PHY111 Pre-class task 3 Vectors 21 February 2025

Learning outcomes: At the end of this lecture students should be able to

- Resolve a vector into its perpendicular components.
- Represent the vector in unit vector and polar form
- Define and calculate the net/resultant vector using vector in unit vector form

Note! : In PHY111, we see you as capable and diligent students. Our teaching philosophy is to support and encourage you to take charge of and take responsibility for your learning in physics, helping you develop into strong academic students. As the PHY111 team, we will do our utmost to create a learning environment that enables this. Therefore, please do your part—you will reap the rewards of your hard work in the future. Complete your PHY111 pre-tasks, quizzes, class tasks, and problem sets diligently. Attend all classes, as this is where you will learn PHY111 physics through talking physics, thinking physics and doing physics.

Instructions:

- Please read the notes on vectors available on Ikamva or any other relevant resources you have. Engage with the material thoroughly and ensure that you fully comprehend it.
- Next, answer the questions in Pre-Class Task 3 and submit your completed task via Ikamva under the "Assignments" link by 20h00 on Thursday, 20 February.

Question 1

1. Study the position vector, $\vec{r}$ = (5 m, 45°) given in polar form. In polar coordinates, 5 m represents radial distance r from the origin (reference point) and 45^0 represent the angle measured anticlockwise from the positive X-axis in the 2-dimensional X-Y Cartesian plane.

1.1 Create a vector diagram to conceptualize the position vector, $\vec{r}$. Additionally, indicate the perpendicular components of the position vector on the sketch.

1.2 Use your knowledge of trigonometry, to the determine the magnitudes of the perpendicular components of the position vector, $\vec{r}$.

1.3 In physics and mathematics, we will use of the concept of unit vectors in vector algebra to describe the directions of the perpendicular components along the axes of the Cartesian plane. The direction along the X-axis will be denoted by the unit vector $\hat{\imath}$. In relation to the origin of the Cartesian plan $+\hat{\imath}$ indicates movement along the positive X-axis, and $-\hat{\imath}$ indicates movement along the negative X-axis. Similarly, the direction along the Y-axis will be represented by the unit vector $\hat{\jmath}$. $+\hat{\jmath}$ indicates movement along the positive Y-axis, $-\hat{\jmath}$ while indicates movement along the negative Y-axis. Using the concept of unit vector any vector can be written in unit vector form, given by $\vec{r} = r_x\hat{\imath} + r_y\hat{\jmath}$ where r_x and r_y are the components of the vector $\vec{r}$ along the x-axis and y-axis, respectively. **Use the information and answers to question 1. to write the position vector, $\vec{r}$ in unit vector form.**

2. Given the force vector, $\vec{F} = 3\ N\hat{\imath} + 4\ N(-\hat{\jmath})$, create a vector diagram to conceptualize the force vector, $\hat{F}$. Additionally, indicate the perpendicular components of the force vector on the sketch. Express the force vector in polar form. Indicate the polar form on the vector diagram.

Question 2

2.2 Define the net or resultant vector of two vectors.

2.2 Can the force vectors, 6 N to the left and 8 N at an angle of 60° clockwise from the positive X-axis, result in a net force of magnitude 3 N? Validate your answer with a calculation. **Hint:** You cannot directly add a vector along a line to a vector in a plane. To perform the calculation:

1) Express both vectors in unit vector form.
2) Determine the resultant components along the X-axis and Y-axis.
3) Visualize this using a vector diagram.
4) Apply the Pythagorean theorem to find the magnitude of the resultant force.

2.3 The force vectors $\vec{F}_1 =$ (10 N, 90^0) and $\vec{F}_2 = 3\ N\hat{\imath} + 4\ N(-\hat{\jmath})$ acts on an object. Determine the net or resultant force acting on the object. Before carrying out the calculation first conceptualize the problem with a vector diagram and use hint in question 2.2 to solve.