KING FAHD UNIVERSITY OF PETROLEUM & MINERALS
ELECTRICAL ENGINEERING DEPARTMENT

EE340-Lab [151] sec #**52**	**Quiz: #PS**	**14 Sep 2015**
Name: *SOLUTION*________________	**ID:**______________________	**Grade**:_______

Problem 1). Given vectors $\overline{\mathbf{A}} = 2\overline{\mathbf{a_x}} + 17\overline{\mathbf{a_y}} + 5\overline{\mathbf{a_z}}$ and $\overline{\mathbf{B}} = 6\overline{\mathbf{a_x}} + 3\overline{\mathbf{a_y}} + 6\overline{\mathbf{a_z}}$, Find**:**

a) $\mathbf{B} \cdot (\mathbf{A} \times \mathbf{B})$

$= \mathbf{0}$ $[$ ***the vector B is orthogonal to the vector*** $(\boldsymbol{A} \times \boldsymbol{B})$

b) Determine the vector component of A that is:

1) Normal to the surface $\mathbf{x = 9}$

$$= \mathbf{2}\ \boldsymbol{a_x}$$

2) Tangential to the surface $\mathbf{z = 4}$

$$= \mathbf{2}\ \boldsymbol{a_x} + \mathbf{17}\ \boldsymbol{a_y}$$

Problem 2).

a) Given that $\overline{\mathbf{E}} = 2\ \overline{\mathbf{a_r}}$, evaluate $\oint_S\ \overline{\mathbf{E}} \cdot \mathbf{dS}$ .Where S is the region between spherical surfaces r = 2 and r = 4

$$dS = dS_1 + dS_2 \ ; \quad dS_1 = +r^2 sin\theta d\theta d\varphi a_{r|at\ r=4} \ ;$$
$$dS_2 = -r^2 sin\theta d\theta d\varphi a_{r|at\ r=2}$$

$$\oint_S \overline{E} \cdot dS = \oint_{S_1} \overline{E} \cdot dS_1 + \oint_{S_2} \overline{E} \cdot dS_2 =$$

$$= \iint_{00}^{2\pi\ \pi} 2\ r^2 sin\theta d\theta d\varphi_{r=4} - \iint_{00}^{2\pi\ \pi} 2\ r^2 sin\theta d\theta d\varphi_{r=2}$$

$$= 2 * (4)^2 * (-cos\theta)\Big|_0^{\pi} * \varphi\Big|_0^{2\pi} - 2 * (2)^2 * (-cos\theta)\Big|_0^{\pi} * \varphi\Big|_0^{2\pi}$$

$$= 2 * 16 * 2 * 2\pi - 2 * 4 * 2 * 2\pi$$

$$= 96\pi$$

b) Find the surface integral of $\overline{\mathbf{F}} = 64\ \overline{\mathbf{a_z}}$ over S, where S is the cylinder defined by $\mathbf{0 \le \rho \le 2, 0 \le z \le 5}$ **and** $\mathbf{0 \le \varphi \le 2\pi}$. Justify your answer.

$$= 0\ (the\ Flux\ of\ a\ constant\ field\ to\ a\ uniform\ surface\ equal\ zero)$$

Problem 3)

a) Write the **divergence** theorem. (only the law)

$$\oint_S \overline{\boldsymbol{E}} \cdot \boldsymbol{dS} = \iiint_V (\boldsymbol{\nabla} . \vec{\boldsymbol{E}}) \boldsymbol{dV}$$

b) If the vector field:

$\overline{\mathbf{G}} = (2Bz - Ay)\overline{a_x} + (2x + Cz)\overline{a_y} + (4y - x)\overline{a_z}$

is **<u>irrotational</u>**, determine the constants: A, B and C.

$$\boldsymbol{irrotational} \Leftrightarrow \boldsymbol{\nabla} \times \vec{\boldsymbol{G}} = \boldsymbol{0}$$

$$\boldsymbol{\nabla} \times \vec{\boldsymbol{G}} = (\boldsymbol{4} - \boldsymbol{C})\boldsymbol{a_x} + (\boldsymbol{2B} + \boldsymbol{1})\boldsymbol{a_y} + (\boldsymbol{2} + \boldsymbol{A})\boldsymbol{a_z} = \boldsymbol{0}$$

$$(\boldsymbol{4} - \boldsymbol{C}) = \boldsymbol{0} \quad ; \quad \boldsymbol{C} = \boldsymbol{4}$$

$$(\boldsymbol{2B} + \boldsymbol{1}) = \boldsymbol{0} \quad ; \quad \boldsymbol{B} = -\frac{\boldsymbol{1}}{\boldsymbol{2}}$$

$$(\boldsymbol{2} + \boldsymbol{A}) = \boldsymbol{0} \quad ; \quad \boldsymbol{A} = -\boldsymbol{2}$$