Al-Mustaqbal University Colleg
Medical Physics Department

General Physics/ lecture 4

First stage

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Lecture 4

Outline

- **Equilibrium.**
- **Work, Energy, power.**

Equilibrium

Equilibrium is defined as ***a state of balance or a stable situation where opposing forces cancel each other and where no changes are occurring***.

Conditions for Equilibrium

- ✓ The first condition of equilibrium is that ***the net force in all directions must be zero.***
- ✓ The second condition of equilibrium says that ***the net torque acting on the object must be zero.***

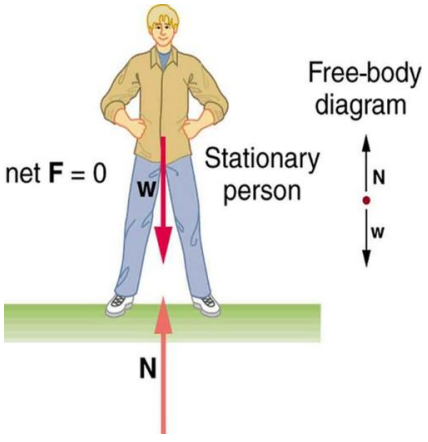
Torque *is a measure of the force that can cause an object to rotate about an axis.*

عزم الدوران هو مقياس لمدى القوة التي تؤثر على جسم ما وتؤدي إلى تدويره

Types of Equilibrium

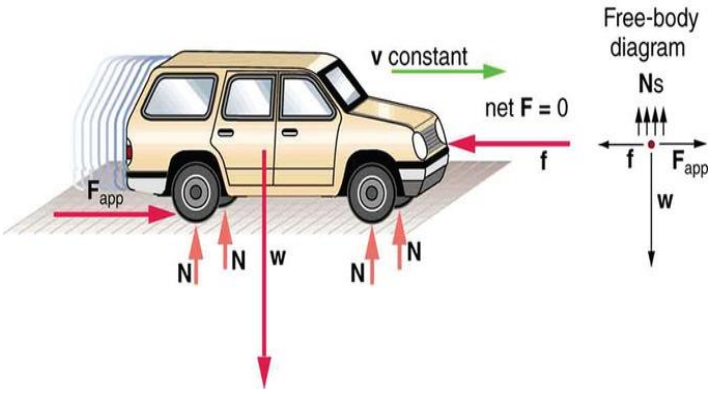
1. Static Equilibrium

Example: The motionless person is in static equilibrium. The forces acting on him add up to zero. Both forces are vertical in this case.



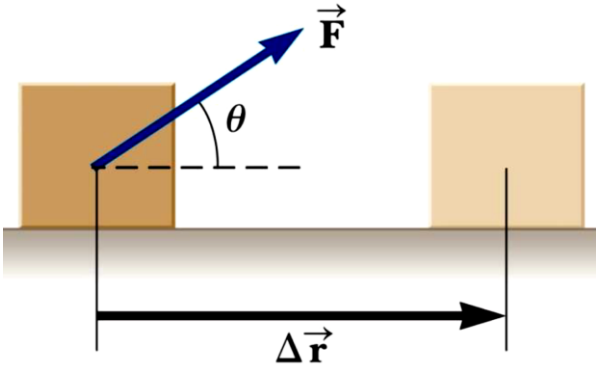
2. ***Dynamic Equilibrium***

Example: This car is in dynamic equilibrium because it is moving at constant velocity. The forces in all directions are balanced.



Work

The work, W, done on a system by an agent exerting a constant force on the system ***is the product of the magnitude F of the force, the magnitude Δr of the displacement of the point of application of the force, and cos θ, where θ is the angle between the force and the displacement vectors***



❖ The work done by a ***force*** on a moving object is ***zero*** when the force applied is ***perpendicular*** to the ***displacement*** of its point of application.

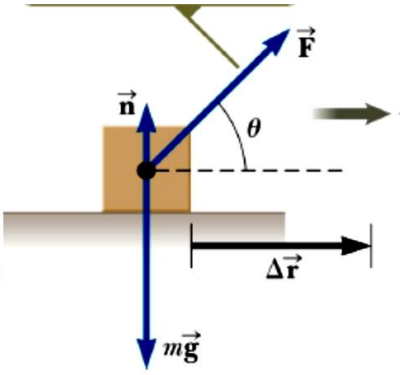
- Work can be given as $W = F\Delta r\cos\theta = \vec{F}\cdot\Delta\vec{r}$

Work is a scalar quantity.

The unit of work is a joule (J = N · m)

- 1 joule = 1 newton · 1 meter = kg · m² / s²

Example: The normal force and the gravitational force do no work on the object. cos θ = cos 90° = 0



Energy

- ✓ A system possesses energy if ***it has the ability to do work***.
- ✓ Energy is ***a scalar quantity.***
- ✓ Units is ***joule*** J= Nm = Kg m^2/S^2
- ✓ Energy can exist in many different forms. All forms of energy are either ***kinetic*** or ***potential***.

1. kinetic energy

Kinetic energy ***is the energy of a particle due to its motion.***

$$K.E = \frac{1}{2} mv^2$$

Where: (m is the mass of the particle) and (is the speed of the particle)

Types and example of kinetic energy:

- mechanical energy — motion of macroscopic systems (machines, wind energy, wave energy, sound energy)
- thermal energy — motion of particles of matter (geothermal energy)
- electric energy — motion of charges (household current, lightning)
- electromagnetic radiation — disturbance of electric and magnetic fields (classical physics) or the motion of photons (quantum physics), (radio, microwaves, infrared, light, ultraviolet, x-rays, gamma rays, solar energy)

2. potential energy

The energy associated with position

Types and examples of potential energy

- gravitational potential energy (roller coaster, waterwheel, hydroelectric power).
- electromagnetic potential energy (electric potential energy, magnetic potential energy, chemical potential energy, elastic potential energy).
- strong nuclear potential energy (nuclear power, nuclear weapons).

- weak nuclear potential energy (radioactive decay).

Power

Power is ***the time rate of energy transfer***. The ***instantaneous power*** is defined as:

$$P \equiv \frac{dE}{dt}$$

The SI unit of power is called the ***watt***. **1 watt = 1 joule / second = 1 kg m^2 / s^3**

Questions

1. Define equilibrium and what is conditions?
2. What is torque?
3. Enumerate types of equilibrium and give example for each type.
4. Give equation of work and its unite.
5. When the work done equal zero? Give example.
6. What is energy and what is forms?
7. Define K.E and give example for each type.
8. Enumerate types of K.E with example for each type.
9. Define P. E and enumerate types with example for each type.
10. Explain the power?