Lectures on Electromagnetic theory I

PH 2151

Lecture 1
(Overview on scalar and vector quantities)

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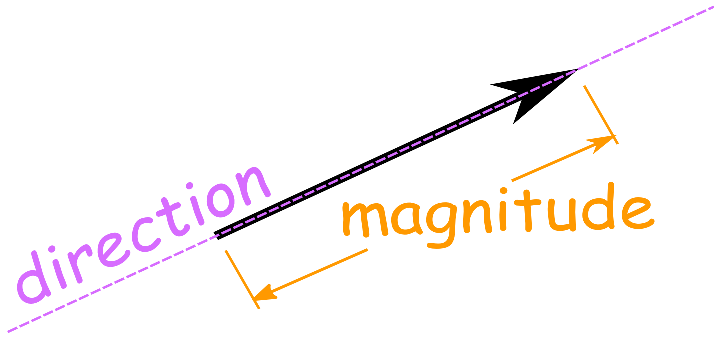
Revision on scalars and vectors

1- Scalar quantities has only magnitude like mass, density, volume and voltage.

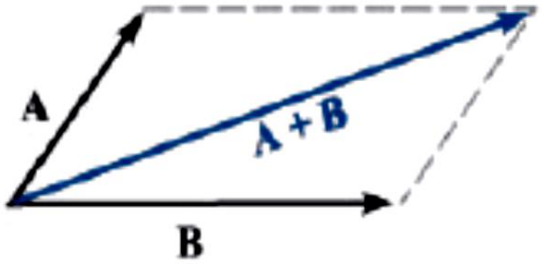
2- Vector quantity has both a **magnitude** (size) and **direction ,vector quantities like force, and velocity.**

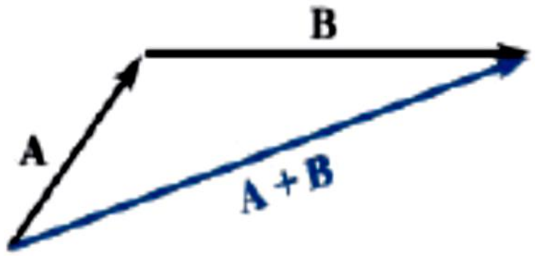


Vectoral addition and subtraction

1- Two vectors may be added **graphically** either by parallelogram method or triangle method or **mathematically by** expressing each vector in terms of horizontal and vertical components.

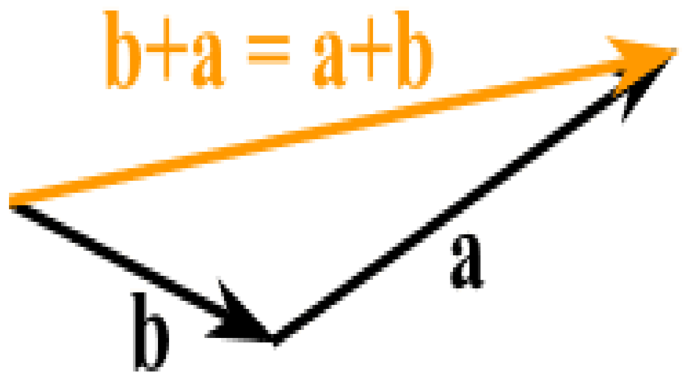
2- The rule for subtraction follows that for addition but the direction of the second is reversed.



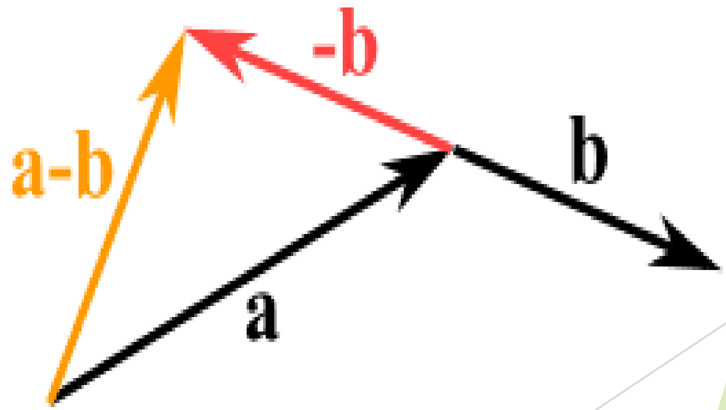


Vectoral addition and subtraction

Adding: We can add two vectors by joining them head-to-tail.



Subtracting: first we reverse the direction of the vector we want to subtract, then add them as usual.



The dot or scaler product

The dot product is defined as

$$\mathbf{A} \cdot \mathbf{B} = |\mathbf{A}|\,|\mathbf{B}| \cos\theta_{AB} \qquad \text{or}$$

$$\mathbf{A} \cdot \mathbf{B} = A_x B_x + A_y B_y + A_z B_z$$

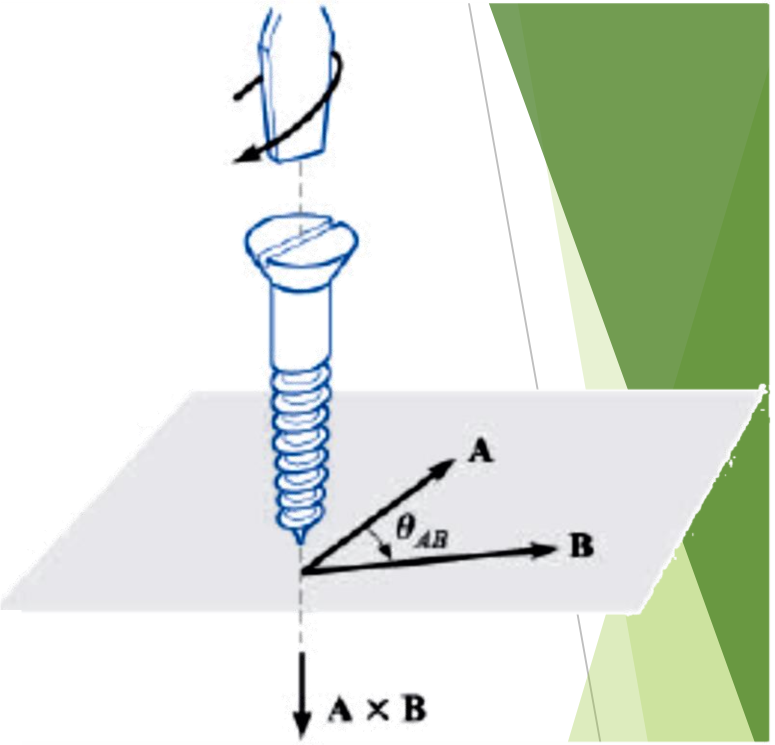
What are the applications of the dot product?

THE CROSS PRODUCT

The cross product is defined as

$$\mathbf{A} \times \mathbf{B} = \mathbf{a}_N |\mathbf{A}|\,|\mathbf{B}| \sin\theta_{AB}$$

$$\mathbf{A} \times \mathbf{B} = \begin{vmatrix} \mathbf{a}_x & \mathbf{a}_y & \mathbf{a}_z \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$



$$\mathbf{a}_x \times \mathbf{a}_y = \mathbf{a}_z,\ \mathbf{a}_y \times \mathbf{a}_z = \mathbf{a}_x,\ \text{and}\ \mathbf{a}_z \times \mathbf{a}_x = \mathbf{a}_y.$$

Algebra:

$$\begin{aligned}\mathbf{A} \times \mathbf{B} = {} & A_xB_x\mathbf{a}_x \times \mathbf{a}_x + A_xB_y\mathbf{a}_x \times \mathbf{a}_y + A_xB_z\mathbf{a}_x \times \mathbf{a}_z \\ & + A_yB_x\mathbf{a}_y \times \mathbf{a}_x + A_yB_y\mathbf{a}_y \times \mathbf{a}_y + A_yB_z\mathbf{a}_y \times \mathbf{a}_z \\ & + A_zB_x\mathbf{a}_z \times \mathbf{a}_x + A_zB_y\mathbf{a}_z \times \mathbf{a}_y + A_zB_z\mathbf{a}_z \times \mathbf{a}_z\end{aligned}$$

Examples in physics.

$$\mathbf{A} \times \mathbf{B} = (A_yB_z - A_zB_y)\mathbf{a}_x + (A_zB_x - A_xB_z)\mathbf{a}_y + (A_xB_y - A_yB_x)\mathbf{a}_z$$

Problems

1- Vector **A** has magnitude 3, vector **B** has magnitude 4 and the angle between **A** and **B** is 60. the value of **A**.**B** equal (3 - 5 - 6 - 10.39)

2- **a**, **b** and **c** are three vectors such that **c** is perpendicular to both **a** and **b** What is the value of **a** × **b** × **c**? { (0,0,0) (1,0,1) (0,1,1) (1,1,1)}

3- Vector **A** has magnitude $3\sqrt{2}$, vector **B** has magnitude 5. The angle between **A**& **B** is 135 and **n** is the unit vector at right angles to both **A**, **B**. What is the value of **A**x**B**=? ($-15\sqrt{2}$ n -15n 15n $15\sqrt{2}$ n)

4-What is the unite vector perpendicular to the plane of the two vectors **A**(3,-2,4) ,**B**(1,-1,-2)?

5-Find the area of triangle **A**(2,-3,1) **B**(1,-1,2) **C**(-1,2,3).