Video Notes # 3 – Newton’s Laws of Motion

**Obj 65: I can describe Newton’s Laws of Motion**

1st Law – An object at \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ will stay at \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and an object in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ will stay in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, unless acted upon by an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

2nd Law – \_\_\_\_\_\_\_\_\_\_\_ equals \_\_\_\_\_\_\_\_\_\_\_\_ times \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. F=mxa

3rd Law – For every \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ there is an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ reaction.

**1st Law of Motion**: (Law of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)

*Inertia is the tendency of an object to resist changes in its velocity: whether in motion or still*

***Example:***

Unless acted upon by an unbalanced force, this golf ball would sit on the tee forever.

Why then, do we observe every day objects in motion slowing down and becoming motionless seemingly without an outside force?

*It’s a force we sometimes cannot see – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

*Objects on earth, unlike the frictionless space the moon travels through, are under the influence of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.*

**There are four main types of friction:**

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ friction: example: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ friction: example: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ friction (air or liquid): example\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ friction: example: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_2nd Law

2nd Law of Motion

Force = Mass x Acceleration

When mass is in kilograms and acceleration is in m/s/s, the unit of force is in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(N).

One newton is equal to the force required to accelerate one kilogram of mass at one meter/second/second.

**Examples:**

2nd Law (F = m x a)

How much force is needed to accelerate a 1400 kilogram car 2 meters per second/per second?

Write the formula: F = m x a

Fill in given numbers and units

F = 1400 kg x 2 meters per second/second

Solve for the unknown

2800 kg-meters/second/second or 2800 N

*Newton’s 2nd Law proves that different masses accelerate to the earth at \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, but with\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

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We know that objects with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ masses accelerate to the ground at the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. (A hammer and a ping pong ball will hit the ground at the same time!) However, because of the 2nd Law we know that they don’t hit the ground with the same \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Practice:**

1. What acceleration will result when a 12 N net force applied to a 3 kg object? A 6 kg object?

2. A net force of 16 N causes a mass to accelerate at a rate of 4 m/s2. Determine the mass.

3. How much force is needed to accelerate a 66 kg skier 1 m/sec/sec?

4. What is the force on a 1000 kg elevator that is falling freely at 9.8 m/sec/sec?



**3rd Law**

For every \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, there is an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

According to Newton, whenever objects A and B interact with each other, they exert \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_upon each other. When you sit in your chair, your body exerts a downward force on the chair and the chair exerts an upward force on your body.

There are two forces resulting from this interaction - a force on the\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and a force on your \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. These two forces are called *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_* and *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_-* forces.

***Newton’s 3rd Law in Nature***

* Consider the propulsion of a fish through the water. A fish uses its fins to push water \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. In turn, the water *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_* by pushing the fish \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, propelling the fish through the water.
  + The \_\_\_\_\_\_\_\_\_\_ of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on the water \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the \_\_\_\_\_\_\_\_\_\_\_\_\_\_of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on the fish; the direction of the force on the water (backwards) is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the direction of the force on the fish (forwards).
* Consider the flying motion of birds. A bird flies by use of its wings. The wings of a bird push air \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. In turn, the air reacts by pushing the bird \_\_\_\_\_\_\_\_\_\_\_\_\_.
  + The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on the air \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on the bird; the direction of the force on the air (downwards) is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the direction of the force on the bird (upwards).
    - Action-reaction force pairs make it possible for birds to fly.

***Other examples of Newton’s Third Law***

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