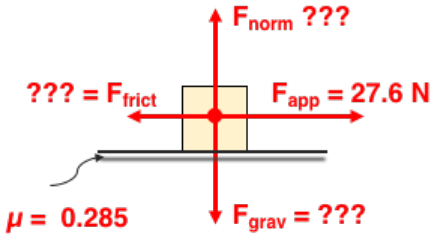
Video Notes for Solving $F_{net} = m \cdot a$ Problems

Example Problem:

A 27.6-N rightward force is applied to accelerate a 4.80-kg box across the floor (μ = 0.285). Fill in all the blanks and determine the acceleration of the box.



m = 4.80 kg

a = ???

F_{net} = ???

Central Questions:

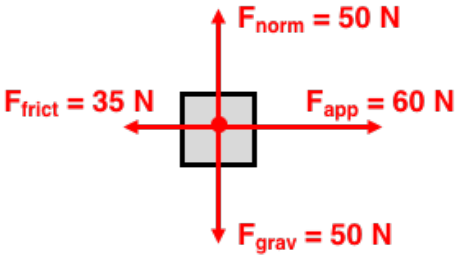
- How do you use the Newton's Second Law equation to analyze and solve for acceleration?

Newton's Second Law Equation:

The Newton's Second Law expresses the relationship between acceleration (a), net force (F_{net}), and mass (m).

$$F_{net} = m \cdot a$$

Important Mathematical Relationships



F_{net} = 25 N

1. The net force is the combined effect of all individual forces. It is often determined from a force diagram. In this diagram, the up and down cancel each other's effect. But the right force is 25 N larger than the left force. So F_{net} is 25 N; it's direction is to the right.
2. The down force can be calculated using the equation $F_{grav} = m \cdot g$ where g = 9.8 N/kg.
3. Vertical forces balance when there is no vertical acceleration. This allows you to equate the up force with F_{grav}.
4. The force of friction (F_{frict}) can be calculated from the normal force (F_{norm}) and the coefficient of friction (μ) using $F_{frict} = \mu \cdot F_{norm}$.

Two Types of Problems:

Type 1:

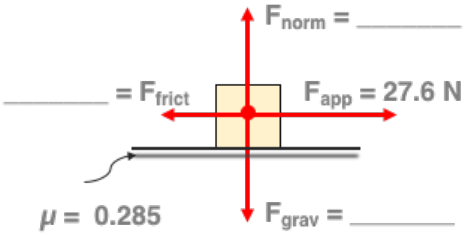
Given: mass and individual force values.
Calculate: Acceleration
Strategy: Use force values to calculate F_{net}. Then use Newton's Second Law equation to calculate acceleration.

Type 2:

Given: mass, acceleration, and some force values
Calculate: an unknown force value
s: Use m and a to calculate F_{net}. Then calculate unknown force using F_{net} and other force values.

Type 1 Example: Solving for Acceleration

A 27.6-N rightward force is applied to accelerate a 4.80-kg box across the floor (μ = 0.285). Fill in all the blanks and determine the acceleration of the box.



m = 4.80 kg

a = _____

Fnet = _____

F_{grav} = (4.80 kg)•(9.8 N/kg) = 47.0 N

Since vertical forces balance:
$F_{norm} = F_{grav}$ = 47.0 N

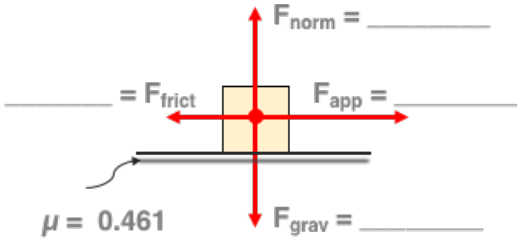
$F_{frict} = \mu \cdot F_{norm}$ = (0.285)•(47.0 N) = 13.4 N

F_{net} = 27.6 N - 13.4 N = 14.2 N, →

a = F_{net}/m = (14.2 N)/(4.80 kg) = 2.96 m/s^2, →

Type 2 Example: Solving for Individual Force

A rightward force is applied to accelerate a 24.6-kg box across the floor (μ = 0.461) with a rightward acceleration of 1.39 m/s^2. Fill in all the blanks and determine the applied force value.



m = 24.6 kg

a = 1.39 m/s^2, →

Fnet = _____

F_{grav} = (24.6 kg)•(9.8 N/kg) = 241 N

Since vertical forces balance:
$F_{norm} = F_{grav}$ = 241 N

$F_{frict} = \mu \cdot F_{norm}$ = (0.461)•(241 N) = 11 N

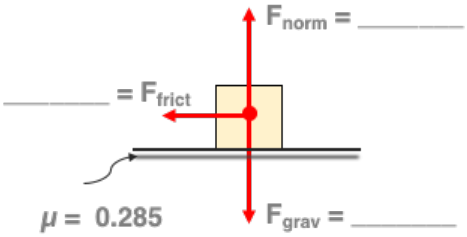
F_{net} = m•a = (24.6 kg)•(1.39 m/s^2)
F_{net} = 34 N, →

$F_{app} = F_{frict} + F_{net}$ = 111 N + 34 N = **145 N**

What if There are 3 Forces?

The leftward force is not balanced. It is equal to the net force (F_{net}).

This simplifies the math.



m = 4.80 kg

a = _____

Fnet = _____