ENG282.

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Mathematical model is a description of a system using mathematical concepts and language. The process of developing a mathematical model is termed modelling.

Data Analysis
This enables the methods engineer to make decision about several things including purpose of the operation, part design characteristics, specifications and tolerance of parts

Project selection
Methods engineers typically work on projects involving new product design, products with a high cost of production to profit ratio and products associated with having poor quality issues.

Question 2.

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

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

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

(iii) $$\left.\frac{d^2r}{dt}\right|_{at\ t=0} = 2i + 18\sin 3(0) + 12e^{2(0)} k$$

$$2i + 0j \qquad 12(1)k$$

3.) $A = (x^2y)i + (xy + yz)j + (xz^2)k$.

$B = (yz)i - 3xzj + 2xyk$.

$\phi = 3x^2y + xyz - 4y^2z^2 - 3$

i) $\nabla\phi = (6xy + yz)i + (3x^2 + xz - 8yz^2)j + (xy - 8y^2z)k$

at point (1, 2, 1)

$(6(1)(2) + 2(1))i + (3(1)^2 + (1)(1) - 8(2)(1)^2)j + ((1)(2) - 8(2)(1))k$

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

$\nabla\phi = 3\left(\frac{14}{3}i - 4j - 10k\right)$

ii) $\nabla \cdot A = \frac{\delta A_x}{\delta x} + \frac{\delta A_y}{\delta y} + \frac{\delta A_z}{\delta z}$

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

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

at (1, 2, 1)

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

$= 8$.

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

$i\left[\frac{\delta}{\delta y}(2xy) - \frac{\partial}{\partial z}(-3xz)\right] - j\left(\frac{d}{dx}(2xy) - \frac{d}{dz}(yz)\right)$,

$+ k\left[\frac{d}{dx}(-3xz) - \frac{d}{dy}(yz)\right]$

$\nabla \times B = i(2x + 3x) - j(2y - y) + k(-3z - z)$

$\nabla \times B = 5xi - yj - 4zk$

at (1, 2, 1)

Grad div A

grad div A $= \nabla (\nabla A) \nabla^2 A$

$$\frac{\partial}{\partial x}\left(\frac{\partial A}{\partial x}\right) + \frac{\partial}{\partial y}\left(\frac{\partial A}{\partial y}\right) + \frac{\partial}{\partial z}\left(\frac{\partial A}{\partial z}\right)$$

div A $= 2xy + (x+z) + 2xz$.

grad div A $= (2y + 1 + 2z)\,i + (2x)\,j + (1 + 2x)\,k$

grad div A $= \left(2(2) + 1\,(2)(1)\right) i + \left(2(1)\right) j + 1 + 2($

grad div A $= 7i + 2j + 3k$.

Curl curl A.

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

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

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

$$i[0 - y] - j[z^2 - 0] + k[y - x^2)$$

$$-yi - z^2 j + (y - x^2) k$$

Curl A $\quad | \partial/\partial x \quad \partial/\partial y \quad \partial/\partial z \quad |$