Science - Physics

Force, Momentum, Impulses :

Newton's 3rd Law of Motion

When there is an interaction between 2 objects, the forces they exercise onto one another will be equal in size but in different directions.

Force-

Vector quantity = size and direction

Unit = Newton

Symbol for force: f

1. Contact forces

Objects exercised by forces when they touch.

Friction force:

- ✓ Occurs when 2 surfaces come into contact, the movement of the one surface counters the other surface.
- ✓ Beside/Parallel to object.

Normal force:

- ✓ Prevents freefall of object.
- ✓ Perpendicular on level it comes from.

2. Non-Contact forces

- Magnetic force
- Electrostatic force
- Gravitational force

A Force Pair will always: -

- ✓ Be the same size, but in different directions -> simultaneously exercised;
- ✓ Works in beside the same line;
- ✓ Works in on different objects.

Static friction:

- ✓ Friction force exercised by 1 surface onto another when no movement takes place
- ✓ Formula: f = UsF_n Us = Static frictional coefficient – proportional constant

Kinetic friction:

- ✓ Friction force exercised by 1 surface onto another when 1 surface glides over the other surface.
- ✓ Formula: f = UxF_n Ux = Kinetic frictional coefficient- proportional constant
- ✓ Static coefficient becomes larger than kinetic coefficient -> always larger

Momentum:

- ✓ Momentum of an object is the product of the mass of the object and its velocity.
- ✓ Formula: momentum = mass x velocity

  P = m x v
- ✓ Unit: K$g \cdot m \cdot s^{-1}$
- ✓ Vector quantity, direction of momentum is the same as the direction of velocity.

Change in momentum:

- ✓ Formula: change in momentum = end momentum – initial momentum

$$\Delta p = MV_f - MV_i$$

- ✓ Momentum of an object is only constant if no net force is exercised onto it.

Newton 2 in terms of momentum:

- ✓ The resulting force exercised onto the object is equal to the tempo of momentum change of the object.
- ✓ Formula: Fres = $\frac{MV_f - MV_i}{\Delta t}$

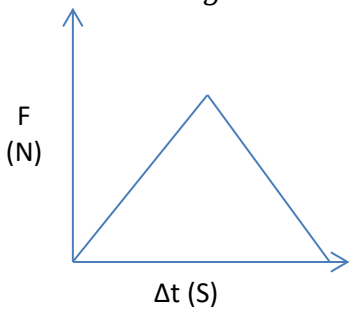
Impulses and change in momentum:

- ✓ Impulse is a measurement of how hard and how long a force is exercised onto an object.

Impulse

- ✓ The product of the force and time wherein the force works
- ✓ Formula: I = Fres Δt
- ✓ Unit: $N \cdot$ S

- ✓ $1N \cdot S = 1Kg \cdot m \cdot s^{-1}$



area = $\frac{1}{2}$ x b x h
= F x Δ
= Impulse

Closed system

- ✓ A system that does not experience any external resulting force, i.e. internal forces are operational

Internal forces:

- ✓ Forces that objects in the system exercise onto one another.

External forces:

- ✓ Forces exercised from the outside of the system onto objects in the system.

Law of Conservation of momentum

- ✓ In a closed system the total linear momentum before collision = total linear momentum after collision in size and direction
- ✓ Formula: $M_1V_{1i} + M_2V_{2i} = M_1V_{1f} + M_2V_{2f}$

Resulting force

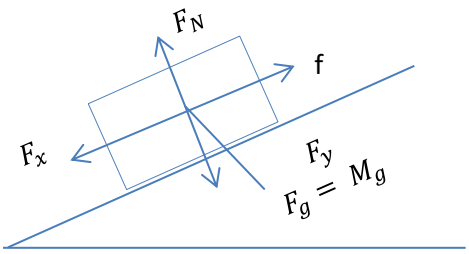
- ✓ The resulting force of 2 or more forces exercised onto an object is that single force that has the same effect on the object as all the forces that are exercised onto the object together.
- ✓ If forces are in the same direction = +
- ✓ If forces are in opposite directions = -
- ✓ When the resulting force = 0, then the force is in equilibrium/ balanced

Newton's 1st Law of Motion

- ✓ An object will remain in a stationary condition or move forward with a constant velocity, in a straight line, unless an imbalanced force is exercised onto it.
- ✓ Describe the tendency of the body to remain stationary.

- ✓ Tendency to keep moving at a constant velocity
- ✓ Natural tendency to offer resistance
- ✓ Measurement of the inertia an object is its mass
- ✓ Also known as law of inertia.

Friction force on an incline



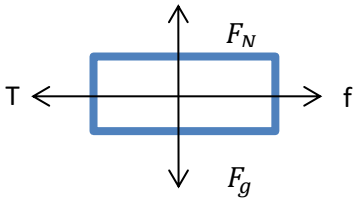
- ✓ Formula: $F_x = Mg\ sin\theta$
  - └ F_x -> The force causes the object to descend down the incline
- ✓ Formula: $F_y = M_g \cos\theta$
  - └ F_y -> The force the object pushes perpendicularly down into the incline with
- ✓ Static frictional coefficient: Us = tanθ

  No unit

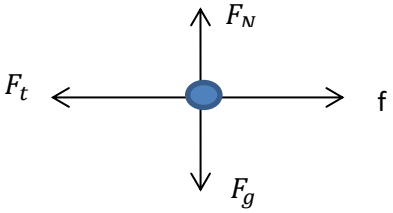
  Only the angle of the incline is important

Tension in a rope:

- ✓ Tension (T) force exercised onto an object, always a pull force
- ✓ Tension is the same everywhere
- ✓ Forces diagram



- ✓ Free-body diagram



Newton's 2nd law of motion

- ✓ When there is an imbalanced force exercising onto the object, the object will accelerate in the direction of the force. The acceleration is directly even to the imbalanced force and conversely even to the mass of the object.
- ✓ Formula: Fres = ma

Gravitational force:

- ✓ Gravity between all particles in the universe.

Newton's Universal Gravitation Law

- ✓ Any 2 objects in the universe attract one another with a force directly even to the product of the masses and conversely even to the square of the distance between their centers.
- ✓ Formula: F = $\frac{GM_1M_2}{r^2}$
- ✓ g – proportional constant = 6.7 x 10^{-11}

Moment of a force

- ✓ Turn effect of a force around the spill is called the moment of a force.

Moment = dependent on

- ✓ Size of force (the larger the force, the larger the moment)
- ✓ Perpendicular distance between spill and force (the further the force, the larger the moment)
- ✓ Formula: moment = force x perpendicular distance from spill

  T = F ⊥ r
- ✓ Unit: $N \cdot M$

Conditions for static equilibrium:

1. Fres must be 0.
2. Resultant moment must be 0.

Object is in equilibrium

- ✓ When the resulting force and the resulting moment on the object is 0.
- ✓ For Tres = 0
- ✓ The sum of the clockwise and anti-clockwise moment must be 0.

Mechanical advantage

- ✓ Ratio between the size of the load force to that of the applied force

A lever

- ✓ A straight or crooked, unbendable bar that can freely turn around an axis, namely a spill, when a force is exercised onto it.
- ✓ Formula: mechanical advantage = $\frac{load\ force}{applied\ force}$
- ✓ Or : mechanical advantage = $\frac{power\ distance\ from\ turning\ point}{load\ distance\ from\ turning\ point}$