Name: Key

Notes - 4.4 Newton's Third Law of Motion: Symmetry in Forces

1. State Newton's 3rd Law of Motion. When one body exerts a force on another, the other body exerts an equal and opposite force on the first body.

2. Forces always occur in pairs, and one body cannot exert a force on another without experiencing a force itself. This is sometimes referred to as action-reaction.

3. Consider the swimmer pushing off from the side of a pool in Figure 4.9. She pushes against the pool wall with her feet and accelerates in the direction opposite to that of her push. The wall has exerted an equal and opposite force back on the swimmer. Why does the swimmer accelerate? Don't these two forces cancel each other out?

Only the wall's force pushes her, so she experiences a net force (and so she will accelerate). The forces (her push and the wall's push) would only cancel if they were acting on the same object.

4. Describe some other examples of Newton's 3rd Law.

Walking: Foot pushes ground backward; ground pushes foot forward.

Car: Tire pushes road backward; road pushes tire forward

Helicopter: Blades push air downward; air pushes blades upward

5. Rockets

A. What is the common misconception regarding rocket propulsion? What is the reality? People think rockets push against the air, but rockets really push their own exhaust backward (so it pushes them forward)

B. What observation disproves this misconception?

Rockets can accelerate in outer space, where there is no air to push

Notes - 5.1 Friction

1. What is friction? A force opposing the relative motion of 2 objects that are in contact with one another.

2. When there is relative motion between objects in contact, the friction is called Kinetic friction. Its symbol is μ_k.

3. When there is no motion between objects in contact, the friction is called Static friction. Its symbol is μ_s.

4. The harder two objects are pushed together, the greater the friction becomes.

5. Write the equation for the magnitude of static friction. $F_{fs} \leq \mu_s F_N$ (Force → friction; Normal force)

6. Write the equation for the magnitude of kinetic friction. $F_{fk} = \mu_k F_N$ (f_s → static)

7. Looking at Table 5.1, which coefficient of friction is greater, static or kinetic?

8. From Table 5.1, give the three highest examples of the coefficient of static friction.
   Rubber on dry concrete 1.0
   Shoes on wood 0.9
   Rubber on wet concrete 0.7

9. From Table 5.1, give the three lowest examples of the coefficient of kinetic friction.
   Bone lubricated with synovial fluid 0.015
   Steel on ice 0.02
   Steel on steel (oiled) 0.03

10. A skier is sliding along a horizontal field of snow If the overall of mass of the skier plus her skis is 62kg, and if ~~she is experiencing~~ a 30N force of friction, what is the coefficient of friction between the skis and the snow? Is this static or kinetic friction?

$F_{fk} = \mu_k F_N$

$30N = \mu_k (608N)$

$\mu_k = 0.049$ ← No units (coefficients don't have units!)