

Newton's Laws

Free-Body Diagrams
FBD

First Law

$$\Sigma F = 0$$

Second Law

$$\Sigma F = ma$$

Third Law

$$F_{1,2} = -F_{2,1}$$

Applications

2 Mass Systems

Atwood Machine
 $a = \left(\frac{M-m}{M+m}\right)g$

Inclined Plane(s)
 $a = \left(\frac{M\sin\theta - m\sin\phi}{M+m}\right)g$

Flat Surface
 $a = \left(\frac{M}{M+m}\right)g$

Push or Pull

Inclined Plane
 $a = g\sin\theta$
Frictionless

Rough and Smooth Surfaces

Force applied PARALLEL to the incline

Force applied PARALLEL to the floor

Force applied PERPENDICULAR to the incline

Force applied at an ANGLE to the incline

Springs
 $F_s = -kx$

Circular Motion
 $F_{net} = m\frac{v^2}{r}$

Uniform

Horizontal Circles

Uniform

Banked Curves

Vertical Circles

Friction

Static
 $f_s \leq \mu_s N$

Kinetic
 $f_k = \mu_k N$

Air Resistance

Standard Problem without Friction
<http://hyperphysics.phy-astr.gsu.edu/hbase/N2st.html#c1>
Standard Problem with Friction
<http://hyperphysics.phy-astr.gsu.edu/hbase/N2st.html#c2>

Mechanics

Enduring Understanding - The summation of forces determines the motion of an object.

Essential Questions

1. When should a free-body diagram, FBD, be drawn?
2. Are Newton's Laws of Motion always applicable?
3. Is the mass or masses responsible for the net force the same masses that are accelerating?
4. How are angles measured?
5. Can kinetic and static friction produce the same effect?
6. What forces can act centripetally?
7. What does a negative sign mean?

