**PHYS 101: General Physics 1 KOÇ UNIVERSITY Fall Semester 2012**

**College of Sciences**

**Section 1 Quiz 1 27 September 2012**

**Closed book. No calculators are to be used for this quiz.**
**Quiz duration: 10 minutes**

**Name: Student ID: Signature:**

Find the vector $\vec{A}$ that has unit magnitude and that is perpendicular to the two vectors $\vec{B} = 2\hat{j} + 3\hat{k}$ and $\vec{C} = \hat{i} - \hat{j}$.

Two methods:

a) $\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$

$\vec{A}\cdot\vec{B} = A_x B_x + A_y B_y + A_z B_z = 0$

$B_y = 2 \quad B_z = 3 \Rightarrow 2A_y + 3A_z = 0 \Rightarrow A_y = \frac{-3A_z}{2}$

$\vec{A}\cdot\vec{C} = A_x C_x + A_y C_y + A_z C_z = 0$

$C_x = 1 \quad C_y = -1 \Rightarrow A_x - A_y = 0 \Rightarrow$ $\boxed{A_x = A_y = \frac{-3A_z}{2}}$ ★

Let $\vec{A}'$ be a vector in the direction of $\vec{A}$; but not with unit length. Choose $A_x = 1$

Using ★ box, $\vec{A}' = \hat{i} + \hat{j} - \frac{3}{2}\hat{k}$

Normalize $\vec{A}' \Rightarrow \vec{A} = \frac{\vec{A}'}{|\vec{A}'|} = \frac{\hat{i} + \hat{j} - \frac{3}{2}\hat{k}}{\sqrt{1+1+\frac{9}{4}}}$

$$\boxed{\vec{A} = \frac{\hat{i} + \hat{j} - \frac{3}{2}\hat{k}}{\sqrt{\frac{22}{4}}}}$$

If we choose $A_x = -1$,

$$\boxed{\vec{A} = \frac{-\hat{i} - \hat{j} + \frac{3}{2}\hat{k}}{\sqrt{\frac{22}{4}}}}$$

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**Section 2** **Quiz 1** **27 September 2012**

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**Quiz duration: 10 minutes**

**Name:** **Student ID:** **Signature:**

Find the angle between $(\vec{A}-\vec{B})$ and $\vec{A}$, for $\vec{A}=4\hat{i}+\hat{j}+2\hat{k}$ and $\vec{B}=2\hat{i}+3\hat{j}+\hat{k}$.

$\vec{A}-\vec{B} = 2\hat{i} - 2\hat{j} + \hat{k}$

$$\cos\theta = \frac{(\vec{A}-\vec{B})\cdot\vec{A}}{|\vec{A}-\vec{B}|\,|\vec{A}|} = \frac{8-2+2}{\sqrt{21}\ \sqrt{9}} = \frac{8}{3\sqrt{21}}$$

$$\theta = \arccos\left(\frac{8}{3\sqrt{21}}\right)$$

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**Section 3 Quiz 1 27 September 2012**

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**Quiz duration: 10 minutes**

**Name: Student ID: Signature:**

Find a vector that is perpendicular to both $(\vec{A}-\vec{B})$ and $(\vec{A}+\vec{B})$ and has a magnitude equal to the scalar product of $\vec{A}$ and $\vec{B}$ where $\vec{A}=2\hat{i}-3\hat{j}+3\hat{k}$ and $\vec{B}=\hat{i}-\hat{j}+2\hat{k}$.

$(\vec{A}-\vec{B}) = \hat{i}-2\hat{j}+\hat{k}$

$(\vec{A}+\vec{B}) = 3\hat{i}-4\hat{j}+5\hat{k}$

$$\vec{X}' = (\vec{A}-\vec{B})\times(\vec{A}+\vec{B}) = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -2 & 1 \\ 3 & -4 & 5 \end{vmatrix}$$

$$= \hat{i}\begin{vmatrix} -2 & 1 \\ -4 & 5 \end{vmatrix} - \hat{j}\begin{vmatrix} 1 & 1 \\ 3 & 5 \end{vmatrix} + \hat{k}\begin{vmatrix} 1 & -2 \\ 3 & -4 \end{vmatrix}$$

$$= -6\hat{i}-2\hat{j}+2\hat{k}$$

$\vec{A}\cdot\vec{B} = 2+3+6 = 11$

$\hat{X}$ : unit vector in the direction of $\vec{X}'$

$$\hat{X} = \frac{-6\hat{i}-2\hat{j}+2\hat{k}}{\sqrt{36+4+4}} = \frac{-3\hat{i}-\hat{j}+\hat{k}}{\sqrt{11}}$$

$$\boxed{\vec{X} = 11\hat{X} = (-3\hat{i}-\hat{j}+\hat{k})\sqrt{11}}$$

If we used $\vec{X}' = (\vec{A}+\vec{B})\times(\vec{A}-\vec{B})$

$$\boxed{\vec{X} = (3\hat{i}+\hat{j}-\hat{k})\sqrt{11}}$$

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**Section 4** **Quiz 1** **27 September 2012**

**Closed book. No calculators are to be used for this quiz.**
**Quiz duration: 10 minutes**

**Name:** **Student ID:** **Signature:**

Find a vector $\vec{A}$ which has magnitude 3 and is parallel to $\vec{B} = 5\hat{i} + 3\hat{j} - \hat{k}$.

$\hat{A}$ : unit vector in the direction of $\vec{A}$

$$\hat{A} = \frac{\vec{B}}{|\vec{B}|} = \frac{5\hat{\imath} + 3\hat{\jmath} - \hat{k}}{\sqrt{25+9+1}} = \frac{5\hat{\imath} + 3\hat{\jmath} - \hat{k}}{\sqrt{35}}$$

$$\vec{A} = 3\hat{A} = \frac{3}{\sqrt{35}}\left(5\hat{\imath} + 3\hat{\jmath} - \hat{k}\right)$$

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**Section 5 Quiz 1 27 September 2012**

**Closed book. No calculators are to be used for this quiz.**
**Quiz duration: 10 minutes**

**Name: Student ID: Signature:**

Calculate the vector product of $(\vec{A}+\vec{B})$ and $(\vec{A}-\vec{B})$ where $\vec{A}=5\hat{i}-2\hat{j}+4\hat{k}$ and $\vec{B}=3\hat{i}+4\hat{j}-2\hat{k}$.

$\vec{A}+\vec{B} = 8\hat{i} + 2\hat{j} + 2\hat{k}$

$\vec{A}-\vec{B} = 2\hat{i} - 6\hat{j} + 6\hat{k}$

$$(\vec{A}+\vec{B})\times(\vec{A}-\vec{B}) = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 8 & 2 & 2 \\ 2 & -6 & 6 \end{vmatrix}$$

$$= \hat{i}\begin{vmatrix} 2 & 2 \\ -6 & 6 \end{vmatrix} - \hat{j}\begin{vmatrix} 8 & 2 \\ 2 & 6 \end{vmatrix} + \hat{k}\begin{vmatrix} 8 & 2 \\ 2 & -6 \end{vmatrix}$$

$$= 24\hat{i} - 44\hat{j} - 52\hat{k}$$