Newton’s Third Law of Motion

by

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P3.3 Newton’s Third Law

Whenever one object exerts a force on another object, a force equal in magnitude and opposite in direction is exerted back on the first object.

P3.3A Identify the action and reaction force from examples of forces in everyday situations (e.g., book on a table, walking across the floor, pushing open a door).

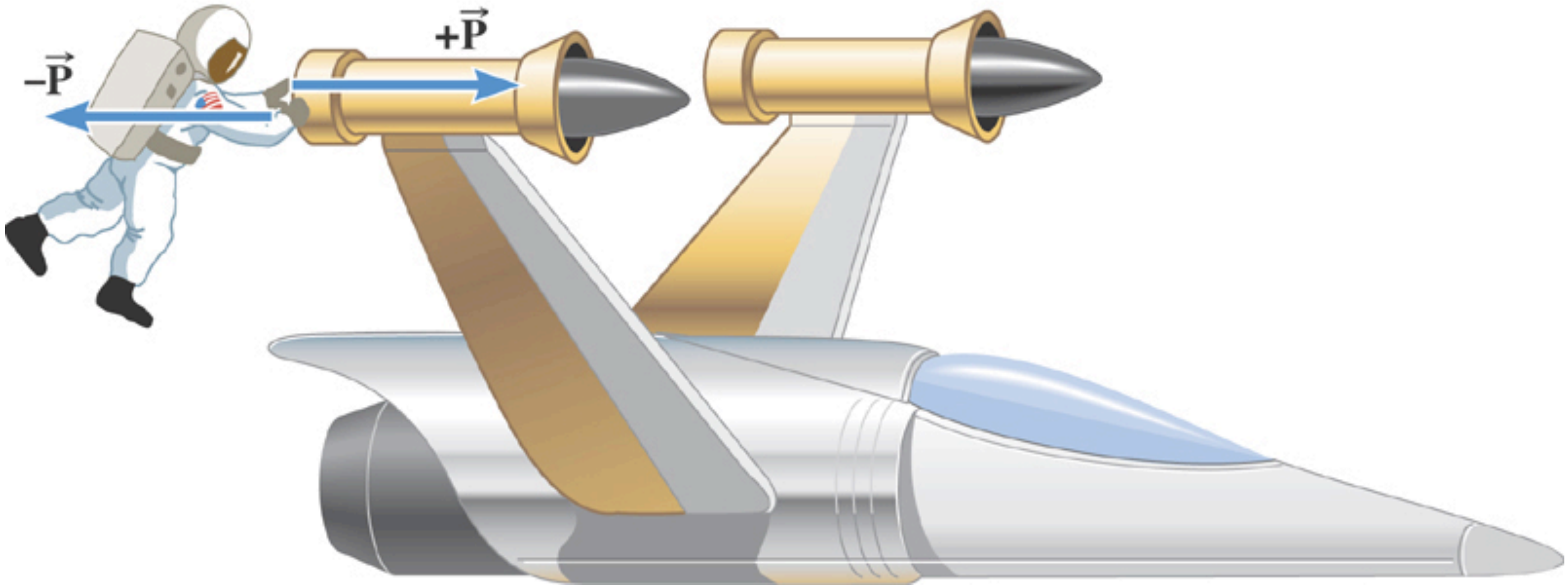
P3.4B Identify forces acting on objects moving with constant velocity (e.g., cars on a highway).

Newton’s Third Law of Motion

All forces come in pairs.

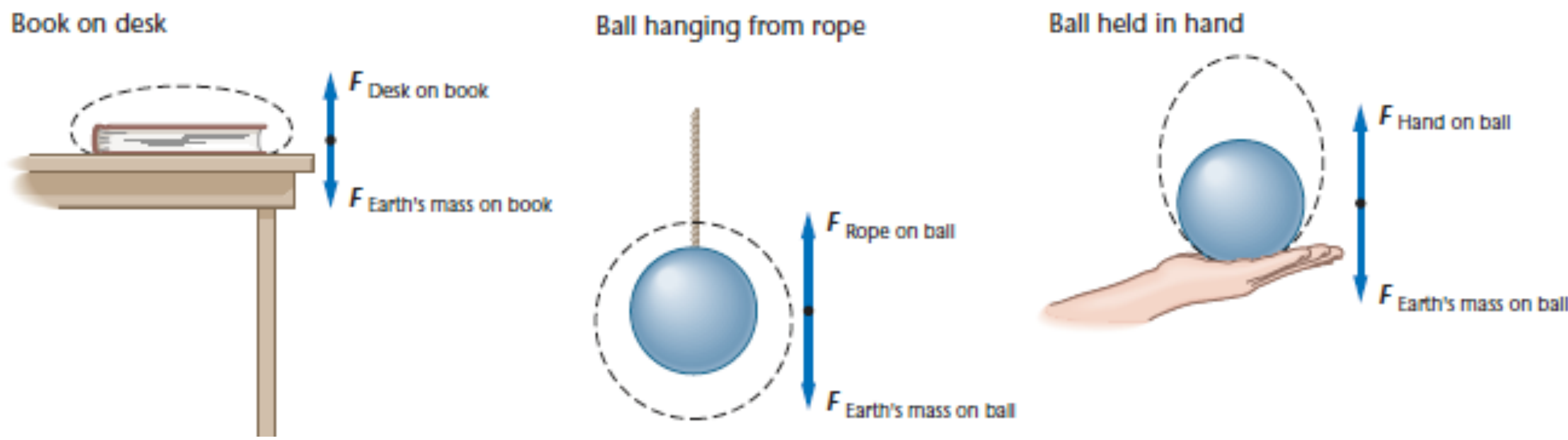
Whenever one body exerts a force on a second body, the second body exerts an oppositely directed force of equal magnitude on the first body.

The two forces are called interaction pairs. They are called sometimes Action-Reaction pairs of forces.

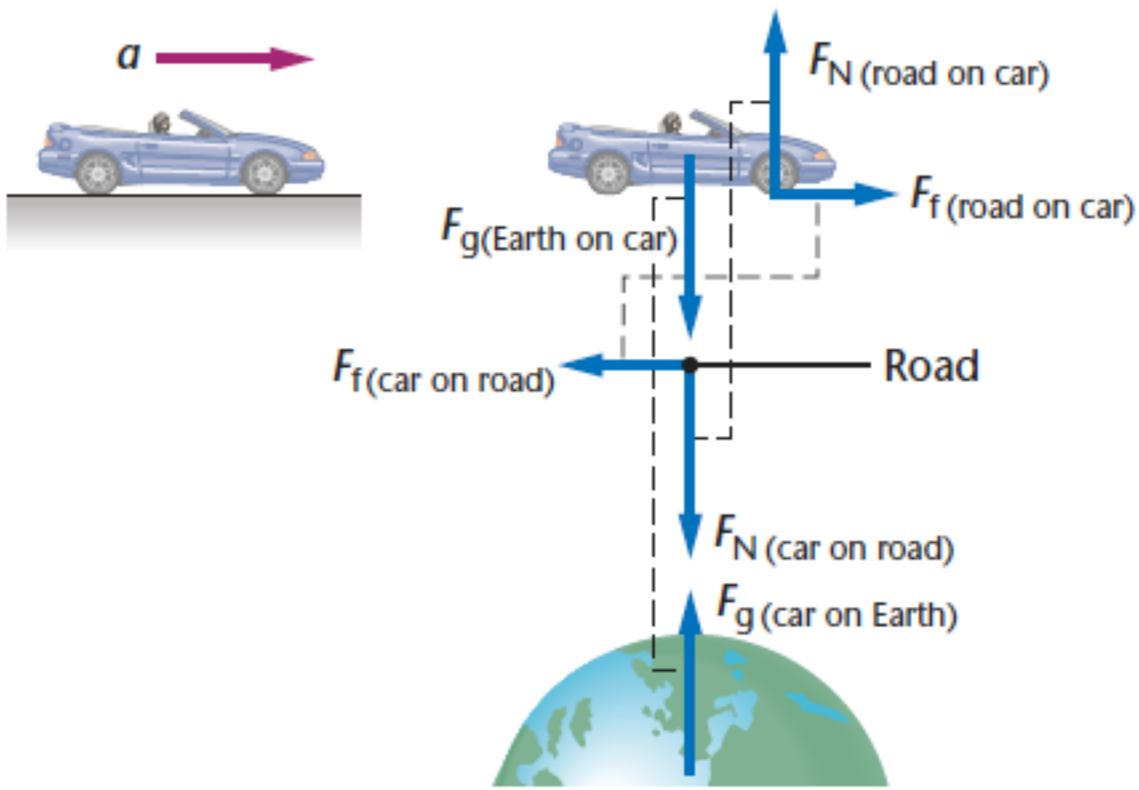


An astronaut pushes on the spacecraft with some force **P**. The spacecraft pushes back on the astronaut with the same force **P** in the opposite direction. So, if the astronaut pushes with a force P = 36 N, the space craft pushes back with a force P = -36 N.

Equilibrium: An object is in equilibrium when it has zero acceleration. The F net acting on it is zero.



2. The Newton Third Law of Motion explain how ***a car accelerates on the highway***.



In the diagram, you can identify three interaction pairs of force. Each pair is connected with a dashed line. Assume that the upward direction (North) is positive, also, the forward direction (east) is also positive.

Example: If the car exerts a normal force on the road directed downward, $- F_{N \text{ (car on the road)}}$, then, the road must exert equal forces on the car and in the opposite upward direction, $+ F_{N \text{ (car on the road)}}$.

$$F_{net} = + F_{N \text{ (car on the road)}} - F_{N \text{ (car on the road)}} = 0N$$

a. Identify each pair of the other forces in the diagram.

b. Which force is responsible for moving the car forward?

c. Why is it hard for a car to accelerate on ice?

3. *The Motion of Water Skier*

The figure below shows a water skier at four different moments:

a) The skier is floating motionless in the water,

b) The skier is being pulled out of the water and up onto the skis.

c) The skier is moving at a constant speed along a straight line.

d) The skier has let go the tow rope and is slowing down.

For each moment, explain whether the net force , F net, acting on the skier is Zero.

Remember: if acceleration = 0 m/s^2, then F net = 0 N, then the skier is in equilibrium.

Acceleration is zero, when the speed does not change over a period of time.