Date: _____

Question 1

(a)

$B = yi(x+z)j$ at $(-2, 6, 3)$

$= yixj + yzzj$

Point $x = -2$, $y = 6$, $z = 3$

From cartesian to cylindrical

$\rho = \sqrt{x^2+y^2} = \sqrt{(-2)^2+(6)^2} = 6.324$

$\phi = \tan^{-1}\left(\frac{y}{x}\right)$ $\tan^{-1}\left(\frac{6}{-2}\right) = -71.56$

$z = z = 3$

$B = 6.324 a\rho - 71.56 a\phi + 3 az$

(b)

Sol:-

For spherical we have to find

r, θ, ϕ

$r = \sqrt{x^2+y^2+z^2}$

$r = \sqrt{3^2+4^2+5^2}$

$r = \boxed{7.07}$

$\phi = \tan^{-1} y/x$

$= \tan^{-1}(4/3)$

$\phi = 53.13^\circ$

$\theta = \cos^{-1} \frac{z}{r}$

$= \cos^{-1} \frac{5}{7.07}$

$\theta = 45^\circ$

$r, \theta, \phi = (7.07, 45^\circ, 53.13^\circ)$

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Date:

c) A (2, 3, -1)

$r = \sqrt{x^2 + y^2 + z^2}$

$= \sqrt{2^2 + 3^2 + (-1)^2}$

$r = 3.74$

$\theta = \cos^{-1} \frac{z}{r}$

$= \cos^{-1} \left(\frac{-1}{3.74} \right)$

$\theta = 105.5^\circ$

$\varphi = \tan^{-1} (y/x)$

$\varphi = 56.3^\circ$

d) B (4, 25, 120)

Sol: Converting to cartesian

We have value of point B given in spherical (r, θ, φ)

We have to find (x, y, z)

$x = r \sin\theta \cos\theta$

$= 4 \sin 25 \cos 120$

$= -0.84$

$y = r \sin\theta \sin\theta$

$= 4 \sin 25 \sin 120$

$y = 1.46$

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Date: _____ (3)

$z = 3.62$

$(x, y, z) = (-0.84, 1.46, 3.62)$

e)

$$F = \frac{K q_1 q_2}{r^2}$$

where $K = \frac{1}{4\pi \varepsilon_0}$

$$F = \frac{2 \times 10^{-9} \times -1 \times 10^{-9}}{4\pi \times 8.85 \times 10^{-12} \times (4 \times 10^{-2})^2}$$

$$F = -1.123 \times 10^{-5}$$

$$F = -11.23\ \mu N$$

f) Find E_1 and E_2

Sol:- $q_1 = -2C$, $q_2 = -1C$

$r = 1m$

$$E_1 = \frac{q_1}{4\pi \varepsilon_0 r^2} = \frac{-2}{4\pi \times 8.85 \times 10^{-12} \times 1^2}$$

$$E_1 = -1.798 \times 10^{10}\ N/C$$

$$E_2 = \frac{-1}{4\pi \varepsilon_0 \times 1^2} = -8.9 \times 10^9\ N/C$$

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Date:_____

(g) $E = 40\ V/cm = 40\ V/10^{-2}m$

$E = 4000\ V/m$

$r = 30 \times 10^{-2}\ m$ $\quad q = ?$

$$E = \frac{q}{4\pi\varepsilon_0 r^2}$$

$$q = E \times 4\pi\varepsilon_0 r^2$$

$$= 4000 \times 4 \times 3.14 \times 8.85 \times 10^{-12} \times (30 \times 10^{-2})^2$$

$$q = 4 \times 10^{-8}\ C$$

(h)

$q_1 = 2 \times 10^{-7}$, $q_2 = 4.5 \times 10^{-7}$

$F = 0.1\ N$

$$F = \frac{q_1 q_2}{4\pi\varepsilon_0 r^2}$$

$$r = \sqrt{\frac{q_1 q_2}{4\pi\varepsilon_0 F}}$$

$$= \sqrt{\frac{2 \times 10^{-7} \times 4.5 \times 10^{-7}}{4\pi\varepsilon_0 (0.1)}}$$

$$r = 0.09\ m$$

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Date: _____ (5)

Question 2 :-

Sol :-

(a) $A = \sqrt{3}\,i_n + i_y$

$|A| = 2$

$B = 2i_n$

$|B| = 2$

$A \cdot B = 2\sqrt{3}$

Now $A \cdot B = |A|\,|B| \cos\theta_{ab}$

$$\cos\theta_{AB} = \frac{A \cdot B}{|A|\,|B|}$$

$$\theta_{AB} = \cos^{-1}\left(\frac{2\sqrt{3}}{2 \times 2}\right)$$

$$\theta_{AB} = 30^\circ$$

(b)

Finding Gradient

i) $f = ax^2 + by^3z$

$$\nabla f = \left(\frac{\partial i}{\partial x} + \frac{\partial}{\partial y} j + \frac{\partial k}{\partial z}\right)(ax^2 + by^3z)$$

$$\nabla f = \frac{\partial}{\partial x} ax^2 i + \frac{\partial}{\partial y} by^3z\,j + \frac{\partial}{\partial z} by^3z\,k$$

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(6)

$\nabla f = 2axi + 3bz y^2 j + by^3 k$

Required

ii) $f = ar^2 \sin\theta + brz \cos 2\theta$

gradient if we have cylindrical

$\nabla = \frac{\partial}{\partial r} r + \frac{1}{r}\frac{\partial}{\partial \theta} \theta + \frac{\partial}{\partial z} z$

$\nabla f = \left(\frac{\partial}{\partial r} \hat{r} + \frac{1}{r}\frac{\partial}{\partial \theta} \theta + \frac{\partial}{\partial z} z\right)\left(ar^2 \sin\theta + brz \cos 2\theta\right)$

$\nabla f = \frac{\partial}{\partial r}\left(ar^2 \sin\theta + brz \cos 2\theta\right) r + \frac{1}{r}\frac{\partial}{\partial \theta}\left(ar^2 \sin\theta + brz \cos 2\theta\right)\theta + \frac{\partial}{\partial z} brz \cos 2\theta z$

$= (2ar \sin\theta + bz \cos 2\theta) r + \frac{1}{r}(ar^2 \cos\theta - 2brz \sin 2\theta)\theta + br \cos 2\theta z$

$\nabla f = (2ar \sin\theta + bz \cos 2\theta) r + (ar \cos\theta - 2bz \sin 2\theta)\theta + br \cos 2\theta z$

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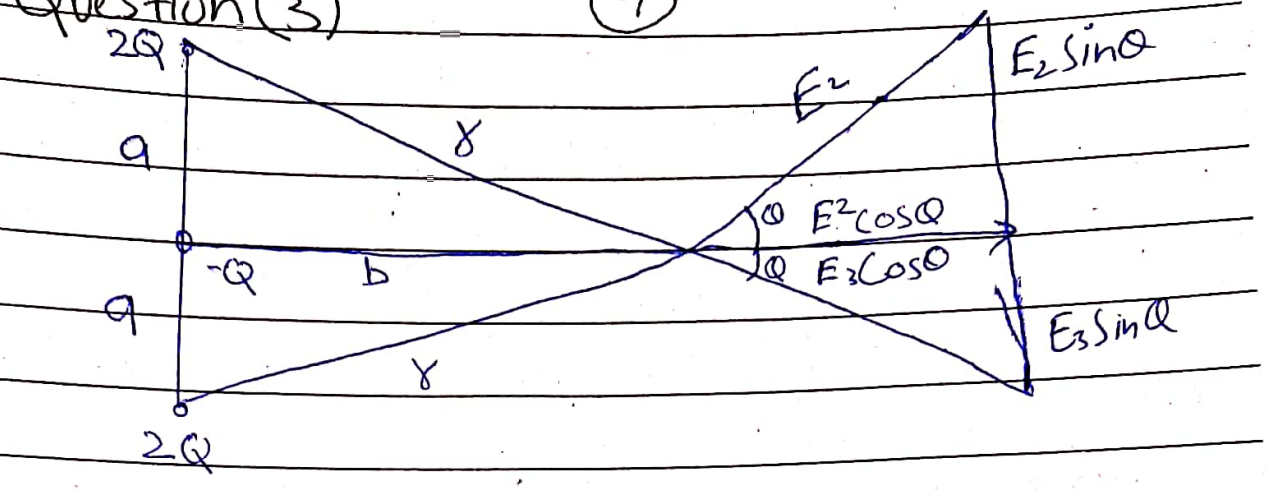
Question (3) (7)



$E_2 = E_3$ both charges are same

so x-compomat becomes

$E_{2+3} = 2E\cos\theta \rightarrow$ eq (1)

Now $E = \frac{KQ}{r^2}$

by pythagoras theorm

$r = \sqrt{a^2+b^2}$

$E = \frac{KQ}{\sqrt{a^2+b^2}}$

(i) $\Rightarrow E_{2+3} = 2\frac{KQ}{\sqrt{a^2+b^2}}\cos\theta$

Now $E_1 = -\frac{KQ}{r^2}$

$E_1 = -\frac{KQ}{b^2}$

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The total Electric field intensity at that point is

$$\vec{E} = \vec{E}_1 + \vec{E}_2 + \vec{3}$$

$$= 2\frac{KQ}{\sqrt{a^2+b^2}}\cos\theta - \frac{KQ}{b^2}$$

$$E = KQ\left(\frac{2}{\sqrt{a^2+b^2}}\cos\theta - \frac{1}{b^2}\right)$$

where $K = \frac{1}{4\pi\varepsilon_0}$

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Department of Electrical Engineering

Assignment

Date: 14-04-2020

Course Details

Course Title: Electro Magnetic Field Theory **Module:** _____

Instructor: _____ **Total Marks:** 30

Student Details

Name: Aqib Shukaib **Student ID:** 6978

Q1: Solve the following short Question	(a)	Transform the vector $B = yi\ (x+z)j$ located at point (-2,6,3) into cylindrical coordinates	Marks 2 CLO 1
	(b)	Convert the point (3,4,5) from Cartesian to spherical coordinates	Marks 2 CLO 1
	(c)	Find the spherical coordinates of A(2,3,-1)	Marks 2 CLO 1
	(d)	Find the Cartesian coordinates of B(4.25,120)	Marks 2 CLO 1
	(e)	Find the force between two charges when they are brought in contact and separated by 4cm apart, charges are 2nC and -1nC, in μN.	Marks 2 CLO 2
	(f)	Find the electric field intensity of two Charges -2C and -1C separated by a distance 1m in air	Marks 2 CLO 2
	(g)	Determine the charge that produce an electric field strength of 40 v/cm at a distance of 30cm in vacuum (in 10^{-8}c)	Marks 2 CLO 2
	(h)	A charge of $2 \cdot 10^{-7}$ C is acted upon by a force of 0.1N. determine the distance to the other charge of $4.5 \cdot 10^{-7}$C, both the charges are in vacuum	Marks 2 CLO 2
Q2:	**(a)**	**Find the angle between the vectors shown in figure.**	**Marks 4**

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