Mohamed Boudiaf University of Msila.
Faculty of sciences
Field : Sciences of matter (SM)
1st year LMD   Semester 01.

جامعـة محمد بوضياف -المسيلـة
كليـة العلـوم
ميدان : علوم المادة
السنة الأولى ل م د - السداسي 01

Physics 01: Mechanics of point particle.

University Year 2023-2024

Series N° 01: Mathematical background

EXERCISE 01:

1- Define the scalar quantity and the vector quantity?

2- Which of the following are vectors and which are scalars: (a) Time (b) Velocity (c) Length (d) Distance (e) Force (f) Temperature (g) Electric field (h) Acceleration (i) Potential (j) Weight.

EXERCISE 02:

The magnitude of the centripetal force $\boldsymbol{F_c}$ acting on an object is a function of mass **M** of the object, its velocity **υ**, and the radius **r** of the circular path. By using the method of dimensional analysis, find an expression for the centripetal force.

EXERCISE 03:

1- Newton's second law states that the acceleration of an object is directly proportional to the force applied and inversely proportional to the mass of the object.

Find the dimensions of force and show that it has units of **kg·m/s²** in terms of SI units.

2- Newton's law of universal gravitation is given by $F = \boldsymbol{G}\,\frac{\boldsymbol{m_1 m_2}}{\boldsymbol{r^2}}$, where $\boldsymbol{F}$ is the force of attraction of one mass m_1 upon another mass m_2 at a distance $\boldsymbol{r}$. Find the SI units of the constant G.

EXERCISE 04:

Use dimensional analysis to show that the expressions of kinetic energy $\boldsymbol{E_k} = \frac{1}{2}\,\boldsymbol{mV^2}$ and potential energy $\boldsymbol{E_p} = \boldsymbol{m.g.h}$ are correct and have the same dimension, where $\boldsymbol{V}$ represent velocity, $\boldsymbol{g}$ is gravitational acceleration, $\boldsymbol{h}$ is height and $\boldsymbol{m}$ is mass.

EXERCISE 05:

1- Represent the following points in the Cartesian referential: $M_1(3,1,-2)$, $M_2(1,2,1)$, $M_3(-3,2,1)$, $M_4(-1,1,2)$ and find the vectors $\vec{A} = \overrightarrow{M_2M_1}$ and $\vec{B} = \overrightarrow{M_4M_3}$

2- Calculate: (a) $\vec{A} + \vec{B}$, (b) $\vec{A} - \vec{B}$, (c) $\|\vec{A}\|$, $\|\vec{B}\|$, (d) $(\vec{A} + \vec{B})^2$, (e) $A^2 + B^2$, (f) $\vec{A}.\vec{B}$, (g) the angle between $\vec{A}$ and $\vec{B}$, (h) $\vec{A} \wedge \vec{B}$, (i) the directional cosines of $\vec{A}$ and $\vec{B}$, (j) the unit vector of $\vec{A}$ and $\vec{B}$.

3- Given the vector $\vec{C} = x\vec{i} + \vec{j} + z\vec{k}$; find x and z for each case: (a) $\vec{C}$ parallel to $\vec{A}$, (b) $\vec{C}$ is perpendicular to ($\vec{A}$ and $\vec{B}$) at the same time.

EXERCISE 06:

1- By using the properties of the vector product, show that the following equation is satisfied in triangle ABC (see figure 1): $\frac{a}{sin\alpha} = \frac{b}{sin\beta} = \frac{c}{sin\gamma}$

2- An object is supported by two cables. Each exerting forces of magnitude P and Q are shown in the figure 2. Gravity exerts a downward force of 400 N on the object. By using the previous equation, find P and Q if the resultant force is zero.

Fig. 1

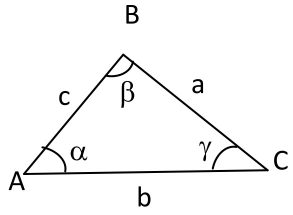
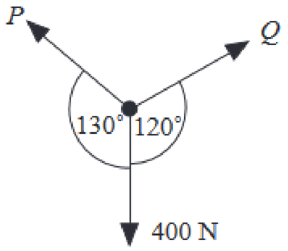


Fig. 2



EXERCISE 07:

1- Given $\vec{A} = 3t\vec{i} - (t^2 + t)\vec{j} + (t^3 - 2t^2)\vec{k}$. Calculate $\frac{d\vec{A}(t)}{dt}$ and $\frac{d^2\vec{A}(t)}{dt^2}$. Apply for t=2.

2- Given $\vec{B} = e^{-wt}\vec{i} + sinwt\vec{j} + coswt\vec{k}$ (w is constant). Calculate $\frac{d\vec{B}(t)}{dt}$ and $\frac{d^2\vec{B}(t)}{dt^2}$

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