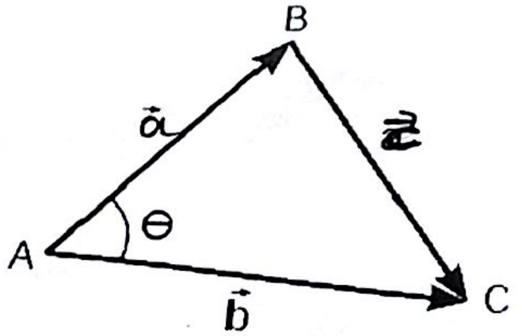
PHYS 101: General Physics KOÇ UNIVERSITY Fall Semester 2013
College of Arts and Sciences
Section 1 Quiz 1 26 September 2013

Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes
First Name: **Last name:** **Student ID:** **Signature:**



Using vector techniques and considering the trianlge formed by three vectors as shown above, show that $c^2 = a^2 + b^2 - 2ab\cos\theta$. (Hint: Consider the vector relation $\vec{\mathbf{c}} = \vec{\mathbf{b}} - \vec{\mathbf{a}}$)

$$\vec{c} = \vec{b} - \vec{a}$$

$$(\vec{c})^2 = (\vec{b} - \vec{a})^2$$

$$|\vec{c}|^2 = |\vec{b} - \vec{a}|^2$$

$$|\vec{c}|^2 = |\vec{b}|^2 + |\vec{a}|^2 - 2\,|\vec{b} \cdot \vec{a}|$$

And $\vec{b} \cdot \vec{a} = |\vec{b}||\vec{a}|\cos\theta$ *

$$\Rightarrow \quad |\vec{c}|^2 = |\vec{b}|^2 + |\vec{a}|^2 - 2\,|\vec{b}||\vec{a}|\cos\theta$$

$$c^2 = a^2 + b^2 - 2ab\cos\theta$$

PHYS 101: General Physics **KOÇ UNIVERSITY** **Fall Semester 2013**

College of Arts and Sciences

Section 2 **Quiz 1** **26 September 2013**

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First Name: **Last name:** **Student ID:** **Signature:**

By direct substitution show that $\vec{\mathbf{A}} \times (\vec{\mathbf{B}} \times \vec{\mathbf{C}}) = \vec{\mathbf{B}}(\vec{\mathbf{A}} \cdot \vec{\mathbf{C}}) - \vec{\mathbf{C}}(\vec{\mathbf{A}} \cdot \vec{\mathbf{B}})$ for the vectors $\vec{\mathbf{A}} = \hat{\imath} - 2\hat{\jmath}$, $\vec{\mathbf{B}} = \hat{\jmath} + \hat{k}$, and $\vec{\mathbf{C}} = \hat{k}$.

$$\vec{B} \times \vec{C} = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ 0 & 1 & 1 \\ 0 & 0 & 1 \end{vmatrix} = \hat{\imath}$$

$$\vec{A} \times (\vec{B} \times \vec{C}) = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ 1 & -2 & 0 \\ 1 & 0 & 0 \end{vmatrix} = 2\hat{k}$$

$$\vec{A} \cdot \vec{C} = (\hat{\imath} - 2\hat{\jmath}) \cdot (\hat{k}) = 0 \Rightarrow \vec{B}(\vec{A} \cdot \vec{C}) = 0$$

$$\vec{A} \cdot \vec{B} = (\hat{\imath} - 2\hat{\jmath}) \cdot (\hat{\jmath} + \hat{k}) = 1 \cdot 0 + (-2) \cdot 1 + 0 \cdot 1 = -2$$

$$\vec{C}(\vec{A} \cdot \vec{B}) = \hat{k}(-2) = -2\hat{k}$$

$$\rightarrow \quad \vec{A} \times (\vec{B} \times \vec{C}) = \vec{B}(\vec{A} \cdot \vec{C}) - \vec{C}(\vec{A} \cdot \vec{B})$$

$$2\hat{k} = 0 - (-2\hat{k})$$

$$2\hat{k} = 2\hat{k} \quad \checkmark$$

PHYS 101: General Physics

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Section 4 Quiz 1 26 September 2013

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First Name: **Last name:** **Student ID:** **Signature:**

You are given vectors $\vec{A} = 5\hat{\imath} - 6.5\hat{\jmath}$ and $\vec{B} = -3.5\hat{\imath} + 7\hat{\jmath}$. A third vector $\vec{C}$ lies in the xy-plane. Vector $\vec{C}$ is perpendicular to vector $\vec{A}$, and the scalar product of $\vec{C}$ with $\vec{B}$ is 15. From this information, find the components of vector $\vec{C}$.

$\vec{C} \perp \vec{A}$, $\vec{C}\cdot\vec{B} = 15$

If $\vec{C}$ is perpendicular to $\vec{A}$, then the angle between them is $90°$

$\vec{C}\cdot\vec{A} = |\vec{C}||\vec{A}| \cos\theta$, $\theta = 90°$

$\vec{C}\cdot\vec{A} = 0$

$\vec{C}\cdot\vec{A} = (C_x\hat{\imath} + C_y\hat{\jmath}) \cdot (5\hat{\imath} - 6.5\hat{\jmath}) = 0$

$5C_x - 6.5C_y = 0$ (1)

$\vec{C}\cdot\vec{B} = (C_x\hat{\imath} + C_y\hat{\jmath}) \cdot (-3.5\hat{\imath} + 7\hat{\jmath}) = 15$

$-3.5C_x + 7C_y = 15$ (2)

Using (1) and (2):

$3.5/ \quad 5C_x - 6.5C_y = 0$

$5/ \quad -3.5C_x + 7C_y = 15$

$12.25C_y = 75$

$C_y = 6.12 \simeq 6.$

$5C_x - 6.5(6.12) = 0$

$C_x = 7.95 \simeq 8$

$\vec{C} = 6\hat{\imath} + 8\hat{\jmath}$

PHYS 101: General Physics | KOÇ UNIVERSITY | Fall Semester 2013

College of Arts and Sciences

Section 5 | Quiz 1 | 26 September 2013

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Quiz duration: 10 minutes

First Name: Last name: Student ID: Signature:

Consider vectors $\vec{A} = -4\hat{\imath} + 5\hat{\jmath}$ and $\vec{B} = 2\hat{\imath} + 5\hat{k}$. Find the $\vec{C}$ which has magnitude 5 and which is parallel to $\vec{A} \times \vec{B}$.

$$\vec{A}\times\vec{B} = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ -4 & 5 & 0 \\ 2 & 0 & 5 \end{vmatrix} = 25\hat{\imath} + 20\hat{\jmath} - 10\hat{k}$$

$$|\vec{A}\times\vec{B}| = \sqrt{625+400+100} = \sqrt{1125} = 33.6$$

$$\frac{\vec{C}}{|\vec{C}|} = \frac{\vec{A}\times\vec{B}}{|\vec{A}\times\vec{B}|}$$

$$\vec{C} = \frac{5\cdot(\vec{A}\times\vec{B})}{33.6} = \frac{5\cdot}{33.6}(25\hat{\imath}+20\hat{\jmath}-10\hat{k})$$

$$\vec{C} = \frac{125}{33.6}\hat{\imath} + \frac{100}{33.6}\hat{\jmath} - \frac{50}{33.6}\hat{k}$$

PHYS 101: General Physics | KOÇ UNIVERSITY | Fall Semester 2013

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Section 3 | Quiz 1 | 26 September 2013

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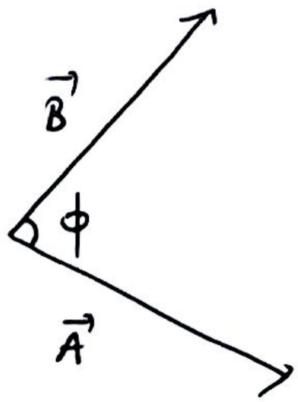
First Name: **Last name:** **Student ID:** **Signature:**

When two vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ are drawn from a common point, the angle between them is ϕ. Using vector techniques show that the magnitude of their vector sum $(|\vec{\mathbf{A}}+\vec{\mathbf{B}}|)$ is given by $\sqrt{A^2+B^2+2AB\cos\phi}$.



$$(|\vec{A}+\vec{B}|)^2=(\vec{A}+\vec{B})\cdot(\vec{A}+\vec{B})$$

$$=|\vec{A}|^2+|\vec{B}|^2+2\,\vec{A}\cdot\vec{B}$$

$$\vec{A}\cdot\vec{B}=|\vec{A}|\,|\vec{B}|\cos\phi$$

$$(|\vec{A}+\vec{B}|)^2=|\vec{A}|^2+|\vec{B}|^2+2|\vec{A}|\,|\vec{B}|\cos\phi$$

$$|\vec{A}+\vec{B}|=\sqrt{A^2+B^2+2AB\cos\phi}$$