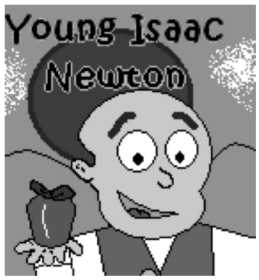
Physics 20 Unit B - Dynamics

Newton's Second Law



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POS Checklist:

☐ apply Newton's second law of motion to explain, qualitatively, the relationships among net force, mass and acceleration

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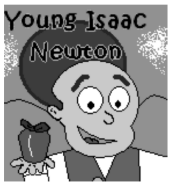
Recall: Newton's First Law: Inertia

"An object at rest (or at a constant velocity) stays at rest (or at a constant velocity) unless acted on by an outside net force."

So, what happens when an object is acted on by a force?

Newton Knows!



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Newton's Second Law

"Any net force produces an acceleration in the direction of the force. The magnitude of the acceleration is directly proportional to the force and inversely proportional to the mass of the object."

Simply put:

$$\vec{F} = m\vec{a}$$

where:

$\vec{F}$ = force (kgm/s^2 or N [a newton])
$\vec{a}$ = acceleration (m/s^2)
m = kg

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Where do the units come from?

According to the equation and unit analysis, the units are:

$$\vec{F} = m\vec{a}$$
$$= (kg)(m/s^2)$$
$$= kgm/s^2$$

However, because this is sort of cumbersome to write, we have replaced this term with N for newtons in Newton's honor.

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In Newton's second law, force is directly proportional to acceleration and acceleration is inversely proportional to mass.

What do you mean by directly/inversely proportional?

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Direct Proportionality

$\vec{F} = m\vec{a}$

$\vec{a} = \frac{\vec{F}}{m}$

As the force increases, the acceleration increases.

$\vec{F} \propto \vec{a}$

$\propto$ = is proportional to

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Inverse Proportionality

$\vec{F} = m\vec{a}$

$\vec{a} = \frac{\vec{F}}{m}$

As the mass increases, the acceleration decreases.

$1 \propto \vec{a}$
m

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Applet: Fan Cart Physics

Try these multiple choice questions.

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Applying the Second Law:

ex) Curtis has a mass of 100 kg. What force is needed to accelerate Curtis to 1.5 m/s²?

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ex) A spring-scale can pull with a force of 2.0 N. What is the maximum acceleration such a scale could give to a 3.5 kg object?

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ex) LD's mass is 88.18 kg. What is his weight?

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HW:

- pg 149 #1 and 2

- read example 3.6 on page 150 and do the practice problem

- read example 3.0 on page 153 and do the 2 practice problems