Newton's 2nd Law of Motion (Law of acceleration)

Note Taking Guide - Episode 402

An object will accelerate in the direction of the net force exerted on it.

Conclusions from experiment:

"a" $\propto$ $a \propto F_{net}$

"F_{net}" and "a" are "Fnet" and "a" are directly proportional

"a" $\propto$ $a \propto \frac{1}{m}$

"m" and "a" are "m" and "a" are inversely proportional

Newton's 2nd Law:

- When a net force is exerted on a object, the object accelerates in the direction of the net force.
- Acceleration is directly proportional to force and inversely proportional to mass.

equation for the law: $\boxed{a = \frac{F_{net}}{m}}$ $F_{net} = m \cdot a$

F_{net} and a are in the same direction. (Show this with arrows: $\vec{F}_{net} = m\vec{a}$)

Insert units for "m" and "a" $F_{net} = kg \times \frac{m}{s^2}$

1 N = force required to accelerate a mass of 1 kg 1 $\frac{m}{s^2}$

In fundamental units, 1N = $\frac{1kg \cdot 1m}{s^2}$

Problem Set #1: Force and acceleration

1. $m = 1400\ kg$, $a = 1.5\ m/s^2$; $F_{net} = ?$

$F_{net} = m \cdot a$

$F_{net} = 14000kg \cdot 1.5 m/s^2$

$\boxed{F_{net} = 2100N}$

2. $F = 18N$, $a = 17\ m/s^2$; $m = ?$

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

$m = \frac{18N}{17 m/s^2} = 1.058kg = 1.1kg$ $\boxed{m = 1.1kg}$

3. $F_{net} = 870N$, $m = 310kg$, $t = 16s$; $d = ?$

$d = d_1 + v_1 \cdot t + \frac{1}{2}at^2$ $d = \frac{1}{2}at^2$

$d_1 = 0m$, $v_1 = 0 m/s$

$a = \frac{F_{net}}{m} = \frac{870N}{310kg} = 2.81 m/s^2$

$d = \frac{1}{2} \cdot 2.81 \frac{m}{s^2} \cdot (16s)^2$

$\boxed{d = 358.4m = 360m}$