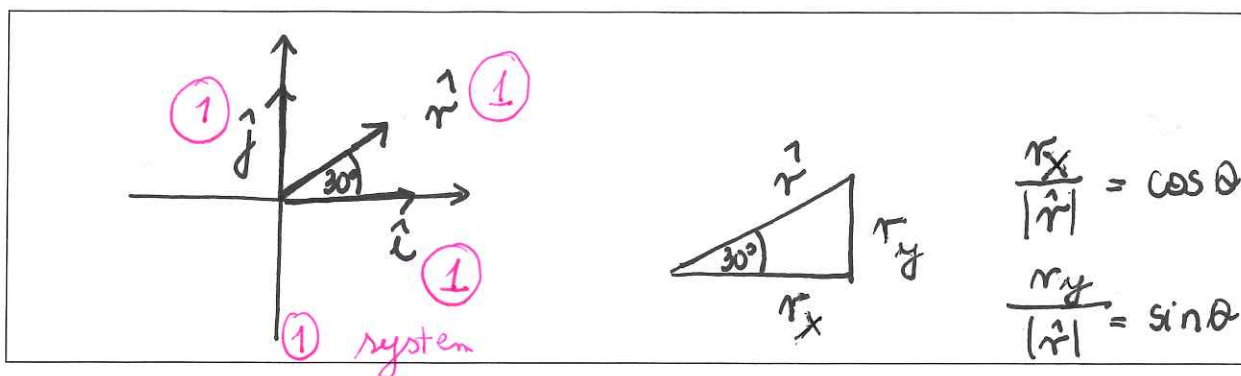


Group #	Student	Last Name	First Name
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(10 marks) In a two dimensional Cartesian system  $\hat{r}$  is located  $30^\circ$  north of east. What is the mathematical expression for  $\hat{r}$  in terms of Cartesian unit vectors?

The questions below walk you through the steps to solve this problem. Please show all work in the boxes provided and then choose the correct answer.

1. (3<sup>4</sup> marks) Draw a two dimensional Cartesian coordinate system (1 mark). Draw  $\hat{r}$  and unit vectors which represent the direction in the positive x-axis and y-axis (1 mark each).



2. (1 mark) Do unit vectors have physical units (such as metres)? Explain.

No, from definition  $\hat{r} = \frac{\vec{r}}{|\vec{r}|}$  vector magnitude, units cancel

3. (3<sup>2</sup> marks) Write a mathematical expression for  $\hat{r}$  in terms of Cartesian unit vectors.

$$\hat{r} = r_x \hat{i} + r_y \hat{j} = \cos(30) \hat{i} + \sin(30) \hat{j}$$

4. (2 marks) Show that  $\hat{r}$  is indeed a unit vector.

$$\begin{aligned} \hat{r} &= 0.866 \hat{i} + 0.5 \hat{j} & \hat{r} &= r_x \hat{i} + r_y \hat{j} \\ |\hat{r}| &= \sqrt{(0.866)^2 + (0.5)^2} = 1 & |\hat{r}| &= \sqrt{(r_x)^2 + (r_y)^2} \end{aligned}$$

(1 mark for the correct answer) Circle answer below:

A.  $\hat{r} = \cos(30)\hat{i} - \sin(30)\hat{j}$     B.  $\hat{r} = \sin(30)\hat{i} + \cos(30)\hat{j}$

C.  $\hat{r} = \sin(30)\hat{i} - \cos(30)\hat{j}$     D.  $\hat{r} = \cos(30)\hat{i} + \sin(30)\hat{j}$

(1)