Momentum

1 Program of Studies Checklist:

- define momentum as a vector quantity equal to the product of the mass and the velocity of an object

What does it mean to be **conserved**?

Definition:

Things that are conserved:

What do you know about **momentum**?

2 Review of Conservation Laws:

2.1 Conservation of _____

- Formulated by _____ in the late 16th century.
- "The _____ of the reactants in a chemical reaction is the same as the _____ of the products"

2.2 Conservation of _____

- Formulated by _____ in the late 16th century.
- "The sum of all _____ in an isolated system remains the same"
- _____ is never created or lost, just changed in form.

Now, _____ and _____ are not the only things that are conserved...there is yet another quantity!

And it has been known for thousands of years...

- in 1000 AD, Sina describes a quantity called "impetus", which is _____ multiplied by _____.
- mid-15th century, Descartes called the same _____ times _____ quantity a "fundamental force of motion"
- mid-16th century, Galileo calls the quantity "impeto"
- 18th century, Newton calls the quantity "motus"

Now, we call the product of _____ and _____ "momentum" - and that's what **we'll** learn about!

3 Momentum

(technically, linear momentum)

where:

$m =$

$v =$

$p =$

All objects _____ have momentum. Momentum is a _____ quantity.

3.1 Units of momentum:

Hmmm - looks like a _____ (kinda)!

Can you turn a _____ into a _____?

Hah! The units of momentum could also be written as _____!

3.2 Instantaneous Momentum

Momentum is a product of _____, but in real life _____ is almost never constant. So, in most cases, it is more correct to say we're working out **instantaneous momentum**.

3.3 Momentum and Newton's Second Law

While he had a funny name for it, Newton had momentum figured out when he penned his famous second law:

Let's take a look at that acceleration...

Newton's Second Law: Momentum

This means that any change in _____ causes a change in _____, and vice-versa.

It's noteworthy that this is actually how Newton defined his second law, as opposed to $F = ma$.

4 Practice Problems

1. A 65 kg girl is driving a 535 kg snowmobile at a constant velocity of 11.5 m/s [60.0° N of E].

   a. Calculate the momentum of the girl-snowmobile system.

   b. Draw the momentum vector for this situation.

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   A loaded transport truck with a mass of 38000 kg is travelling at 1.20 m/s [W]. What will be the velocity of a 1400 kg car if it has the same momentum?

5 Proportion Problems

Mr. Mikula is cross-country skiing at a speed of v. If he doubles his speed, how does his momentum change? His momentum would _____.

Example:

A watermelon truck is driving down a road when it hits a bump and loses some watermelons. The driver slows down to 1/3 of his original speed, and the truck loses 1/20 of its mass in watermelons. How has the momentum of the truck changed?

6 Homework:

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