LA IMMACULADA CONCEPCION SCHOOL
SENIOR HIGH SCHOOL
GRADE 11 – CORE: PHYSICAL SCIENCE

MAY 4-8, 2020
TOPIC: MOMENTUM

Momentum

- Term commonly used in athletes
- Is a quantity of motion that an object has
- The amount of momentum of an object has depends on two factors: mass and velocity of an object
- Momentum (P) Mass (M) Velocity (P)
- The unit for momentum is kilogram-per/seconds (kg-m/s)

Example:

Which has a greater momentum – a 70 kg soccer player running with a speed of 4 m/s or a .50 kg bullet fired at a speed of 500 m/s?
Solution:
1. Soccer player: p=mv = (70kg) (4m/s) = 280kgm/s
2. Bullet: p = mv = (.5 kg) (600 m/s) = 300kgm/s

: Therefore, the bullet, though it's less massive, has a greater momentum.

Impulse

- The more momentum an object has, the harder it to stop. Hence, a larger amount of force must be applied, or it must be subjected to a force for a longer period of time or both.
- When a force acts on an object for a period of time, its velocity changes so as momentum. This change in momentum can be determined by using Newton's 2nd law of motion.
- Formula is $F. \triangle t = m. \triangle V$
- The product of force and time on the equation is also known as the IMPULSE
- We can also define impulse as a change in momentum as: $I = F. \triangle T$

Example:

A force of 15 N is applied on a box weighing 5kg. If the time the force is applied on a box is 10 s, what is its impulse?
Solution:
$I = F. \triangle T = (15N)(10\ s) = 150\ (kg\text{-}m/s)$

Law of Conservation of Momentum

- States that "the total momentum of a system remains the same if there is no net external force acting on it." This can be proven through Newton's Second law of Motion.

- The **Law of Conservation of Momentum** can be applied in the collision of object. There are two types of collisions: elastics and inelastic

Elastic collision

Two objects move separately after collision and the total kinetic energy of the system remains the same. In equation form, the Law of Conservation of Momentum in elastic collisions is expressed as follows:

$$m1\ v2 + m2v2 = m1\ v'1 + m2\ v'2$$

m1 = mass of the first object.
m2 = mass of the second object.
v1 = velocity of the first object.
v2 = velocity of the second object.
v'1 = velocity of the first object after collision
v'2 = velocity of the second object after collision

Inelastic collision

The two objects stick together after collision.

$$m1v2 + m2v2 = (m1 + m2)\ v$$

m1 = mass of the first object
m2= mass of the second object

v1 = velocity of the first object
v2 = velocity of the second object
v = velocity of the two objects after collision

NEWTON'S LAW OF MOTION

Motion according to Aristotle and Galileo

	ARISTOTLE	GALILEO
Vertical motion	• Any object which is not in its natural place will strive to get there Ex. A stone falls, smoke rises • Object fall at a rate proportional to their weight. Heavier objects fall must faster than lighter objects	• Any two objects that are dropped together will fall together regardless of their weight if air resistance is negligible • Objects fall at the same rate.
Horizontal motion	• Force is needed to start and sustain the motion of an object	• Force is not needed to sustain motion of an object. • Force is required to change motion (to accelerate)
Projectile motion	• A force is needed to start an object to move through air until its natural motion eventually brings it to earth.	• A projectile is influenced by vertical motion due to the force of gravity and horizontal motion that is uniform.

Newton's Laws of Motion

Isaac Newton (1642 – 1727) – he made a systematic study of motion and extended the ideas of Galileo by formulating the three laws of motion.
- The three laws of motion were compiled through his work, Philisophiæ Naturalis Principia Mathematica.

❖ LAW OF INERTIA
- The first law states that *an object remains at rest or in uniform motion unless acted on by an external unbalanced force.*

  Inertia – intrinsic property of a material body which resists a change in its state of rest or of uniform motion along a straight line.

- The mass in the quantitative measure of inertia of a body. The larger the mass of a body, the more difficult to change its state of motion.
- A **force** is an action exerted upon a body that changes its state, either of rest or of uniform motion in a straight line.

❖ LAW OF ACCELERATION
- The second law states that *the acceleration of the body is directly proportional to the net force acting on the body and inversely proportional to the mass of the body.*
- This deals with the effect of net force on the change in velocity or acceleration.
- Describes the relationship between a net force and the resulting acceleration.

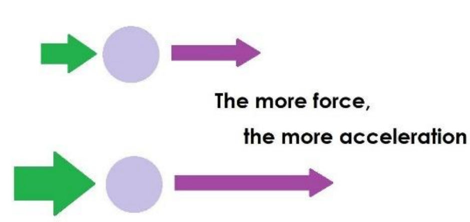
In equation,

Acceleration = $\frac{net\ Force}{mass}$

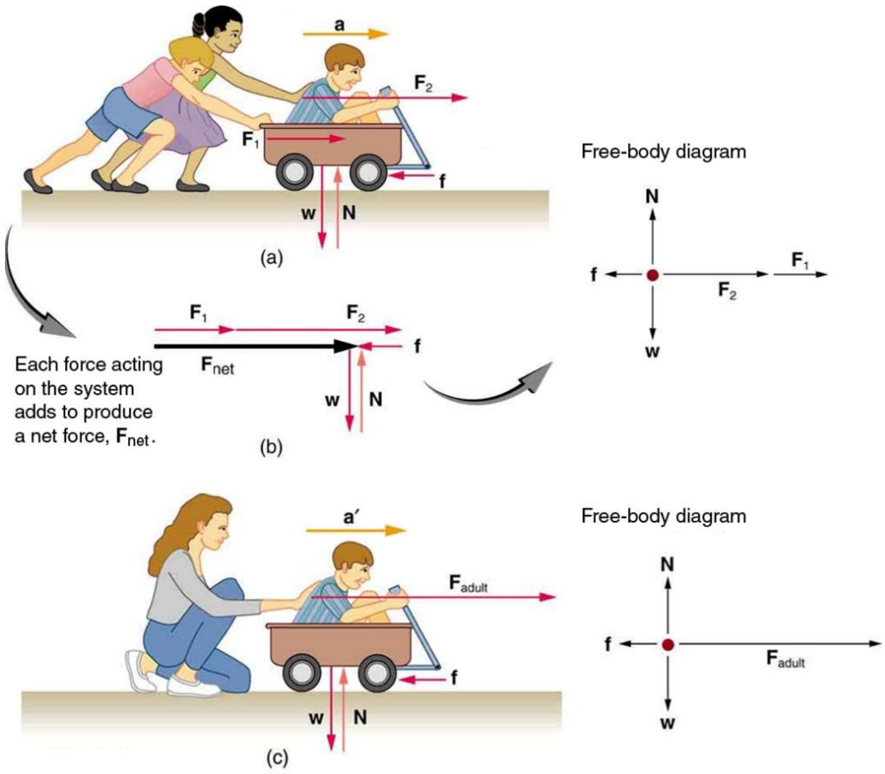
Which is expressed in symbol as

a= $\frac{Fnet}{m}$ **or** F_{net} **= ma**

The SI unit for force is (Newton) N = kg m/s^2



The diagrams show the relationship among force (F), mass (m), and acceleration (a).



- ✓ If the mass is doubled, the acceleration is halved
- ✓ If the net force is doubled, the acceleration is also doubled.

Sample Problems:

1. What net force is required to give a 135 kg box an acceleration of 150 m/s^2.

Given :

m = 135 kg

a = 1.5 m/s^2

required:

Fnet = ?

Solution:

Fnet = ma

= (135 kg)(1.5 m/s^2)

= 202.5 N

2. What is the mass of a sky driver who has a net force of 260 N and an acceleration of 4 m/s^2.

Given :

Fnet = 260N

a = 4 m/s2

required: m = ?

equation: m = Fnet/ a

solution : m =$\frac{260N}{4\ m/s2} = 65kg$

❖ LAW OF INTERACTION

- The third law states that, *when one object exerts force on another, the second objects exerts an equal but opposite force on the first.*
- Deals with forces due to the interaction of two objects.
- Action and Reaction forces, forces that are equal and in opposite directions.

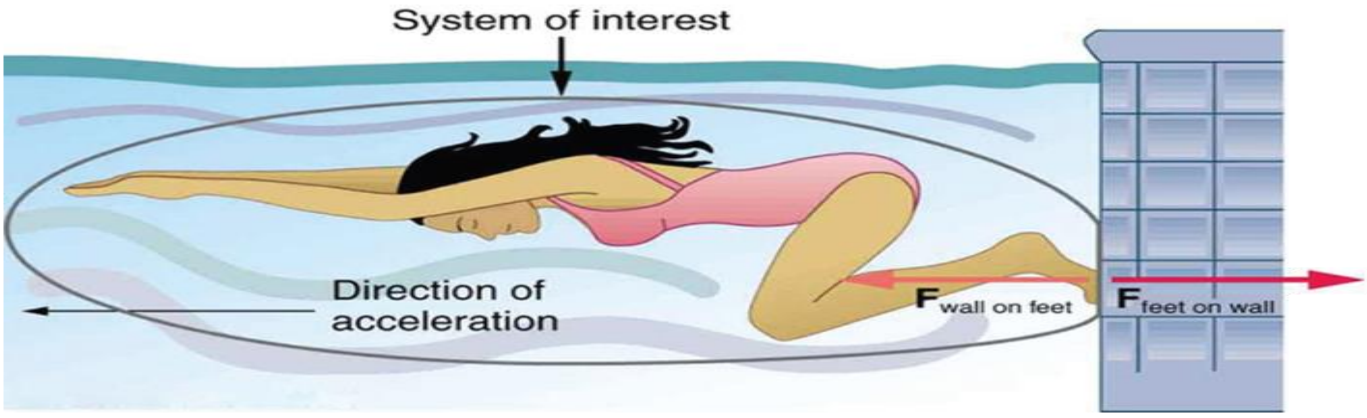
TO DO LIST

I. Answer the following Problem. Write this in a 1 WHOLE SHEET OF PAPER.

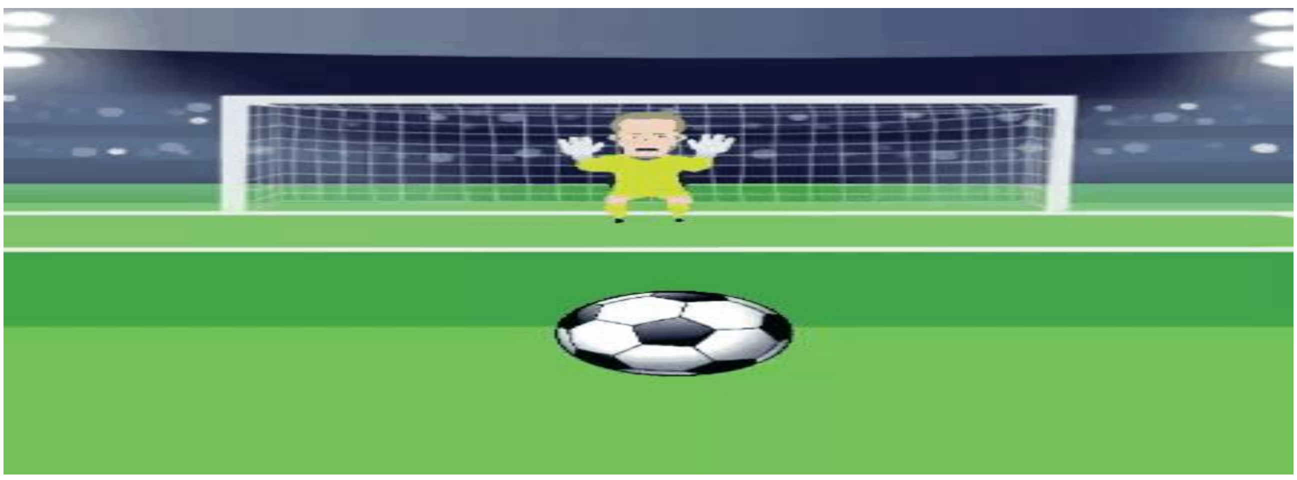
1. A 130 kg lineman is moving west with a speed of 2.0 m/s. he tackles an 80.0 kg football fullback who was moving east, at speed of 8 m/s. if after the collision both players stuck together, what was their velocity?
2. Suppose an 8.0 kg ball is moving with a velocity of 5.0 m/s. strikes a 10.0 kg ball initially at rest: after the collision, the 8.0 kg ball continues to move in the same direction with a velocity of 3.0 m/s. what is the velocity of the 3.0 kg ball after the collision?
3. A force of 15 N is applied on a box weighing 5 kg. if the force applied to the box is 10 s, what is its impulse?

II. Activity. Directions: Create two examples in each where Elastic and Inelastic Collision is present. Make sure to include details in each example. Do this in a Short Bond Paper.

III. Directions: Analyze the given situations. Draw the illustrative examples and answer the following questions below. Do this on short Bond paper.



1. Describe the force given on $\mathbf{F}_{\text{wall on feet}}$ to $\mathbf{F}_{\text{feet on wall}}$.
2. Describe the force given on $\mathbf{F}_{\text{feet on wall}}$ to $\mathbf{F}_{\text{wall on feet}}$.
3. What will happen when the swimmer exerts force to the direction of acceleration in the water?



4. Describe the soccer ball when it is sitting at rest.
5. Determine where the ball will go after you kick it.

Day 2

Seatwork

Directions: Solve the following problems about Acceleration.

1. If a car can accelerate at $2 m/s^2$, what acceleration can it attain if it is towing another car of equal mass?
2. A car has a mass of 1000kg. What is the acceleration produced by a force of 2000N?
3. How much force, or thrust, must a 30,000-kg jet plane develop to achieve an acceleration of $1.5 m/s^2$?

MAY 4-8, 2020
TOPIC: NEWTON'S LAW OF UNIVERSAL GRAVITATION

Law of Universal Gravitation
- States that every object in the universe is attracted to another object with a force that is directly proportional to the product of the mass of each object and inversely proportional to the square of the distance between the centers of their masses.
- In equation,

$$F_{(g)} = G\frac{m.m2}{d2}$$

Where: F_g is the force of gravity
m_1 and m_2 are the masses of two objects
d_r is the distance between the canters of the two objects
G is the gravitational constant
The value of G was determined experimentally by Henry Cavendish to be,

$$6.67 \times 10^{-11}\ N.\ m^2/kg^2$$

- This law is related to law of action and reaction.

If object A exerts a gravitational force on object B, object B exerts an equal and opposite gravitational force on object A.
- This law is also related to Newton's second law of motion

The acceleration due to gravity on earth is 9.8 m/s^2.

Consider the mass accelerating towards the center of the earth. Applying Newton's second law and law of universal gravitation,

$$F_{net} = F_g$$
$$M_0 a = G\frac{m_o m_e}{d2}$$
$$a = G\frac{m_e}{d2}$$
$$a = \frac{(6.67 \times 10^{-11}\ N.m^2/kg^2)(5.98 \times 10^{24} kg)}{(6.37 \times 10^6 m)}$$
$$a = 9.8\ m/s^2$$

Sample problem:
Calculate the force of gravitational attraction between the earth and a 50-kg man who is standing at a distance 6.38 $\times 10^6$m from the earth's center.

Given: $m_1 = 5.98 \times 10^{24}$ kg (mass of the earth)
$m_2 = 50$ kg (mass of the man)
dr = 6.38 $\times 10^6$ m
G = 6.67x10-11 $N.m^2/kg^2$

Required: F_g =

Equation: $Fg = G\frac{m1.m2}{d^2}$

Solution: $a = \frac{(6.67 \times 10^{-11}\ N.m^2/kg^2)(5.98 \times 10^{24} kg)(50kg)}{(6.37 \times 10^6 m)^2}$

Answer: **F_g = 489.95 N**

TO DO LIST:

I. Answer the following. Write your answer in a 1 whole sheet of paper

What happens to the force of gravitational attraction if?

1. Masses remain the same and the distance separating the masses is doubled.
2. Masses remain the same and the distance is reduced to one-half.
3. Distance remains the same and one of the masses is increased four times.
4. Distance remains the same and one of the masses is halved

II. Solve the following.

1. The gravitational force between two objects is $3x10^{-8}$ N. if the mass of one object is 35 kg, find the mass of the other object if they are separated by a distance of 1.2 m.

2. Determine the distance between a 60kg and a 70 kg object which are 2m apart if the gravitational force between them is $7x10^{-8}$ N.

ACTIVITY IN MOMENTUM, AND COLLISION

I. Answer the following questions briefly. Copy and answer in a 1 whole sheet of paper.

1. Compare elastic, inelastic, and perfectly inelastic collision of a rubber ball dropped on a cemented floor. Include illustrations in your explanation.

2. Are pulse and force the same thing? Explain.

3. Are impulse and momentum the same thing? Explain.

4. Explain if the length of the time that a force acts on an object has or has no effect on the impulse produced.

II. Identify and assess the impact of technologies or procedures that apply the principles of momentum.

a. Describe the technology or procedure.

b. Explain the principle used.

c. Discuss the impact to society and environment.

d. Gives its limitation/trade off.

e. Propose practical ways to improve these technologies/ procedures.

MAY 4-8, 2020
TOPIC: LIGHT AS WAVE AND PARTICLE

Light
- Commonly considered as an electromagnetic wave that displays different wave properties
- Some have attributed particle-like properties to light.
- Light reflects in the same manner that any wave would reflect.
- Light refracts in the same manner that any wave would refract. Light diffracts in the same manner that any wave would diffract.

Quantization of Light Energy
Max Planck
- He introduced his idea on quantization of light energy and was strengthened by Albert Einstein.
- The idea was originated from the study of the spectrum produced by a blackbody.
- He came up with a formula to explain the distribution of wavelength that are emitted from a heated blackbody.

The formula led Planck concludes that light could not be absorbed or emitted from a surface of the blackbody in continuously varying energies but not only in discrete chunks or quanta whose energy depended on frequency.

It is given as

$$E = hf$$

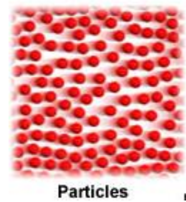
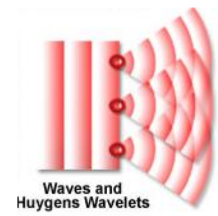
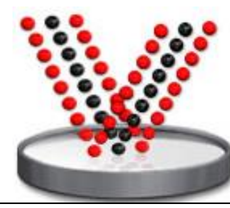
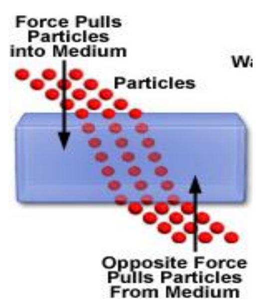
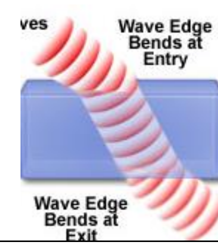
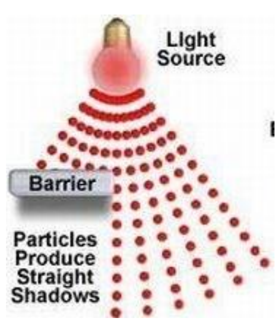
Where E is the energy (in joule, J)
h is Planck's constant (6.626×10^{-34} Js)
f is the frequency (in hertz, Hz)

The relationship between energy and frequency explains the following:
- Red light is used in photographic dark rooms because red light has the longest wavelength and the lowest frequency among the region of the visible spectrum.
- People get easily sunburned by UV light but not visible light because UV has shorter wavelength and higher frequency, than visible light.

Interaction of Light with Matter
- Ideas about the nature of light led to two different theories of light.

Christian Huygens
- He proposed the Wave theory

Isaac Newton
- He proposed the Particle (Corpuscular) theory

PROPERTY	PARTICLE (CORPUSCULAR) THEORY	WAVE THEORY
PROPAGATION Light travels in straight lines.	light travels as a shower particle in a straight line 	light travels as wavelets similar to the ripples spreading across a surface of pond distributed by a stone dropped on it. 
REFLECTION Light bounces as it strikes a surface	light emitted by a source whether far or near strikes a smooth surface as stream or particles. 	light emitted by a source spread in all directions as it strikes a smooth surface. 
REFRACTION Light bends as it passes from one medium to another	a special force directed perpendicular to the first medium changes the speed of the particles as they enter the second medium. 	when a beam of light travels between two different media, a small portion of each angled wave from impact the second medium while the rest of the wave is still travelling in the first medium at different speed, thus changing the angle of propagation. 
DIFFRACTION Light spreads out as it passes a barrier or a slit.	when light particles travelling in straight lines encounter the edge of a barrier, they cast a shadow because the unblocked particles continue in a straight line and cannot spread out behind the edge. 	when a wavefront from a point source reaches the edge of a corner, a secondary wave is formed at that point and makes another waveffront. 

TO DO LIST

Answer the following in a 1 whole sheet of paper.

1. Describe and give an example of a blackbody.

2. What is the relationship of energy and frequency of light?

3. How can light be separated into different colorss?

4. How is reflection explained by the wave and particle model of light?