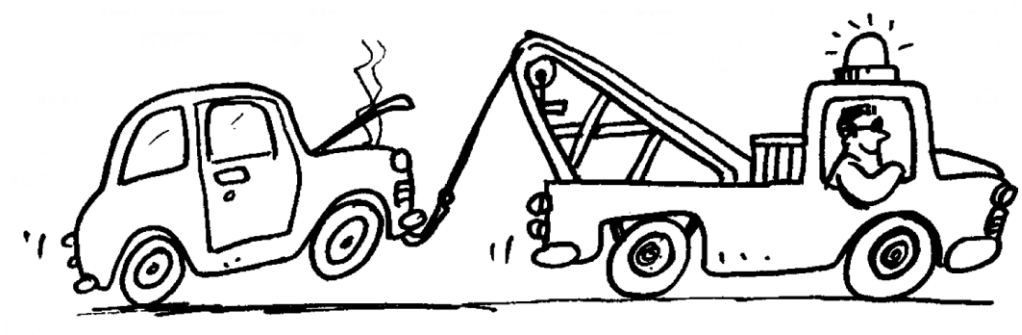
- Image shows:
  - Force of gravity on the car and wall(arrows down)
  - Normal Force on the car and wall (arrows up)
  - Force the car applies to the wall.
  - Forces the wall applies to the car.

Example of Free-Body Diagram



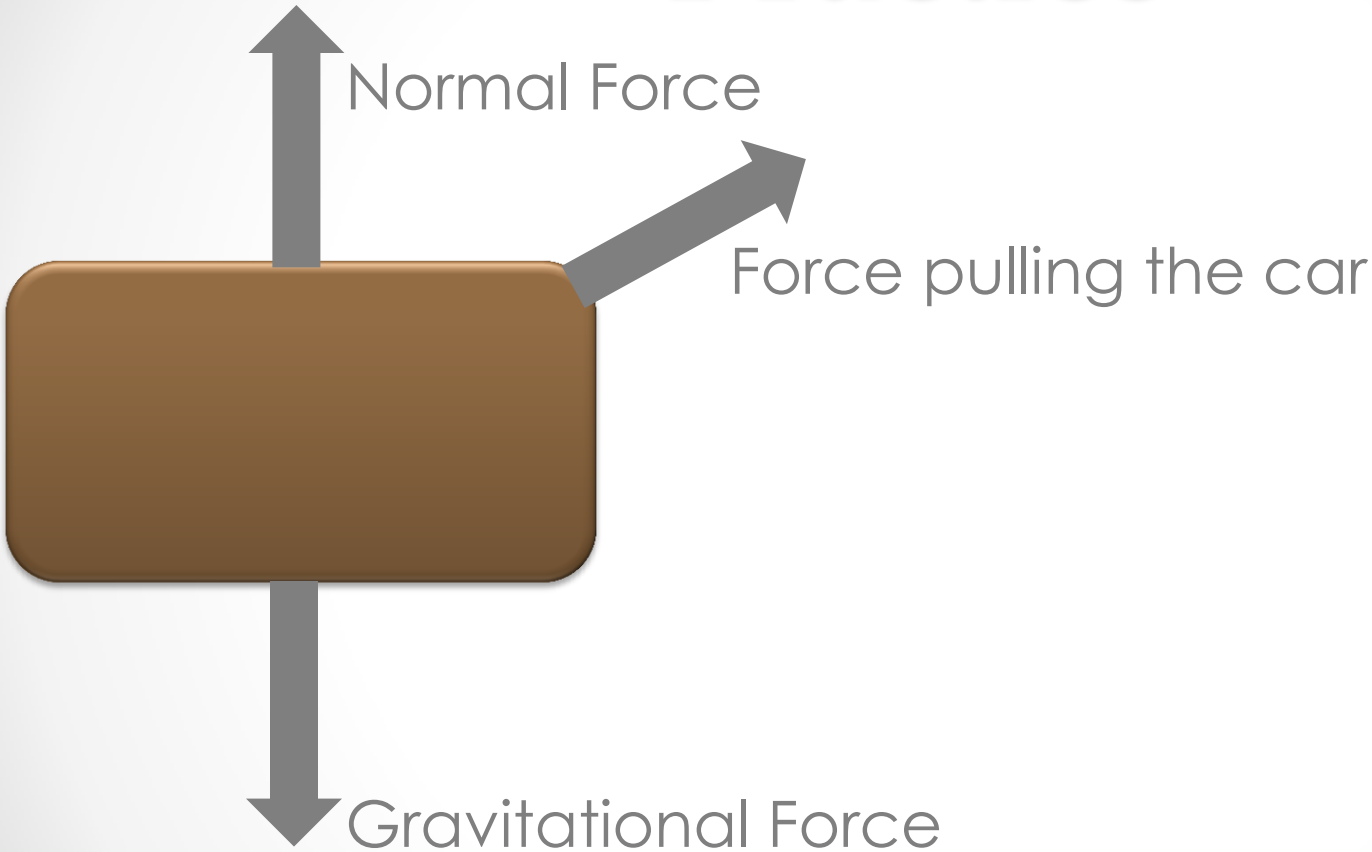
- Want to only consider forces on the car:
  - Force of gravity on the car (arrow down)
  - Normal Force on the car (arrow up)
  - Forces the wall applies to the car. (arrow to the left)

Practice



- Draw a Free-body diagram of the car.
- Consider forces applied on the car.
  - Gravity always exists, pushing down.
  - A normal force exerts to keep the car on the road.
  - Forces applied to pull the car.
- Simplify the picture.

Practice



Practice 2

Step 1: Read the question.

- A truck pulls a trailer on a flat stretch of road. The forces acting on the trailer are the force due to gravity (250 000 N downward), the force exerted by the road (250 000 N upward), and the force exerted by the cable connecting the trailer to the truck (20 000 N to the right).

Practice 2

Step 2: Identify the object and applied forces

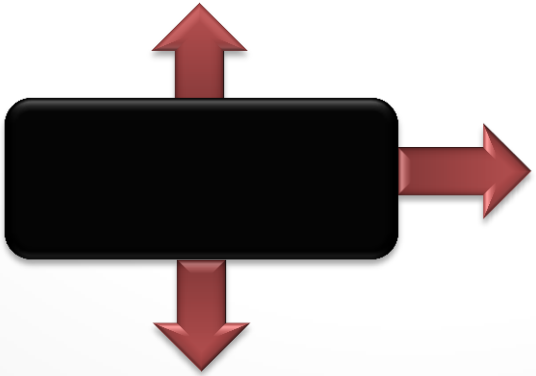
- A truck pulls a **trailer** on a flat stretch of road. The forces acting on the **trailer** are the **force due to gravity** (250 000 N downward), the **force exerted by the road** (250 000 N upward), and the **force exerted by the cable** connecting the trailer to the truck (20 000 N to the right).

Practice 2

Step 3: Draw a box (keep it simple)

Step 4: Draw arrows representing the forces

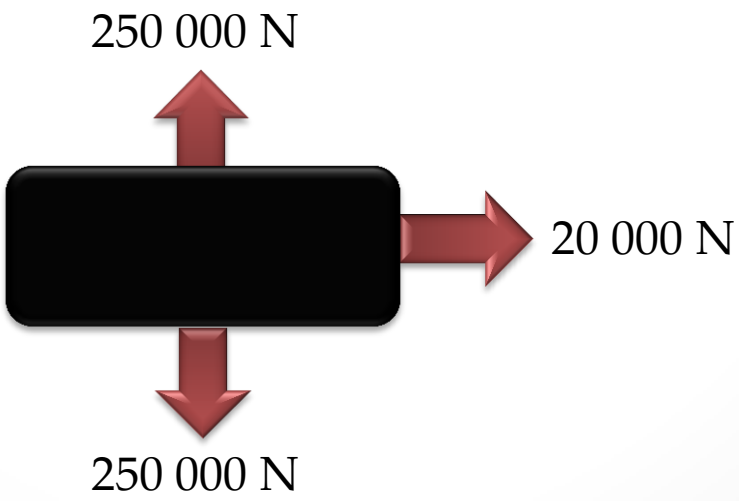
- **force due to gravity** (downward)
- **force exerted by the road** (upward)
- **force exerted by the cable** (to the right).



Practice 2

Step 5: Label the vectors with values

- **force due to gravity** (250 000 N downward)
- **force exerted by the road** (250 000 N upward)
- **force exerted by the cable** (20 000 N to the right).



- **Finished**

Try the following:

Bring these to school tomorrow:

1. 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.
2. A football is moving upwards towards its peak after having been *booted* by the punter. Neglect air resistance. Diagram the forces acting upon the football as it rises upward towards its peak.
3. A force is applied to the right to drag a sled across loosely packed snow with a rightward acceleration. Neglect air resistance. A free-body diagram for this situation looks like this.