Name: _____ Cohort: _____ Date: _____

Forensic Engineering Unit Study Guide

NEWTON'S LAWS OF MOTION

Newton's First Law (Law of Inertia): An object remains at rest or in motion unless an unbalanced force acts on it.

- **Balanced** Force: forces acting on an object will not change the objects motion.
- **Unbalanced** Force: forces acting on object will change the object's motion.
- Forces acting against each other can be **balanced**, canceling each other out and having no net effect.
- **Friction** is always a force that **opposes** motion.
    - If friction force and motion force are equal, the object will be at rest. If the object is moving, friction force will slow the motion.

Newton's 2nd Law: An object will accelerate in the direction of the force.

- There is a relationship between force, mass, and acceleration. Newton explained the relationship between crash forces and inertia in his 2nd Law of Motion.
- **Force = mass x acceleration**
- **Acceleration** can be changed by changing the amount of **force** applied or the **mass** of the object.

Newton's 3rd Law: For every action, there is an equal and opposite reaction.

- If one object exerts a force on another object, then the second object exerts a force of equal strength in the opposite direction on the first object.

Vocabulary:

- **Inertia** is the property of matter that causes it to resist any change in motion
- **Momentum** is inertia in motion.
- **Impulse** changes an object's momentum.
- **Kinetic Energy** is energy due to motion
- **Potential Energy** is energy due to position or its condition (stored energy).
    - You have the most potential energy at the top of the pendulum swing and the most kinetic energy at the bottom of the pendulum swing.
    - The amount of kinetic energy equals potential energy at the midpoint of the pendulum swing.

Equations:

$F = m \times a$ ("Force equals the mass times acceleration")

$F = \frac{m \Delta v}{t}$ ("Force equals the mass times the change in velocity over time")

$Ft = m \Delta v$ ("Force times time equals the mass times the change in velocity")

Ft this is referred to as the **impulse**

$m \Delta v$ this is referred to as the **change in momentum**

$KE = 1/2\ mv^2$ **("**Kinetic Energy equals one half mass times its velocity squared")

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ENGINEERING DESIGN PROCESS

The engineering design process is a creative planning process that leads to useful products and systems.

The design process is never final; there are always multiple solutions to a problem.

The **steps** of the Engineering Design Process:

1. Identify the Problem to be solved by Asking Questions
2. Imagine, Plan and Brainstorm
3. Create a Prototype
4. Test and Evaluate
5. Improve Design
6. Share and Present Solutions

Important: You must plan **BEFORE** building!

Vocabulary:

- **Criteria**: The desired elements and features of a product or system that usually relate to their purpose or function. What you would like to have in a product.
- **Constraint:** The limits on a design such as size, material, cost, etc.

FORENSIC ENGINEERING

- Forensic engineers apply the field of engineering to cases of the law when necessary.
- Forensic engineers apply scientific methodology to investigate the failures of materials, components, products and structures.
- This means that a forensic engineer is called to a scene where a car, aircraft, bridge, piece of machinery, or product has malfunctioned in order to collect evidence, investigate the cause, and testify in court if needed.

Forensic Engineers analyze cases and consider the following **questions** when investigating those cases:

1. What happened?
2. Why did it happen?
3. What should the original engineers have done in order to have prevented it from happening?
4. What would new engineers need to concern themselves with to make sure nothing like this happens again in the future?