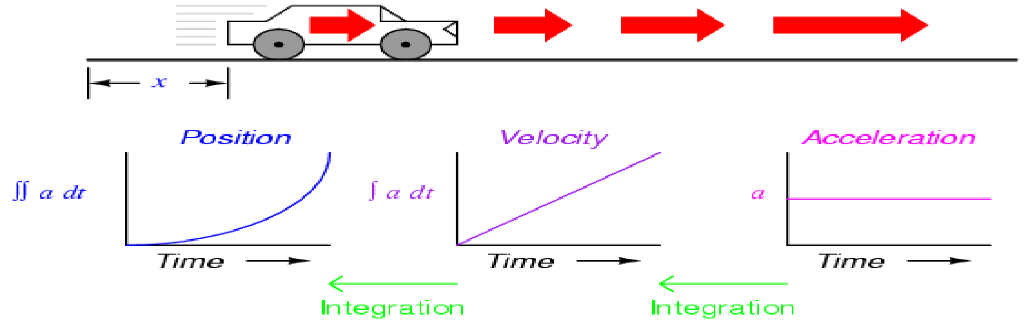
Hilla University Collage

Department of Prosthetics Dental Technology



Lecture one

Review of General Physics, Concepts and Laws

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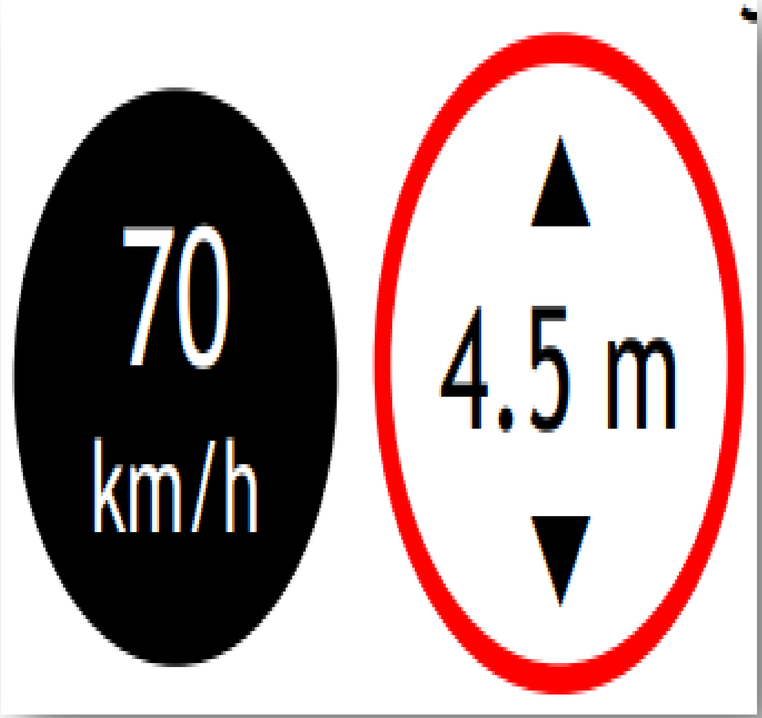
Physical quantities

A physical quantity is quantity that can be measured and consists of a magnitude and unit.



SI units are used in Scientific works

Measuring length

Physical quantities

Quantitative versus qualitative:

- Most observation in physics are quantitative.
- Descriptive observations (qualitative) are usually imprecise.

Qualitative Observations:	**Quantitative Observations:**
How do you measure artistic beauty?	What can be measured with the instruments on an airplane?

Physical quantities

Are classified into two types:

- **Base quantities:** are the quantities on the basis of which other quantities are expressed.
- **Derived quantities:** The quantities that are expressed in terms of base quantities

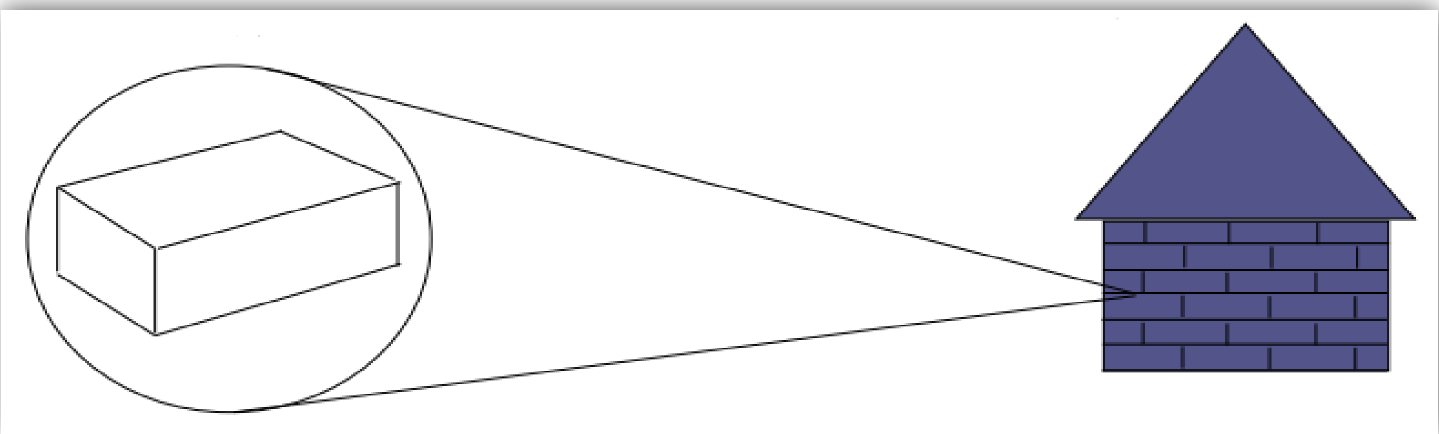
Base quantity:

For example:

is like the brick – the basic building block of a house

Derived quantity:

For example: is like the house that was build up from a collection of bricks (basic quantity)



The International System of Units

The International System of Units, abbreviated SI from its French name and popularly known as the metric system. It depends on the basic units

- **SI Units** - International System of Units

Base Quantities	Name of Unit	Symbol of Unit
length	metre	m
mass	kilogram	kg
time	second	s
electric current	ampere	A
temperature	kelvin	K
amount of substance	mole	mol

and from them we can derive the units of all physical quantities, for example, the SI unit for power, called the watt (W), is defined in terms of the base units for mass, length, and time.

$$\mathbf{1\ watt = 1\ W = 1\ kg\ .\ m^2\ /s^3}$$

The International System of Units

To express the very large and very small physical quantities, we use scientific notation (powers of 10).

3 560 000 000 m = 3.56 *10^9 m or 0.000 000 492 s = 4.92 * 10^{-7} s.

Thus, we can express a particular electric power as

1.27 gigawatts =1.27 *10^9 watts = 1.27 GW

or a particular time interval as

2.35 nanoseconds =2.35*10^{-9} s = 2.35 ns.

- Prefixes simplify the writing of very large or very small quantities

Prefix	Abbreviation	Power
nano	n	10^{-9}
micro	µ	10^{-6}
milli	m	10^{-3}
centi	c	10^{-2}
deci	d	10^{-1}
kilo	k	10^{3}
mega	M	10^{6}
giga	G	10^{9}
Tera	?	??

The Equations & Units of base quantities

1. Equation: area = length × width

In terms of base units: Units of area = m × m = m^2

2. Equation: volume = length × width × height

In terms of base units: Units of volume = m × m × m = m^3

- **Work out the derived quantities for:**

Equation: density = mass / volume **Units of density = kg m^{-3}**

Equation: $velocity(v) = \frac{distance}{time} = \frac{X}{t}$ **Units of speed = ms^{-1}**

Equation: $acceleration(a) = \frac{velocity}{time} = \frac{v}{t}$ **Units of acceleration = ms^{-2}**

Equation: force = mass × acceleration **Units of force = kg ms^{-2}**

The Equations &Units of derived quantities

Equation: Pressure = $\frac{force}{area}$

Units [N/m^2]

Equation: Work = Force × Displacement

Units [N. m] = J

Equation: Power = $\frac{work\ done}{time}$

Units [J/s] = watt

The Scalar quantities

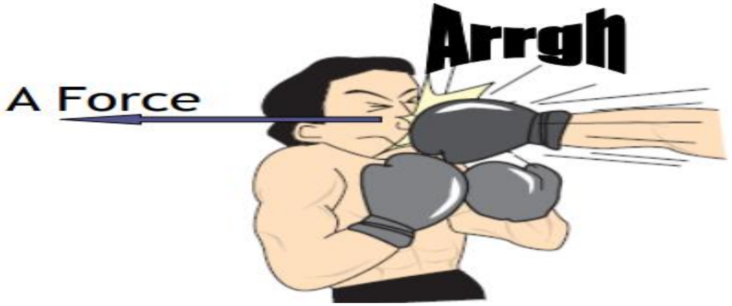
Scalar quantities: are quantities that have magnitude only.

Two examples are shown below:

Scalar quantities: are added or subtracted by using simple arithmetic.

The Vector quantities

Vector quantities: are quantities that have both magnitude and direction



Magnitude = 100 N

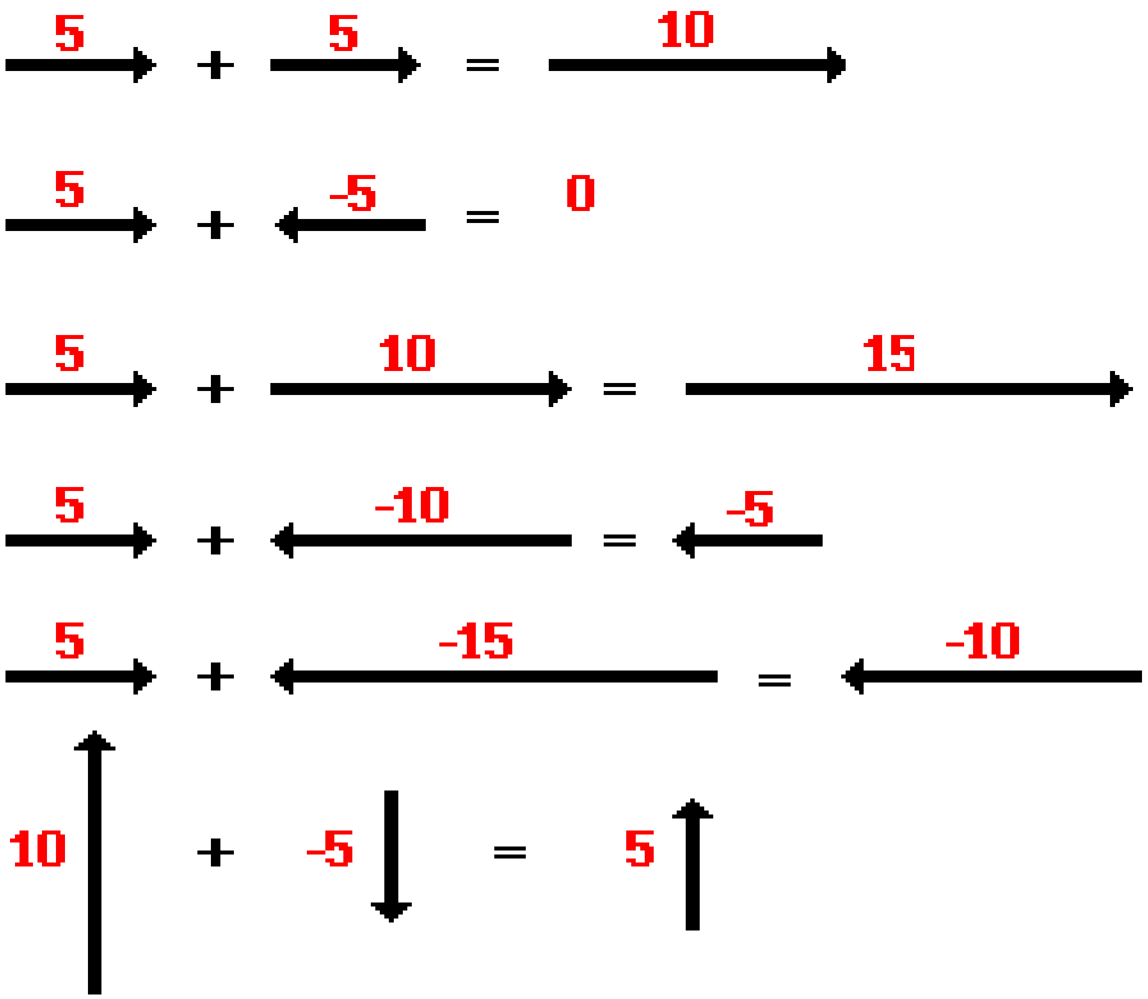
Direction = Left

- **Examples of scalars and vectors**

Scalars	Vectors
distance	displacement
speed	velocity
mass	weight
time	acceleration
pressure	force
energy	momentum
volume	
density	

Adding/Subtracting Vectors

- **Parallel vectors can be added arithmetically**



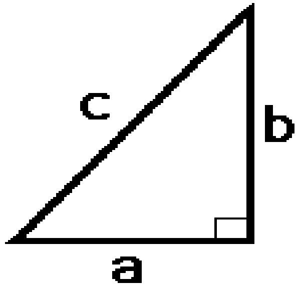
Adding/Subtracting Vectors

- **Non-parallel vectors are added by graphical**

  - Vectors can be represented graphically by arrows.
  - The length of the arrow represents the magnitude of the vector.
  - The direction of the arrow represents the direction of the vector

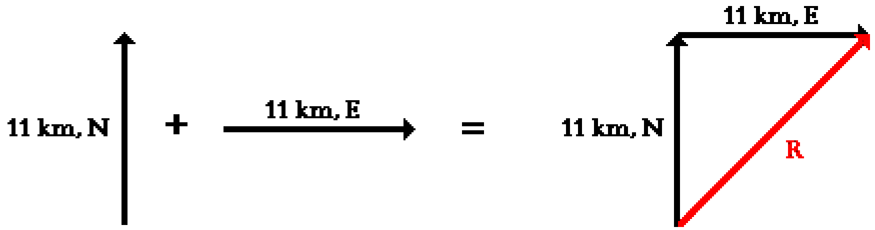
Pythagorean theorem

The Pythagorean theorem is a useful method for determining the result of adding two (and only two) vectors that make a right angle to each other. The method is not applicable for adding more than two vectors or for adding vectors that are not at 90-degrees to each other.



$$a^2 + b^2 = c^2$$

For example:



$$11^2 + 11^2 = R^2$$

$$242 = R^2$$

$$15.6 = R$$

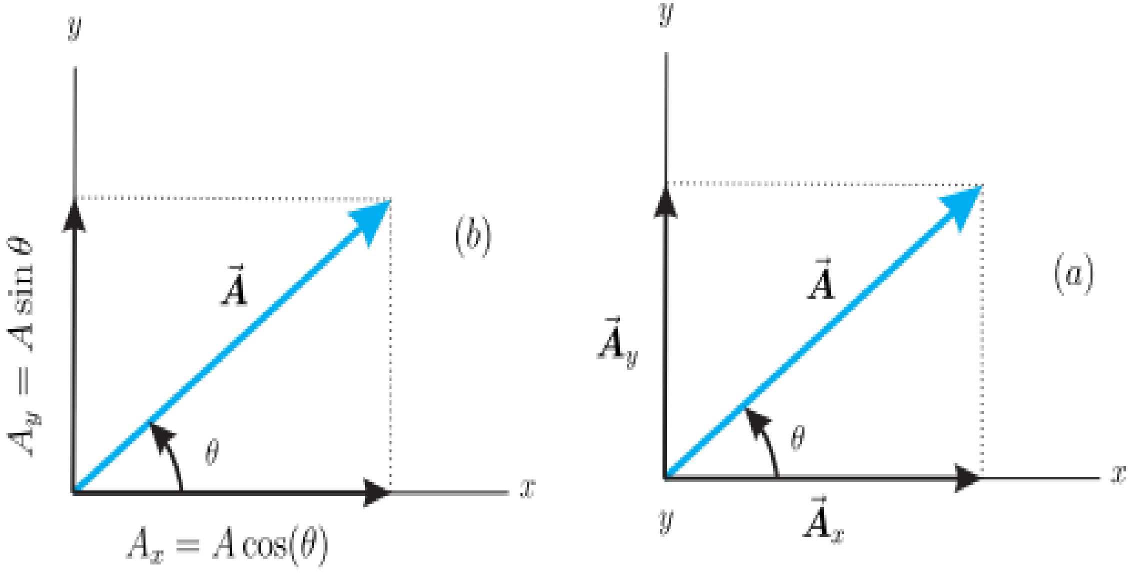
Vector components

In the Cartesian coordinate system of two dimensions, Fig. below each vector for example $\vec{A}$ can be represented by the sum of two perpendicular vectors, $\vec{A}_x$ parallel to x-axis and $\vec{A}_y$ parallel to y-axis. These two vectors are called the

component vectors of $\vec{A}$

$$\vec{A} = \vec{A}_x + \vec{A}_y$$

with



$$\vec{A}_x = A_x\hat{\mathbf{x}}, \quad \vec{A}_y = A_y\hat{\mathbf{y}}$$

Vectors Products

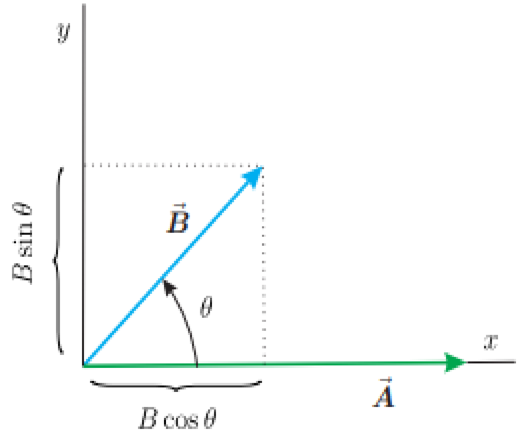
Scalar Product:

The scalar product of two vector $\vec{A}$ and $\vec{B}$ is given by

$$\vec{A}\cdot\vec{B} = |\vec{A}||\vec{B}|\cos\theta = AB\cos\theta$$

The scalar product is a scalar quantity and can be

- Positive when θ is between 0◦ and 90◦.
- Zero for θ = 90◦ .
- Negative as θ between 90◦ and 180◦ .



$$\vec{A}\cdot\vec{B} = A_xB_x + A_yB_y + A_zB_z$$

$$\cos\theta = \frac{\vec{A}\cdot\vec{B}}{AB} = \frac{A_xB_x + A_yB_y + A_zB_z}{AB}$$

$$A = \sqrt{A_x^2 + A_y^2 + A_z^2} \qquad B = \sqrt{B_x^2 + B_y^2 + B_z^2}$$

Questions

1. Earth is approximately a sphere of radius $6.37 * 10^6$ m. What are:

   (a) its circumference in kilometres:

   (b) its surface area in square kilometres.

   (c) its volume in cubic kilometres? (H.W)

2. The micrometre (1 μm) is often called the micron.

   (a) how many microns make up *1.0 km*?

   (b) What fraction of a centimetre equals *1.0 μm*? (H.W)

3. a) Assuming that water has a density of exactly $1\ g/cm^3$ find the mass of one cubic meter of water in kilograms.

   (b) Suppose that it takes *10.0 h* to drain a container of $5700\ m^3$ of water. What is the “mass flow rate,” in kilograms per second, of water from the container?(H.W).

Questions

4. The position of a particle moving along an x axis is given by $x = 12t^2 - 2t^3$, where x is in meters and t is in seconds. Determine

(a)the position at $t = 1 sec.$

(b) the velocity after 2sec.

(c) the acceleration of the particle at $t = 4.0\ s$

(d)the force, if the mass of particle is 2kg.

(e) the work done by the force at distance 5m. (H.W)

(f) the power of particle at t = 20 sec. (H.W)

(g) the pressure on area $4m^2$. (H.W)

5. Let us have the following vectors:

$$\vec{\mathbf{A}} = 6\hat{\mathbf{x}} + 5\hat{\mathbf{y}} + 7\hat{\mathbf{z}}$$

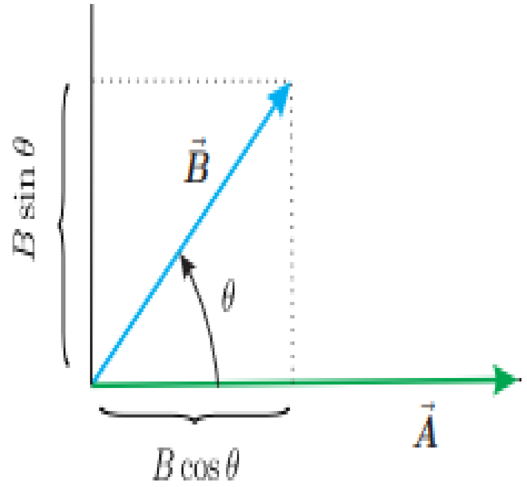
$$\vec{\boldsymbol{B}} = 3\hat{\boldsymbol{x}} + 8\hat{\boldsymbol{y}} + 2\hat{\boldsymbol{z}}$$

Find:

(a) $\vec{A} \cdot \vec{B}$

(b) $3\vec{A} - 2\vec{B}$

(c) *The angle* θ *between* $\vec{A}$ *and* $\vec{B}$



THANK YOU FOR LISTENING