Assiut University | First Year
Faculty of Engineering
Electrical Engineering Dept. | Electric Fields

Sheet no. (1)

1- Given the vectors $\mathbf{A} = -6\mathbf{a_x} + 2\mathbf{a_y} - 4\ \mathbf{a_z}$and $\mathbf{B}\ = 4\mathbf{a_x} + 3\mathbf{a_y} - 2\mathbf{a_z}$ Find (a) a unit vector in the direction of **A**+2**B**; (b) the magnitude of **A**+2**B**; (c) the vector **C** such that **A**+**B**+**C**=**0**.

2- The vectors **A** = $4\mathbf{a_x} + 5\mathbf{a_y} - 2\mathbf{a_z}$ and **B** =$2\mathbf{a_x} + 8\mathbf{a_y} + 3\mathbf{a_z}$ are represented by directed line segments that extend outward from the origin of a cartesian coordinate system. (a) What is the separation of their tips? (b) Find a unit vector in the direction of **A.** (c) Find a vector **C** that is parallel to **A** and has the length of **B**.

3- A certain vector field is specified by:

$$\mathbf{A} = \frac{100\ (x - y + z)}{x^2 + y^2 + z^2}\mathbf{a}_x - xyz\ \mathbf{a}_y + 8(x + y - z)\ \mathbf{a}_z$$

For the interval $0 \leq x \leq 10$ along the line y = 1, z = 2, sketch the variation of (a) $\mathbf{A}_x$ versus x; (b) $|\mathbf{A}|$ versus x.

4- At the point C (2, 30º, 5), a vector **A** is expressed in cylindrical coordinates as $20\ \mathbf{a}_\rho - 30\ \mathbf{a}_\phi + 10\ \mathbf{a}_z$. (a) Find $|\mathbf{A}|$ at C; (b) Calculate the angle between **A** at C and the surface $\rho = 2$.

5- The surfaces of a volume are defined by ρ = 5 and 12, ϕ = 0.1π and 0.4π and z = -1 and 3. (a) Find the length of the straight line connecting diametrically opposite corners of the volume. (b) Find the area of the six faces. (c) Find the volume enclosed.

6- Express the vector field $\mathbf{W} = (x^2 - y^2)\mathbf{a}_y + xz\ \mathbf{a}_z$ in: (a) cylindrical coordinates at P (ρ = 6, ϕ = 60º, z = -4); (b) spherical coordinates at Q (r = 4, θ = 30º, ϕ = 120º).

7- At point B (r = 5, θ = 120º, ϕ = 75º) a vector field has the value **A** = - 12 $\mathbf{a_r}$ - 5 $\mathbf{a_\theta}$ + 15$\mathbf{a_\phi}$. Find the vector component of **A** that is: (a) normal to the surface r = 5, (b) tangent to the surface r = 5, (c) tangent to the cone θ = 120º; (d) Find a unit vector that is perpendicular to **A** and tangent to the cone θ = 120 º.

8- A field is given in spherical coordinates as **F**= [(cosθ) / r^2] $\mathbf{a_r}$ + [(sinθ / r] $\mathbf{a_\theta}$. (a) Express **F** in terms of x, y, z, $\mathbf{a_x}$, $\mathbf{a_y}$ and $\mathbf{a_z}$. (b) Evaluate **F** at (1, 2, 3).

9- Two vectors are defined at point P as **F** = 10 $\mathbf{a_r}$ - 3 $\mathbf{a_\theta}$ + 5 $\mathbf{a_\phi}$ and **G** = 2 $\mathbf{a_r}$+ 5 $\mathbf{a_\theta}$ + 3 $\mathbf{a_\phi}$. Determine (a) **F. G**; (b) the scalar component of **G** in the **F** direction at P; (c) the vector component of **G** in the **F** direction at P; (d) **G** x **F**; (e) a unit vector perpendicular to both **F** and **G** at P.