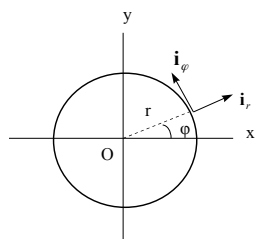**PHYSICS 501**
**1st HOMEWORK**
**Dr. V. Lempesis**



**1.** For objects that move in a circle about an origin O, it can be convenient to use the mutually perpendicular unit vectors $\mathbf{i}_r$ and $\mathbf{i}_\varphi$ as shown in figure. Express $\mathbf{i}_r$ and $\mathbf{i}_\varphi$ as a combination of $\mathbf{i}$ and $\mathbf{j}$.

(5 marks)

**2.** Show that $\mathbf{A} \cdot \mathbf{B} \times \mathbf{C} = \begin{vmatrix} A_x & A_y & A_z \\ B_x & B_y & B_z \\ C_x & C_y & C_z \end{vmatrix}$.

(5 marks)

**3.** Using the vectors $\mathbf{P} = \mathbf{i}\cos\theta + \mathbf{j}\sin\theta$, $\mathbf{Q} = \mathbf{i}\cos\phi - \mathbf{j}\sin\phi$, prove the familiar trigonometric identity

$$\cos(\theta + \phi) = \cos\theta\cos\phi - \sin\theta\sin\phi.$$

(5 marks)

**4.** Prove that two vectors $\mathbf{A}$ and $\mathbf{B}$ must have equal magnitudes if their sum $\mathbf{A+B}$ is perpendicular (orthogonal) to their difference $\mathbf{A-B}$.

(5 marks)

**For the girls: Please send your answers in pdf form (typed or in clearly handwritten form) in my email address (vlempesis@ksu.edu.sa). Please use ONE file for your entire homework NOT one file per page. Please do not forget to put your name and your ID number on it AND on your file name.**
**Your deadline is on Sunday 23th September 2018 at 23:59.**

**For the boys: You will hand in your homework in hard copy in our class on Monday 24th September.**