Learning Intentions

- Learn Newton's First and Third Laws of Motion.
- Learn what causes the normal force.
- Learn how to calculate the force of friction and the coefficient of friction.

Definitions and Formulas

1. Newton's First Law: If the net force on an object is _____, the object will remain at _____ or will continue in uniform motion in a _____ _____.
    a. Also known as the Law of _____.
2. Newton's Third Law: In every interaction between two objects, the _____ force exerted on one object is _____ and _____ to the _____ force on the other object.
    a. Also known as the Law of _____ and _____.
3. The _____ force is the "pushing" force that arises when two surfaces are pushed together.
    a. The force is caused by _____ _____ of the electrons on the two surfaces.
    b. A normal line is _____ (at a _____ degree angle) to a given surface.
    c. If there is too much force applied against a surface, the surface will _____ .

4. _____ is the "pulling" force that acts _____ the motion (or intended motion) of an object.

5. In Physics 11, we use a very simple mathematical model for the incredibly complex interaction between the two surfaces. The _____ of _____ friction is used between two non-moving surfaces, and the _____ of _____ friction is used when the two surfaces are sliding past each other.
    a. The _____ of _____ friction is always larger than the _____ of _____ friction.
    b. In more advanced _____ (the study of friction), Strybeck curves are used to calculate the coefficient of friction. In this situation, the coefficient of friction depends on the _____ _____ of the two interacting surfaces.

6. The _____-_____ phenomenon can causes objects to stutter or jerk when the object is at the threshold of movement.

Questions

1. A 25 kg child sits on the ground, watching clouds float by at 12 km/h. Draw a free-body diagram of the child. What is the net force on the child?
2. A 10 kg cat is sliding to the right at a constant velocity of 3 m/s [E] across a frictionless floor. Draw a free-body diagram of the cat. What is the net force on the cat?
3. A fully-fueled Airbus A380 plane has a mass of 570,000 kg. Shortly after takeoff, it is flying at a constant velocity of 1,020 km/h [W]. Draw a free-body diagram of the plane. What is the net force on the plane?
4. A snowboarder rides down a 35 degree slope at a constant velocity of 42 km/h. Draw a free-body diagram of the snowboarder. What is the net force on the snowboarder?
5. A box with a weight of 300 N is sitting on the floor. Someone pushes on the box with a horizontal force of 20 N, causing it to almost start moving. Draw a free body diagram of the box. What is the coefficient of static friction between the box and the floor?
6. Is it possible for the action force of boxer A hitting boxer B to exceed the reaction force of Boxer B pushing back on boxer A? How does a boxer win a fight?
7. A sailor is adrift in the middle of the ocean, on a windless day. He makes a fan, and creates a southerly breeze into his sail. In what direction will he move?
8. A scientist claims he can cause the Earth to move by jumping up and down. Is he correct?
9. In Stephen Seagal's 2016 movie "Contract to Kill", a machine gun is mounted on a small drone copter. Why would this not work in real life?
   https://youtu.be/9mYwPuSOST8?t=1280 (watch from 21:20 to 22:40)

See over →

Answers

1. $\mathbf{F}_{\mathbf{net}} = 0$ N
2. $\mathbf{F}_{\mathbf{net}} = 0$ N
3. $\mathbf{F}_{\mathbf{net}} = 0$ N
4. $\mathbf{F}_{\mathbf{net}} = 0$ N
5. $\mu = 0.067$
6. No. They win a fight by exerting force on parts of their body that can take a lot of force (their hands) and on parts of their opponent’s body that cannot take a lot of force (the head and stomach)
7. He will not move.
8. Yes, but the movement will be negligible.
9. The reaction force backwards from firing a gun would destabilize the drone.