$i\left(\frac{\partial}{\partial y}(2xy)-\frac{\partial}{\partial z}(-3xz)\right]-j\left[\frac{\partial}{\partial x}(2xy)-\frac{\partial}{\partial z}(yz)+\right.$

$k\left[\frac{\partial}{\partial x}(-3xz)-\frac{\partial}{\partial y}(y^2\right.$

$=(2x+3x)i-j(2y-y)+k(-3z-z]$

$\nabla\times B$ at $(1,2,1)$

$\nabla\times B=(2\times1+3\times1)i-j(2\times2-2)+k(-3\times1-1)$

$\nabla\times B=(5)i-j(2)+k(-4)$

$\nabla\times B=5i-2j-4k$

Grad of div A

$\nabla\cdot A=2xy+(x+z)+2xz$

$\nabla A=\left[i\frac{\partial}{\partial x}+j\frac{\partial}{\partial y}+k\frac{\partial}{\partial z}\right]\nabla\cdot A$

$\nabla A=\left[(2y+1+2z)i+j(2x)+(1+2x)k\right]$

$\nabla(\nabla\cdot A)$ at $(1,2,1)$

$\nabla(\nabla\cdot A)=(2\times2+1+2\times1)i+(2\times1)j+(1+2\times1)k$

$=(7)i+(2)j+3k$

$7i+2j+3k$

Curl curl A

$\text{curl } A=\nabla\times A=\begin{vmatrix} i & j & k \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ x^2y & (xy+yz) & (xz^2) \end{vmatrix}$

$i\begin{vmatrix} \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ (xy+yz) & (xz^2) \end{vmatrix}-j\begin{vmatrix} \frac{\partial}{\partial x} & \frac{\partial}{\partial z} \\ x^2y & (xz^2) \end{vmatrix}+k\begin{vmatrix} \frac{\partial}{\partial x} & \frac{\partial}{\partial y} \\ x^2y & (xy+yz) \end{vmatrix}$

$i\left(\frac{\partial}{\partial y}(xz^2)-\frac{\partial}{\partial z}(xy+yz)\right)-j\left[\frac{\partial}{\partial x}(xz^2)-\frac{\partial}{\partial z}(x^2y)\right]$

$+k\left[\frac{\partial}{\partial x}(xy+yz)-\frac{\partial}{\partial y}(x^2y)\right]$

$i\left[0-y\right]-j\left[z^2-0\right]+k\left[y-x^2\right]$

at $(\cancel{1,2}$

$\nabla \times A = -y\,i - z^2 j + (y - x^2)k$

$$\nabla \times (\nabla \times A) = \begin{vmatrix} i & j & k \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ -y & -z^2 & (y-x^2) \end{vmatrix}$$

$$i \left| \frac{\partial}{\partial y}(y-x^2) - \frac{\partial}{\partial z}(-z^2) \right| - j \left| \frac{\partial}{\partial x}(y-x^2) - \frac{\partial}{\partial z}(-y) \right|$$

$$+k \left| \frac{\partial}{\partial x}(-z^2) - \frac{\partial}{\partial y}(-y) \right|$$

1) Mathematical modelling is a description of a system ~~using mathematical~~ concepts and lan

Mathematical models ~~are~~ defined as a process of developing a mathematical model.

methods of developing model in engineering system

1) Radioactivity

2) Mixing problems

Question 2

1) $r = (t^2+3t)i - 3\sin 3t\, j + 3e^{2t}k$

a) $\frac{dr}{dt} = (2t+3)i - (6\cos 3t)j + (6e^{2t})k$

b) $\frac{d^2r}{dt^2} = (2)i + (18\sin 3t)j + (12e^{2t})k$

$\frac{d^2r}{dt^2}$ at $t=0$ $= 2i + 18\sin 0\, j + 12e^0 k$

$\frac{d^2r}{dt^2}$ at $t=0$ $= 2i + 12k$

$\left|\frac{d^2r}{dt^2}\right|_{t=0} = \sqrt{2^2+12^2}$

$= \sqrt{4+144}$

$\left|\frac{d^2r}{dt^2}\right|_{t=0} = \sqrt{148} = 12.2$ units

$$\nabla\phi = \left[i\frac{\partial}{\partial x} + j\frac{\partial}{\partial y} + k\frac{\partial}{\partial z}\right]\phi$$

$$\nabla\phi = i\frac{\partial\phi}{\partial x} + j\frac{\partial\phi}{\partial y} + k\frac{\partial\phi}{\partial z}$$

$$\nabla\phi = i\left[yz+6xy\right] + j\left[3x^2 + xz - 8yz^2\right] + k\left[xy - 8y^2 z\right]$$

at point $(1,2,1)$

$$\nabla\phi = i\left[2\times1+12\right] + j\left[3\times1^2 + 1\times1 - 8\times2\times1^2\right] + k\left[1\times2 - 8\times2^2\times1\right]$$

$$\nabla\phi = i(14) + j(-12) + k(-30)$$

$$\nabla\phi = 2i + 12j + 30k$$

$\nabla\cdot A$

$$\nabla = i\frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z}$$

$$A = a_x i + a_y j + a_z k$$

$$\nabla\cdot A = \left[i\frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z}\right]\cdot\left[a_x i + a_y j + a_z k\right]$$

$$\nabla\cdot A = \frac{\partial}{\partial x}\cdot a_x + \frac{\partial}{\partial y}\cdot a_y + \frac{\partial}{\partial z}\cdot a_z$$

$$= 2xy + (x+2) + 2xz$$

$\nabla\cdot A$ at $(1,2,1)$

$$\nabla\cdot A = 2\times1\times2 + (1+1) + 2\times1\times1$$

$$\nabla\cdot A = 4+2+2$$

$$\nabla\cdot A = 8$$

$$\nabla\times B = \begin{vmatrix} i & j & k \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ yz & -3xz & 2xy \end{vmatrix}$$

$$i\begin{vmatrix} \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ -3xz & 2xy \end{vmatrix} - j\begin{vmatrix} \frac{\partial}{\partial x} & \frac{\partial}{\partial z} \\ yz & 2xy \end{vmatrix} + k\begin{vmatrix} \frac{\partial}{\partial x} & \frac{\partial}{\partial y} \\ yz & -3xz \end{vmatrix}$$