Qu. 2

$r = (t^2+2t)i - 6\cos 4t\, j + 5e^{4t}k$

$\frac{dr}{dt} = (2t+2)i - 6(-\sin 4t)4j + 5e^{4t}k$

$\frac{dr}{dt} = 2i + 24\sin 4t\, j + 20e^{4t}k$

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

$= 0i + (24-0)j + 20e^{4(0)}k$

$= \frac{24 + 20k}{\sqrt{(0)^2 + (24)^2 + (20)^2}}$

$= \frac{24 + 20k}{\sqrt{576 + 400}}$

$= \frac{24 + 20k}{\sqrt{976}}$

Qu.3

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

$B = yz\,i - 3xz\,j + 2xy\,k$

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

(i) $\nabla\phi = \left(\frac{d}{dx}i + \frac{d}{dy}j + \frac{d}{dz}k\right)(3x^2y + xyz - 4y^2z^2 - 3)$

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

$= (6(1)(2) + 2(1))\,i + (3(1)^2 + 1(1) - 8(2)(1))\,j + (1(2) - [illegible])\,k$

$\nabla\phi = 14i - 12j - [illegible]k$

(ii) $\nabla\cdot A = \left(\frac{d}{dx}i + \frac{d}{dy}j + \frac{d}{dz}k\right)(x^2y\,i + (xy + yz)\,j + [illegible])$

$= (2xy + y + z^2)\,i + (x^2 + (y + z))\,j + [illegible]$

$= (2(1)(2) + 2 + 1^2)\,i + (1^2 + (2))\,j + [illegible]$

$\nabla\cdot A = 6i + 3j + 4k$

(iii) $\nabla \times B =$

i	j	k
$\partial/\partial x$	$\partial/\partial y$	$\partial/\partial z$
yz	$-3xz$	$2xy$

$\nabla \times F$

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

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

$$= 5x\, i - y j - 4z k$$

$$\nabla \times B = 5(1) i - (2) j - 4(1) k$$

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

iv grad div A

$$\text{div } A = 2xy\, i + (x+z) j + 2xz\, k$$

$$\text{grad div } A = \left(\frac{d}{dx} i + \frac{d}{dy} j + \frac{d}{dz} k \right) (2xy\, i + (x+z) j + 2xz$$

$$= (2y + (z+1) + 2z) i + (2x) j + (x+1) + 2x) k$$

$$= (2(2) + (1+1) + 2(1)) i + (2(1)) j + (2+2(1)) k$$

$$\text{grad div } A = 8i + 2j + 4k$$

$\nabla \times F$

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

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

$$= 5x\, i - y j - 4z k$$

$$\nabla \times B = 5(1) i - (2) j - 4(1) k$$

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

iv grad div A

$$\text{div } A = 2xy\, i + (x+z) j + 2xz\, k$$

$$\text{grad div } A = \left(\frac{d}{dx} i + \frac{d}{dy} j + \frac{d}{dz} k \right) (2xy\, i + (x+z) j + 2xz$$

$$= (2y + (z+1) + 2z) i + (2x) j + (x+1) + 2x) k$$

$$= (2(2) + (1+1) + 2(1)) i + (2(1)) j + (2+2(1)) k$$

$$\text{grad div } A = 8i + 2j + 4k$$